
Hazus: Earthquake Global Risk Report

Region Name: CalaverasCNCCCS

Earthquake Scenario: calaverascnccccshaw0_m7p29_se

Print Date: April 29, 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 37 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 64,963.17 square miles and contains 3,782 census tracts. There are over 5,683 thousand households in the region which has a total population of 16,396,729 people. The distribution of population by Total Region and County is provided in Appendix B.

There are an estimated 5,092 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 263,087 and 214,403 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 5,092 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 279 hospitals in the region with a total bed capacity of 42,667 beds. There are 6,088 schools, 1,622 fire stations, 547 police stations and 94 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 477,490.00 (millions of dollars). This inventory includes over 12,159.61 miles of highways, 12,894 bridges, 281,432.60 miles of pipes.

Table 1: Transportation System Lifeline Inventory

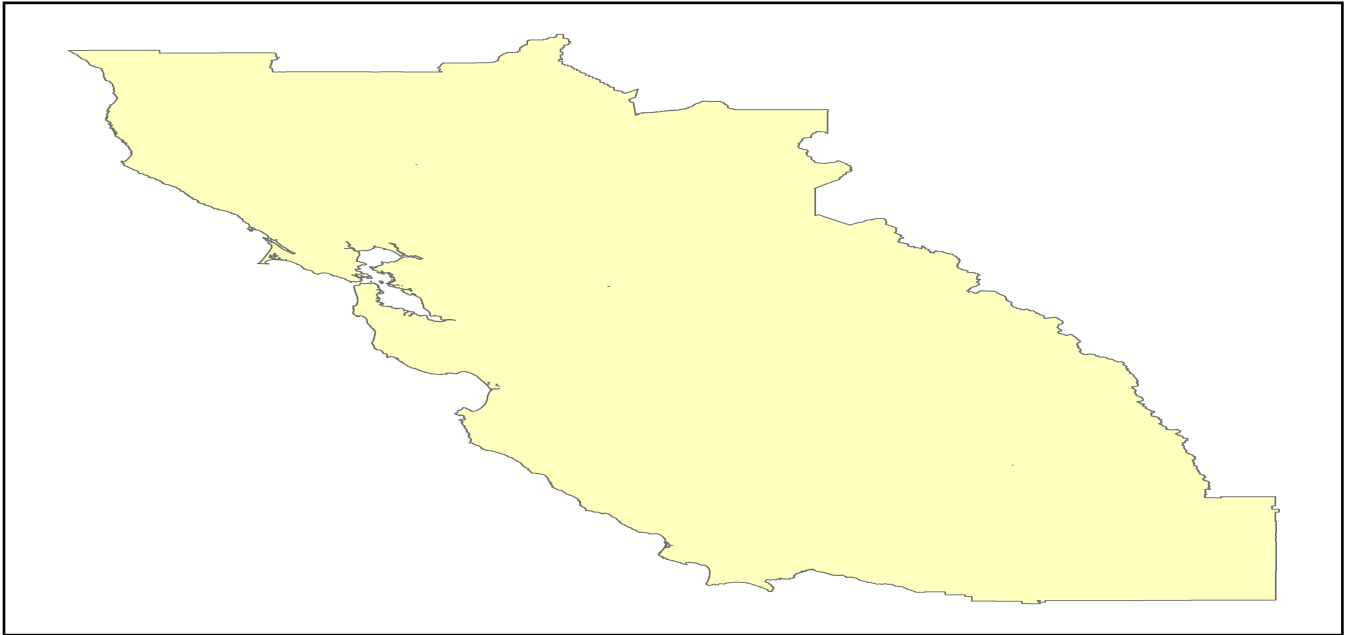
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	12,894	61797.6755
	Segments	7,844	104810.3565
	Tunnels	51	1005.9853
	Subtotal		167614.0173
Railways	Bridges	1,937	11021.5300
	Facilities	96	255.6480
	Segments	3,440	68224.1940
	Tunnels	3	1.8495
	Subtotal		79503.2215
Light Rail	Bridges	112	15.3529
	Facilities	255	4154.0000
	Segments	15	5403.2756
	Tunnels	0	0.0000
	Subtotal		9572.6285
Bus	Facilities	57	128.4708
	Subtotal		128.4708
Ferry	Facilities	25	33.2750
	Subtotal		33.2750
Port	Facilities	370	1410.3825
	Subtotal		1410.3825
Airport	Facilities	133	3006.7016
	Runways	190	1819.1450
	Subtotal		4825.8466
		Total	263,087.80

