Hazus: Earthquake Global Risk Report

Region Name: Compton

Earthquake Scenario: Compton

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.

Table of Contents

Section	Page #
General Description of the Region	3
Building and Lifeline Inventory	4
Building Inventory	
Critical Facility Inventory	
Transportation and Utility Lifeline Inventory	
Earthquake Scenario Parameters	7
Direct Earthquake Damage	8
Buildings Damage	
Essential Facilities Damage	
Transportation and Utility Lifeline Damage	
Induced Earthquake Damage	14
Fire Following Earthquake	
Debris Generation	
Social Impact	15
Shelter Requirements	
Casualties	
Economic Loss	17
Building Related Losses	
Transportation and Utility Lifeline Losses	

Appendix A: County Listing for the Region

Appendix B: Regional Population and Building Value Data

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 13 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 73,530.68 square miles and contains 5,610 census tracts. There are over 8,148 thousand households in the region which has a total population of 24,407,523 peopleF. The distribution of population by Total Region and County is provided in Appendix B.

There are an estimated 6,951 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 295,097 and 194,066 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 6,951 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 345 hospitals in the region with a total bed capacity of 63,645 beds. There are 7,824 schools, 1,397 fire stations, 472 police stations and 123 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 489,163.00 (millions of dollars). This inventory includes over 12,749.29 miles of highways, 12,131 bridges, 267,256.02 miles of pipes.