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	5591.5522
	Facilities	28	1100.2320
	Pipelines	0	0.0000
		Subtotal	6691.7842
Waste Water	Distribution Lines	NA	3354.9313
	Facilities	196	33702.5528
	Pipelines	0	0.0000
		Subtotal	37057.4841
Natural Gas	Distribution Lines	NA	2236.6209
	Facilities	14	590.2548
	Pipelines	1,098	19717.3205
		Subtotal	22544.1962
Oil Systems	Facilities	33	3.8940
	Pipelines	0	0.0000
		Subtotal	3.8940
Electrical Power	Facilities	560	148042.7411
		Subtotal	148042.7411
Communication	Facilities	540	63.7200
		Subtotal	63.7200
	Total		214,403.80

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	calaverascnccccshaw0_m7p29_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	7.29
Depth (km)	NA
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	NA

Direct Earthquake Damage

Building Damage

Hazus estimates that about 102,074 buildings will be at least moderately damaged. This is over 2.00 % of the buildings in the region. There are an estimated 1,340 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

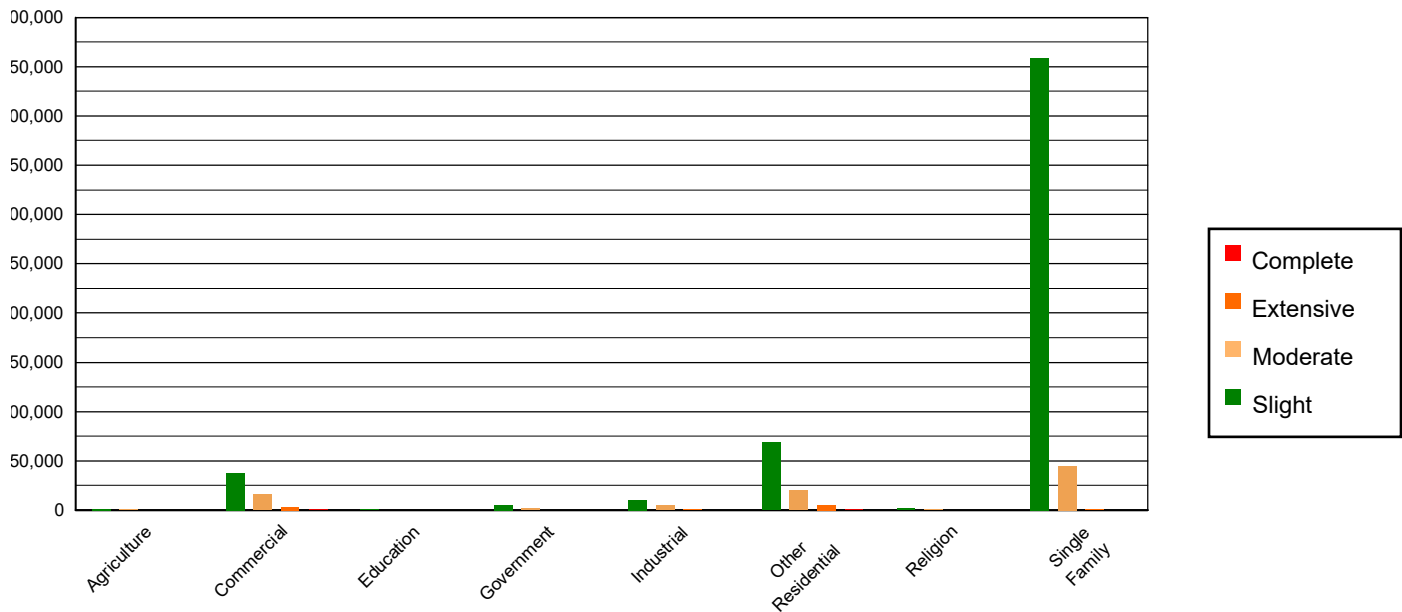


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	35506.63	0.81	1532.12	0.26	610.19	0.68	115.96	1.11	19.11	1.43
Commercial	268729.95	6.10	37721.41	6.45	16411.73	18.18	3106.71	29.72	535.21	39.92
Education	9124.95	0.21	772.70	0.13	248.35	0.28	45.75	0.44	8.25	0.62
Government	15308.65	0.35	5104.93	0.87	2292.73	2.54	353.82	3.39	39.87	2.97
Industrial	74223.11	1.69	10632.70	1.82	4846.24	5.37	944.60	9.04	143.35	10.69
Other Residential	572143.00	12.99	68763.68	11.75	20282.66	22.47	5280.28	50.52	540.38	40.30
Religion	16696.65	0.38	2002.76	0.34	940.53	1.04	197.51	1.89	33.56	2.50
Single Family	3413105.05	77.49	458694.86	78.38	44650.16	49.46	406.92	3.89	21.01	1.57
Total	4,404,838		585,225		90,283		10,452		1,341	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	3844045.24	87.27	512082.88	87.50	48294.22	53.49	375.58	3.59	14.01	1.05
Steel	90358.13	2.05	14585.44	2.49	10220.28	11.32	2432.21	23.27	379.65	28.32
Concrete	101921.00	2.31	17585.20	3.00	8101.01	8.97	2174.49	20.81	329.59	24.58
Precast	56894.57	1.29	8271.78	1.41	4275.78	4.74	390.99	3.74	26.03	1.94
RM	169032.20	3.84	15495.77	2.65	5770.40	6.39	366.69	3.51	4.59	0.34
URM	28206.83	0.64	11007.70	1.88	6060.84	6.71	1315.94	12.59	293.36	21.88
MH	114380.03	2.60	6196.38	1.06	7560.05	8.37	3395.63	32.49	293.50	21.89
Total	4,404,838		585,225		90,283		10,452		1,341	

*Note:

- RM Reinforced Masonry
- URM Unreinforced Masonry
- MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 42,667 hospital beds available for use. On the day of the earthquake, the model estimates that only 36,615 hospital beds (86.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 94.00% of the beds will be back in service. By 30 days, 99.00% 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	279	13	0	254
Schools	6,088	353	0	5,316
EOCs	94	4	0	86
PoliceStations	547	15	0	495
FireStations	1,622	41	0	1,508