Table 1: Transportation System Lifeline Inventory

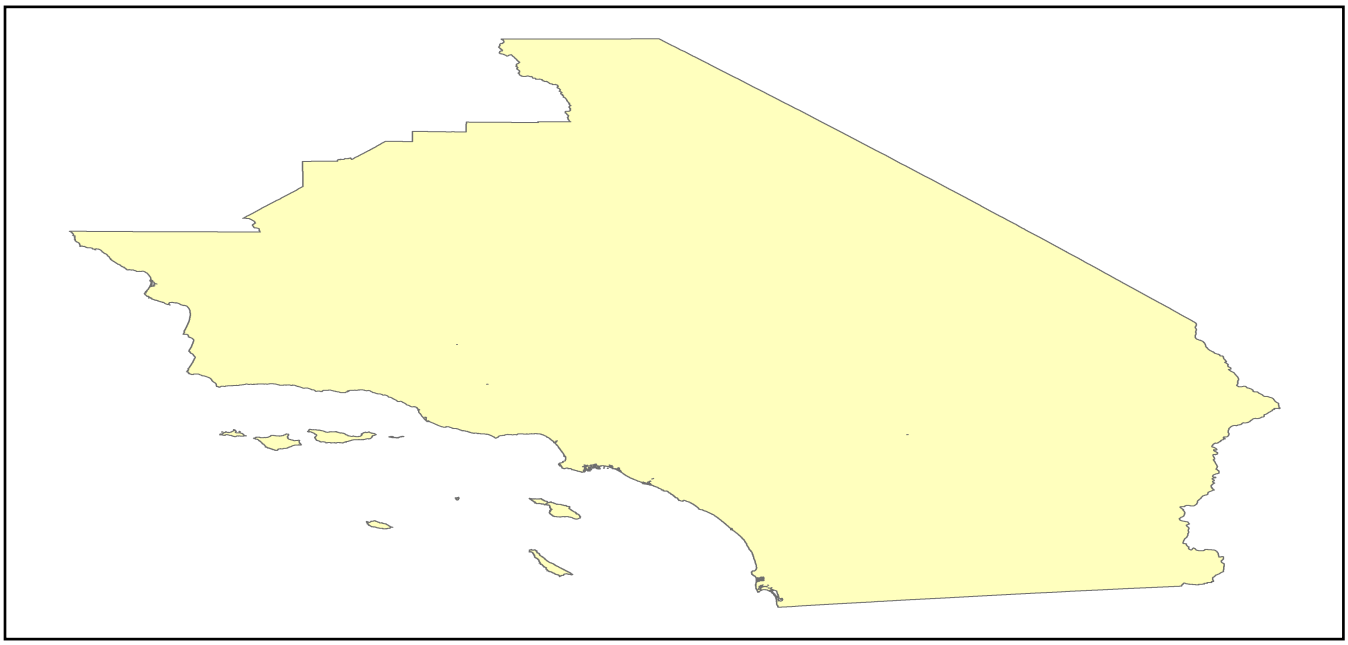
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	12,131	68183.0231
	Segments	10,189	129524.7356
	Tunnels	62	553.5147
		Subtotal	**198261.2734**
Railways	Bridges	2,182	12415.5800
	Facilities	116	308.9080
	Segments	2,017	67063.3892
	Tunnels	0	0.0000
		Subtotal	**79787.8772**
Light Rail	Bridges	51	13.2750
	Facilities	149	3200.8000
	Segments	8	5399.1047
	Tunnels	0	0.0000
		Subtotal	**8613.1797**
Bus	Facilities	45	97.2975
		Subtotal	**97.2975**
Ferry	Facilities	22	29.2820
		Subtotal	**29.2820**
Port	Facilities	354	1349.3930
		Subtotal	**1349.3930**
Airport	Facilities	167	4844.7583
	Runways	188	2114.4318
		Subtotal	**6959.1901**
		Total	**295,097.50**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	5307.8476
	Facilities	53	2082.5820
	Pipelines	0	0.0000
		Subtotal	**7390.4296**
Waste Water	Distribution Lines	NA	3184.7085
	Facilities	136	23385.4448
	Pipelines	0	0.0000
		Subtotal	**26570.1533**
Natural Gas	Distribution Lines	NA	2123.1390
	Facilities	44	1599.3257
	Pipelines	362	19300.5635
		Subtotal	**23023.0282**
Oil Systems	Facilities	68	8.0240
	Pipelines	0	0.0000
		Subtotal	**8.0240**
Electrical Power	Facilities	635	137018.3076
		Subtotal	**137018.3076**
Communication	Facilities	476	56.1680
		Subtotal	**56.1680**
		Total	**194,066.10**