Transportation Lifeline Damage

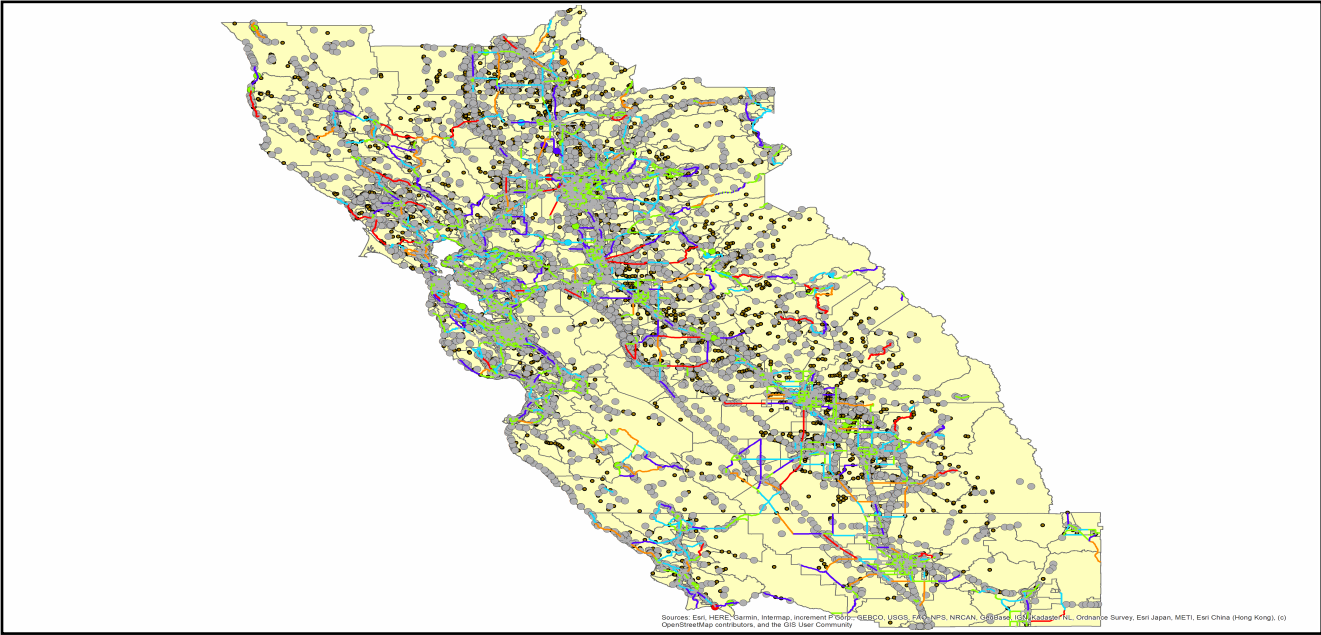


Table 6: Expected Damage to the Transportation Systems

System	Component	Locations/ Segments	Number of Locations_			
			With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	7,844	0	0	7,844	7,844
	Bridges	12,894	16	0	12,879	12,887
	Tunnels	51	0	0	51	51
Railways	Segments	3,440	0	0	3,440	3,440
	Bridges	1,937	0	0	1,937	1,937
	Tunnels	3	0	0	3	3
	Facilities	96	0	0	96	96
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	57	0	0	57	57
Ferry	Facilities	25	0	0	25	25
Port	Facilities	370	0	0	370	370
Airport	Facilities	133	2	0	133	133
	Runways	190	0	0	190	190

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	28	3	0	23	28
Waste Water	196	5	0	173	196
Natural Gas	14	0	0	14	14
Oil Systems	33	0	0	33	33
Electrical Power	560	35	0	536	559
Communication	540	20	0	527	540

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

System	Total Pipelines Length (miles)	Number of Leaks	Number of Breaks
Potable Water	173,721	9196	2299
Waste Water	104,233	4620	1155
Natural Gas	3,479	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	5,683,063	411,378	356,535	248,854	0	0
Electric Power		374,220	232,312	91,267	7,457	511

Induced Earthquake Damage

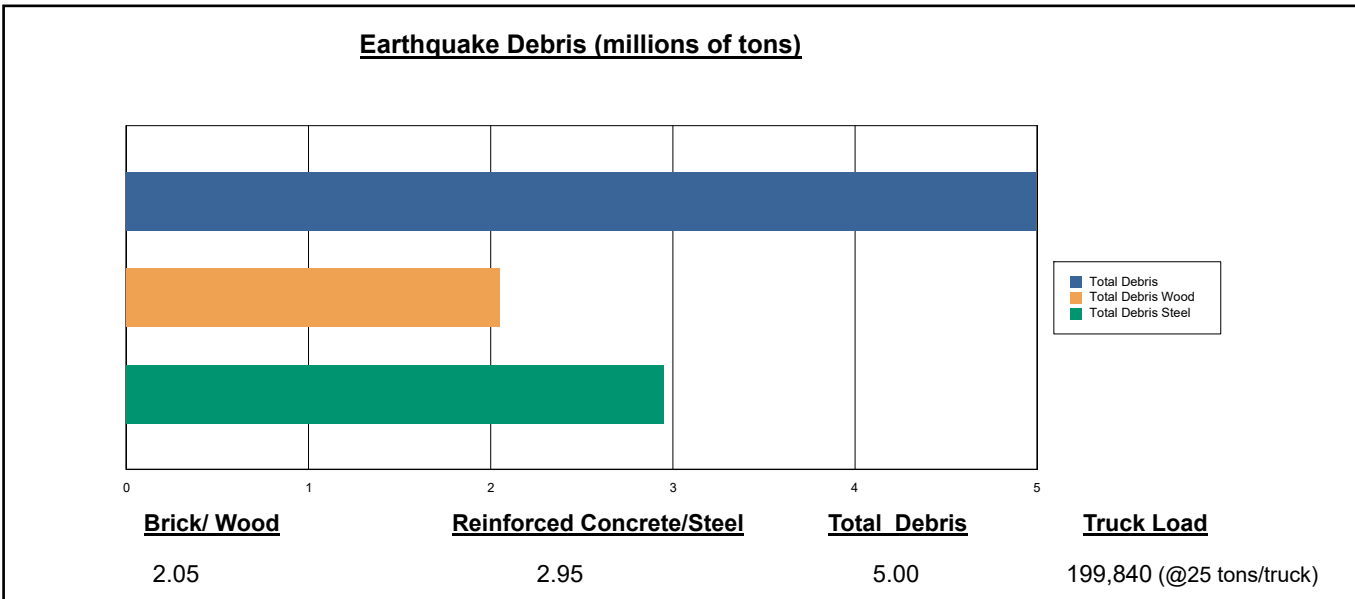
Fire Following Earthquake

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 78 ignitions that will burn about 1.91 sq. mi (0.00 % of the region's total area.) The model also estimates that the fires will displace about 19,926 people and burn about 2,618 (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.

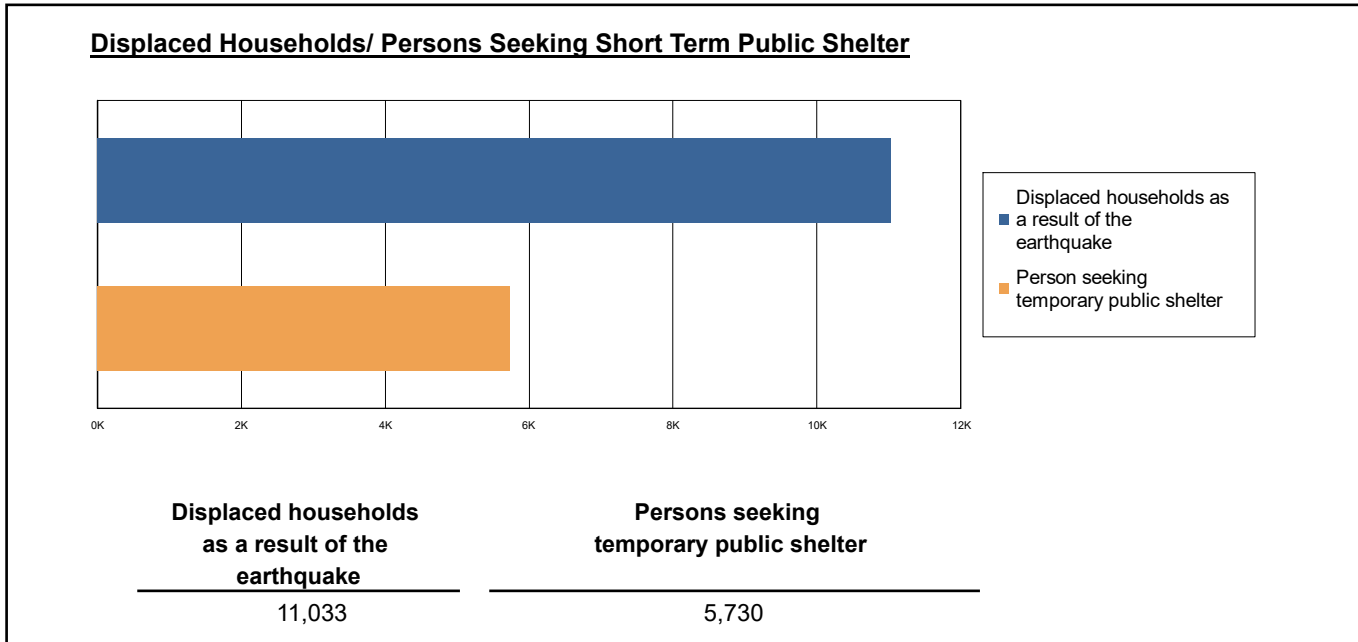
The model estimates that a total of 4,996,000 tons of debris will be generated. Of the total amount, Brick/Wood comprises 41.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 199,840 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.