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	Compton
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	7.45
Depth (km)	NA
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	NA

Direct Earthquake Damage

Building Damage

Hazus estimates that about 896,487 buildings will be at least moderately damaged. This is over 13.00 % of the buildings in the region. There are an estimated 48,231 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

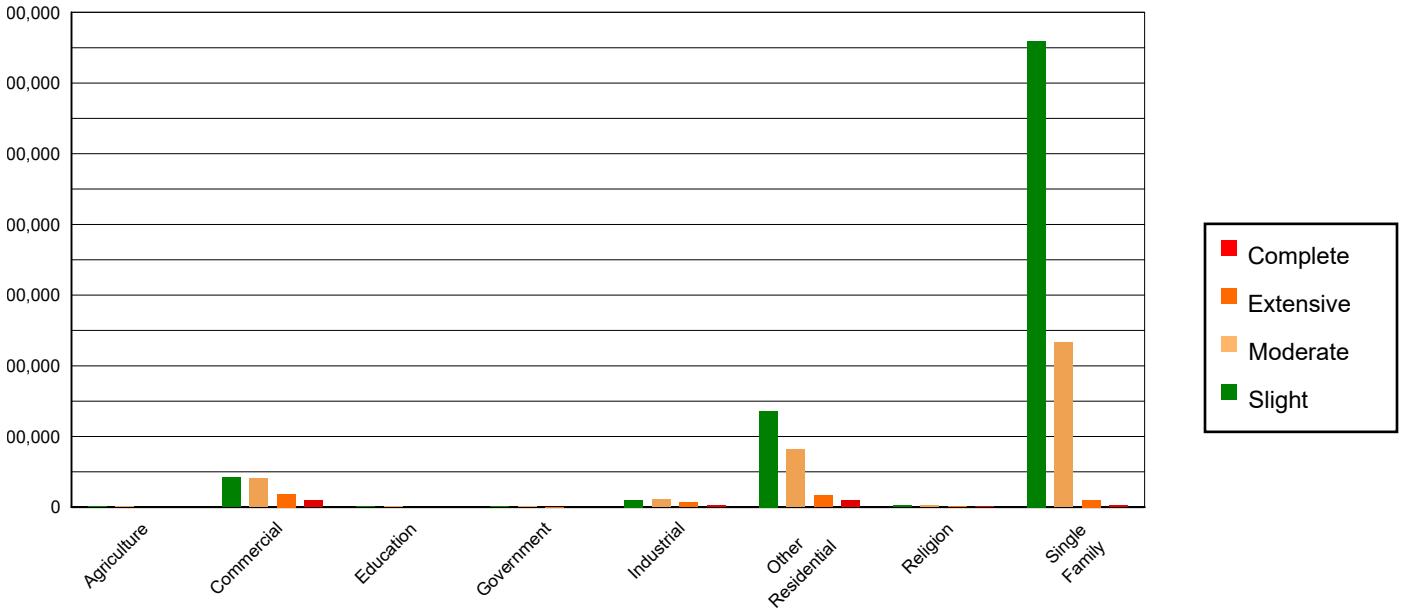


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	16258.75	0.37	1416.62	0.08	828.47	0.11	365.95	0.34	174.22	0.36
Commercial	254661.65	5.85	82937.32	4.87	80378.66	10.85	37253.02	34.76	18010.35	37.34
Education	8552.68	0.20	2539.30	0.15	1605.91	0.22	349.06	0.33	188.05	0.39
Government	32274.51	0.74	1363.23	0.08	1281.08	0.17	599.98	0.56	203.20	0.42
Industrial	62679.85	1.44	20567.39	1.21	22050.67	2.98	12704.39	11.86	5194.69	10.77
Other Residential	588853.08	13.53	271881.78	15.96	164111.53	22.14	33971.21	31.70	18692.40	38.76
Religion	13462.40	0.31	3860.90	0.23	4083.50	0.55	2012.37	1.88	1071.83	2.22
Single Family	3374695.80	77.55	1318999.52	77.43	466753.64	62.98	19905.99	18.58	4697.05	9.74
Total	**4,351,439**		**1,703,566**		**741,093**		**107,162**		**48,232**	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	3845835.35	88.38	1596119.35	93.69	606479.02	81.84	25424.75	23.73	3397.79	7.04
Steel	65296.94	1.50	13264.84	0.78	22833.83	3.08	17713.14	16.53	9778.80	20.27
Concrete	60454.03	1.39	18370.59	1.08	24834.48	3.35	13966.86	13.03	8454.52	17.53
Precast	31393.45	0.72	9650.12	0.57	12761.92	1.72	5175.78	4.83	919.15	1.91
RM	167278.28	3.84	50745.38	2.98	61423.40	8.29	26307.05	24.55	2605.90	5.40
URM	5121.16	0.12	1536.54	0.09	2900.37	0.39	6318.06	5.90	15424.08	31.98
MH	176059.50	4.05	13879.24	0.81	9860.44	1.33	12256.32	11.44	7651.55	15.86
Total	**4,351,439**		**1,703,566**		**741,093**		**107,162**		**48,232**	

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 63,645 hospital beds available for use. On the day of the earthquake, the model estimates that only 35,824 hospital beds (56.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 65.00% of the beds will be back in service. By 30 days, 79.00% 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	345	114	25	191
Schools	7,824	2,790	846	4,341
EOCs	123	45	7	58
PoliceStations	472	116	29	310
FireStations	1,397	314	73	976