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 11,033 households to be displaced due to the earthquake. Of these, 5,730 people (out of a total population of 16,396,729) will seek temporary shelter in public shelters.



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	44.42	7.06	0.73	1.43
	Commuting	0.49	0.66	1.10	0.21
	Educational	0.00	0.00	0.00	0.00
	Hotels	2.01	0.20	0.01	0.01
	Industrial	49.00	7.41	0.72	1.41
	Other-Residential	1329.15	179.93	16.23	31.28
	Single Family	1076.61	46.71	0.56	1.05
	Total	2,502	242	19	35
	2 PM	Commercial	2958.55	472.59	49.31
Commuting		4.37	5.91	9.89	1.92
Educational		663.57	103.06	11.12	21.55
Hotels		0.39	0.04	0.00	0.00
Industrial		359.27	54.57	5.37	10.35
Other-Residential		417.58	58.65	5.62	10.42
Single Family		296.62	13.53	0.21	0.37
Total		4,700	708	82	140
5 PM		Commercial	2073.35	332.94	35.13
	Commuting	85.97	115.35	193.89	37.59
	Educational	93.53	13.00	1.30	2.50
	Hotels	0.60	0.06	0.00	0.00
	Industrial	224.54	34.11	3.35	6.47
	Other-Residential	504.94	70.24	6.64	12.32
	Single Family	393.38	17.91	0.26	0.45
	Total	3,376	584	241	126

Economic Loss

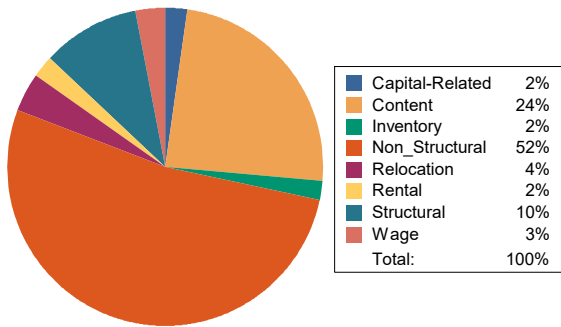
The total economic loss estimated for the earthquake is 53,966.92 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

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 46,776.66 (millions of dollars); 12 % 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 50 % 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)