Transportation Lifeline Damage

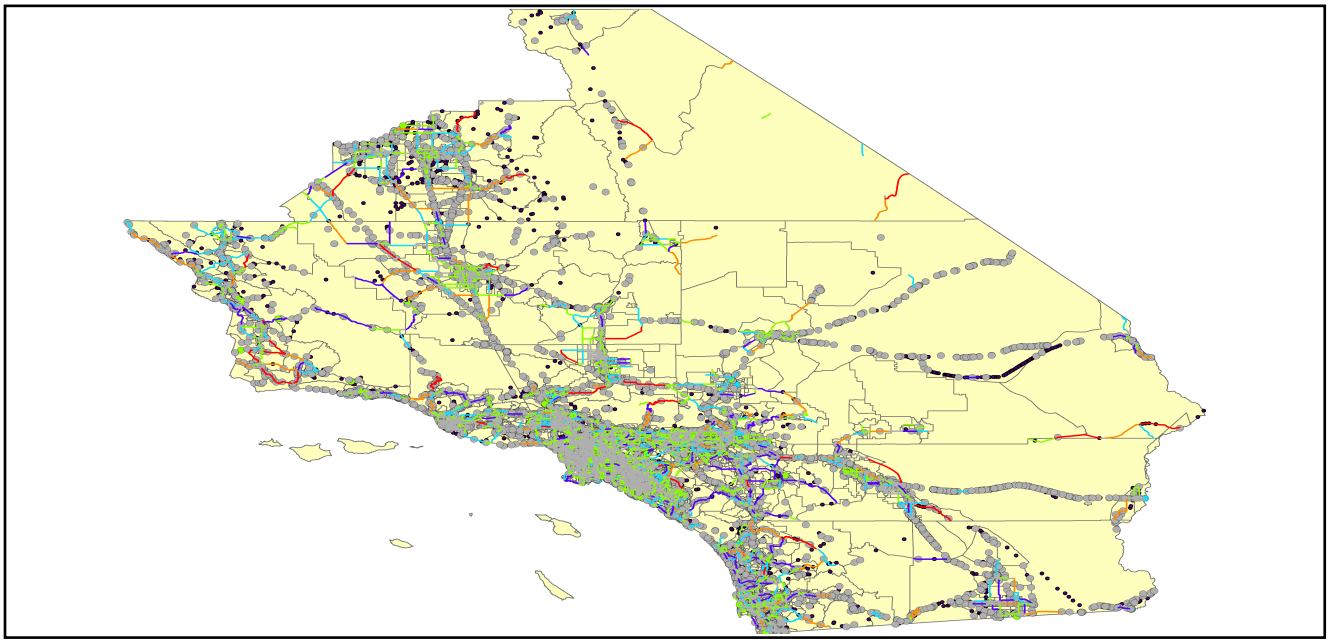


Table 6: Expected Damage to the Transportation Systems

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	10,189	0	0	10,189	10,189
	Bridges	12,131	815	102	11,422	11,870
	Tunnels	62	0	0	62	62
Railways	Segments	2,017	0	0	2,017	2,017
	Bridges	2,182	0	0	2,182	2,182
	Tunnels	0	0	0	0	0
	Facilities	116	42	0	98	116
Light Rail	Segments	8	0	0	8	8
	Bridges	51	0	0	51	51
	Tunnels	0	0	0	0	0
	Facilities	149	66	0	109	149
Bus	Facilities	45	10	0	40	45
Ferry	Facilities	22	5	0	22	22
Port	Facilities	354	36	0	351	354
Airport	Facilities	167	32	0	152	167
	Runways	188	0	0	188	188

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	53	12	0	38	53
Waste Water	136	19	0	103	136
Natural Gas	44	10	0	34	44
Oil Systems	68	44	0	21	33
Electrical Power	635	97	2	550	588
Communication	476	53	0	437	476

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

System	Total Pipelines Length (miles)	Number of Leaks	Number of Breaks
Potable Water	164,907	31599	7900
Waste Water	98,944	15873	3968
Natural Gas	3,405	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	8,148,162	2,545,937	2,517,545	2,459,160	2,069,389	1,156,197
Electric Power		3,015,487	2,235,233	1,148,525	171,108	3,646

Induced Earthquake Damage

Fire Following Earthquake

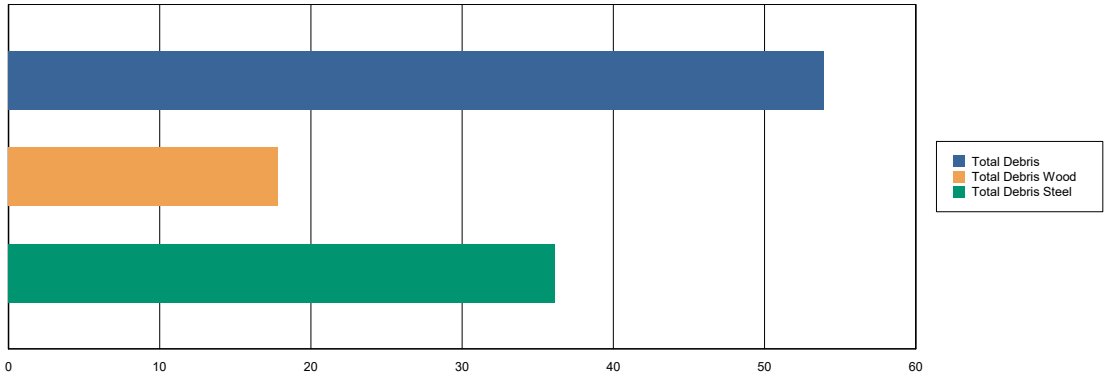
Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 158 ignitions that will burn about 1.49 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 20,359 people and burn about 2,500 (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 53,926,000 tons of debris will be generated. Of the total amount, Brick/Wood comprises 33.00% 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 2,157,040 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Earthquake Debris (millions of tons)



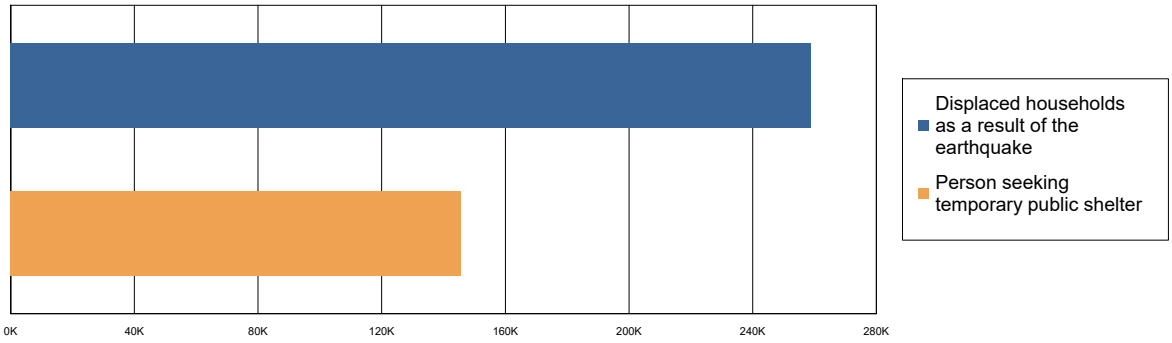
Brick/ Wood	Reinforced Concrete/Steel	Total Debris	Truck Load
17.80	36.13	53.93	2,157,040 (@25 tons/truck)

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 258,750 households to be displaced due to the earthquake. Of these, 145,563 people (out of a total population of 24,407,523) 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
258,750	145,563