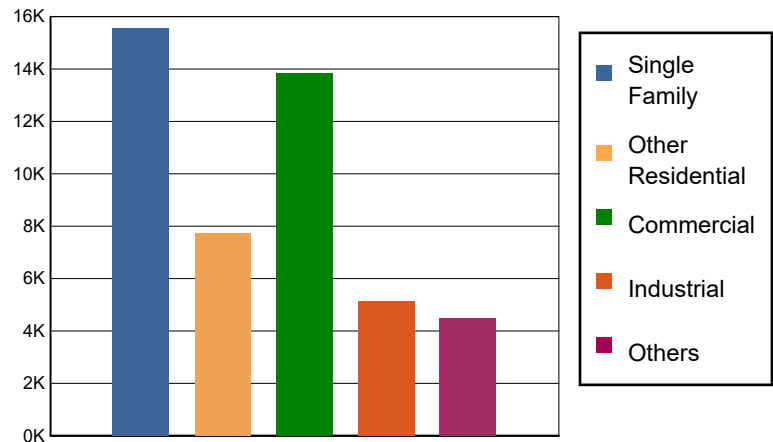


Table 11: Building-Related Economic Loss Estimates
(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.0000	105.2038	1078.5768	49.8386	142.0872	1,375.7064
	Capital-Related	0.0000	44.7223	1002.2115	30.1529	23.2829	1,100.3696
	Rental	109.0912	383.7660	531.8203	29.2566	75.4855	1,129.4196
	Relocation	324.9736	246.0775	733.0484	136.5002	358.2401	1,798.8398
	Subtotal	434.0648	779.7696	3345.6570	245.7483	599.0957	5404.3354
Capital Stock Losses							
	Structural	1514.4258	796.1560	1424.3524	484.7176	484.2571	4,703.9089
	Non_Structural	9789.7656	4796.7324	5394.8409	2420.3611	2131.4192	24,533.1192
	Content	3817.6801	1346.9680	3155.4026	1748.2965	1212.3151	11,280.6623
	Inventory	0.0000	0.0000	533.0994	256.6858	64.8523	854.6375
	Subtotal	15121.8715	6939.8564	10507.6953	4910.0610	3892.8437	41372.3279
	Total	15555.94	7719.63	13853.35	5155.81	4491.94	46776.66

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	104810.3565	0.0000	0.00
	Bridges	61797.6755	504.0044	0.82
	Tunnels	1005.9853	3.2508	0.32
	Subtotal	167614.0173	507.2552	
Railways	Segments	68224.1940	0.0000	0.00
	Bridges	11021.5300	49.2076	0.45
	Tunnels	1.8495	0.0917	4.96
	Facilities	255.6480	17.4101	6.81
	Subtotal	79503.2215	66.7094	
Light Rail	Segments	5403.2756	0.0000	0.00
	Bridges	15.3529	0.2443	1.59
	Tunnels	0.0000	0.0000	0.00
	Facilities	4154.0000	423.9176	10.21
	Subtotal	9572.6285	424.1619	
Bus	Facilities	128.4708	5.1734	4.03
	Subtotal	128.4708	5.1734	
Ferry	Facilities	33.2750	2.9875	8.98
	Subtotal	33.2750	2.9875	
Port	Facilities	1410.3825	133.5309	9.47
	Subtotal	1410.3825	133.5309	
Airport	Facilities	3006.7016	276.6094	9.20
	Runways	1819.1450	0.0000	0.00
	Subtotal	4825.8466	276.6094	
Total		263,087.84	1,416.43	

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	1100.2320	51.7954	4.71
	Distribution Lines	5591.5522	41.3834	0.74
	Subtotal	6691.7842	93.1788	
Waste Water	Pipelines	0.0000	0.0000	0.00
	Facilities	33702.5528	886.4012	2.63
	Distribution Lines	3354.9313	20.7879	0.62
	Subtotal	37057.4841	907.1891	
Natural Gas	Pipelines	19717.3205	0.0000	0.00
	Facilities	590.2548	0.1560	0.03
	Distribution Lines	2236.6209	7.1218	0.32
	Subtotal	22544.1962	7.2778	
Oil Systems	Pipelines	0.0000	0.0000	0.00
	Facilities	3.8940	0.1020	2.62
	Subtotal	3.8940	0.1020	
Electrical Power	Facilities	148042.7411	4763.0593	3.22
	Subtotal	148042.7411	4763.0593	
Communication	Facilities	63.7200	3.0228	4.74
	Subtotal	63.7200	3.0228	
	Total	214,403.82	5,773.83	

Appendix A: County Listing for the Region

Alameda,CA
Amador,CA
Butte,CA
Calaveras,CA
Colusa,CA
Contra Costa,CA
El Dorado,CA
Fresno,CA
Glenn,CA
Kern,CA
Kings,CA
Lake,CA
Madera,CA
Marin,CA
Mariposa,CA
Mendocino,CA
Merced,CA
Monterey,CA
Napa,CA
Nevada,CA
Placer,CA
Sacramento,CA
San Benito,CA
San Francisco,CA
San Joaquin,CA
San Luis Obispo,CA
San Mateo,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
	Butte	211,632	25,875	16,639	42,514
	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
	Glenn	28,917	2,791	3,717	6,508
	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
	Mendocino	91,601	14,237	8,510	22,748
	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
	Nevada	102,241	17,908	6,108	24,016
	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 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		16,396,729	2,034,730	1,047,968	3,082,715