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	589.38	153.86	22.40	44.08
	Commuting	4.60	6.55	10.56	2.07
	Educational	0.00	0.00	0.00	0.00
	Hotels	32.62	7.72	1.00	1.97
	Industrial	663.11	167.36	23.23	45.40
	Other-Residential	26216.68	6413.00	856.01	1676.73
	Single Family	8337.33	1089.03	92.73	182.50
	Total	**35,844**	**7,838**	**1,006**	**1,953**
2 PM	Commercial	39729.99	10459.39	1541.40	3001.75
	Commuting	41.43	58.97	95.04	18.63
	Educational	12619.31	2923.22	406.01	784.00
	Hotels	6.30	1.50	0.20	0.38
	Industrial	4891.71	1238.07	173.33	335.20
	Other-Residential	8475.64	2149.34	307.30	569.09
	Single Family	2473.71	346.26	32.99	61.80
	Total	**68,238**	**17,177**	**2,556**	**4,771**
5 PM	Commercial	28201.52	7482.46	1119.70	2141.67
	Commuting	819.00	1162.99	1877.66	367.92
	Educational	2178.09	453.46	58.83	111.47
	Hotels	9.77	2.31	0.30	0.59
	Industrial	3057.32	773.80	108.33	209.50
	Other-Residential	10319.72	2583.72	364.94	675.48
	Single Family	3181.60	433.44	39.82	74.56
	Total	**47,767**	**12,892**	**3,570**	**3,581**

Economic Loss

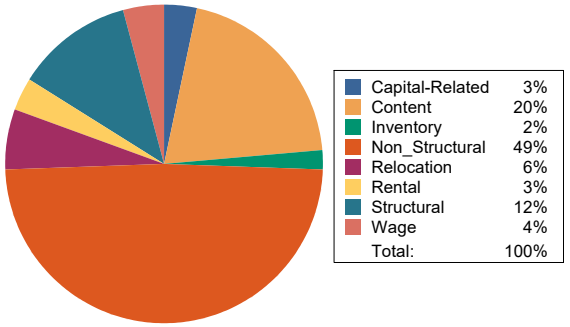
The total economic loss estimated for the earthquake is 339,014.71 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

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 314,002.06 (millions of dollars); 17 % 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 41 % 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)

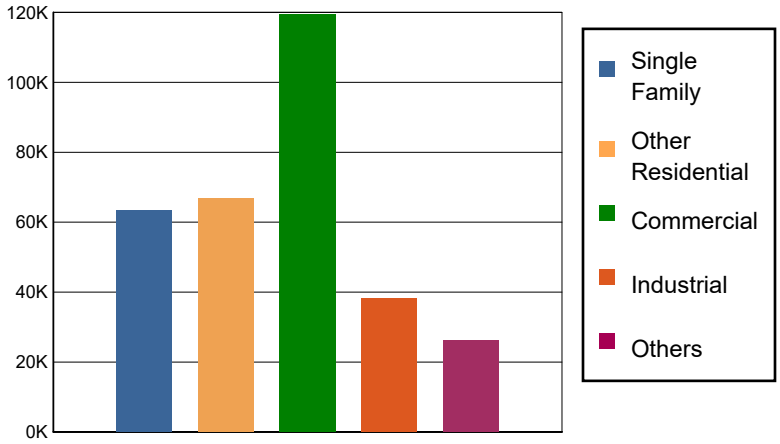


Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.0000	1858.5914	9968.0272	527.7620	764.5270	13,118.9076
	Capital-Related	0.0000	790.4373	9037.6968	338.8713	247.1758	10,414.1812
	Rental	946.3134	4215.2530	4855.0714	258.5899	404.3606	10,679.5883
	Relocation	3492.9004	2727.3171	7440.9068	1217.2806	3521.0562	18,399.4611
	Subtotal	**4439.2138**	**9591.5988**	**31301.7022**	**2342.5038**	**4937.1196**	**52612.1382**
Capital Stock Losses							
	Structural	7159.3430	7059.1639	15367.2565	4978.3700	3061.0206	37,625.1540
	Non_Structural	38105.2474	40715.7648	45558.2725	17316.7948	12576.8266	154,272.9061
	Content	13748.5349	9358.7286	22858.0414	11904.6686	5608.1396	63,478.1131
	Inventory	0.0000	0.0000	4190.5592	1731.7996	91.3921	6,013.7509
	Subtotal	**59013.1253**	**57133.6573**	**87974.1296**	**35931.6330**	**21337.3789**	**261389.9241**
	Total	**63452.34**	**66725.26**	**119275.83**	**38274.14**	**26274.50**	**314002.06**

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	129524.7356	0.0000	0.00
	Bridges	68183.0231	3691.4389	5.41
	Tunnels	553.5147	35.4647	6.41
	Subtotal	**198261.2734**	**3726.9036**	
Railways	Segments	67063.3892	0.0000	0.00
	Bridges	12415.5800	263.8667	2.13
	Tunnels	0.0000	0.0000	0.00
	Facilities	308.9080	66.0096	21.37
	Subtotal	**79787.8772**	**329.8763**	
Light Rail	Segments	5399.1047	0.0000	0.00
	Bridges	13.2750	0.7183	5.41
	Tunnels	0.0000	0.0000	0.00
	Facilities	3200.8000	1028.0144	32.12
	Subtotal	**8613.1797**	**1028.7327**	
Bus	Facilities	97.2975	14.7926	15.20
	Subtotal	**97.2975**	**14.7926**	
Ferry	Facilities	29.2820	4.9328	16.85
	Subtotal	**29.2820**	**4.9328**	
Port	Facilities	1349.3930	265.3208	19.66
	Subtotal	**1349.3930**	**265.3208**	
Airport	Facilities	4844.7583	1339.1185	27.64
	Runways	2114.4318	0.0000	0.00
	Subtotal	**6959.1901**	**1339.1185**	
	Total	**295,097.49**	**6,709.68**	

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	2082.5820	184.2327	8.85
	Distribution Lines	5307.8476	142.1933	2.68
	Subtotal	**7390.4296**	**326.4260**	
Waste Water	Pipelines	0.0000	0.0000	0.00
	Facilities	23385.4448	1358.0281	5.81
	Distribution Lines	3184.7085	71.4273	2.24
	Subtotal	**26570.1533**	**1429.4554**	
Natural Gas	Pipelines	19300.5635	0.0000	0.00
	Facilities	1599.3257	94.2327	5.89
	Distribution Lines	2123.1390	24.4705	1.15
	Subtotal	**23023.0282**	**118.7032**	
Oil Systems	Pipelines	0.0000	0.0000	0.00
	Facilities	8.0240	1.7995	22.43
	Subtotal	**8.0240**	**1.7995**	
Electrical Power	Facilities	137018.3076	16421.9351	11.99
	Subtotal	**137018.3076**	**16421.9351**	
Communication	Facilities	56.1680	4.6103	8.21
	Subtotal	**56.1680**	**4.6103**	
	Total	**194,066.11**	**18,302.93**	

Appendix A: County Listing for the Region

Imperial,CA

Inyo,CA

Kern,CA

Kings,CA

Los Angeles,CA

Orange,CA

Riverside,CA

San Bernardino,CA

San Diego,CA

San Luis Obispo,CA

Santa Barbara,CA

Tulare,CA

Ventura,CA

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
California					
	Imperial	179,702	20,945	12,603	33,548
	Inyo	19,016	2,951	1,970	4,921
	Kern	909,235	87,567	59,168	146,736
	Kings	152,486	13,719	7,861	21,581
	Los Angeles	10,014,009	950,697	566,995	1,517,692
	Orange	3,186,989	363,381	176,806	540,188
	Riverside	2,418,185	281,482	137,249	418,731
	San Bernardino	2,181,654	225,045	152,557	377,602
	San Diego	3,298,634	375,834	193,238	569,072
	San Luis Obispo	282,424	41,720	20,896	62,616
	Santa Barbara	448,229	49,971	28,481	78,452
	Tulare	473,117	43,262	31,210	74,472
	Ventura	843,843	99,299	52,072	151,371
Total Region		**24,407,523**	**2,555,873**	**1,441,106**	**3,996,982**