

## Hazus: Earthquake Global Risk Report

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**Region Name:** CoronadoBankalt2v2

**Earthquake Scenario:** coronadobankalt2shaw\_m7p38\_se

**Print Date:** May 21, 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 9 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 53,758.93 square miles and contains 5,401 census tracts. There are over 7,846 thousand households in the region which has a total population of 23,480,480 people. The distribution of population by Total Region and County is provided in Appendix B.

There are an estimated 6,630 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 272,266 and 178,921 (millions of dollars) , respectively.

## Building and Lifeline Inventory

### Building Inventory

Hazus estimates that there are 6,630 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 88% 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 326 hospitals in the region with a total bed capacity of 59,608 beds. There are 7,402 schools, 1,275 fire stations, 430 police stations and 117 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 451,187.00 (millions of dollars). This inventory includes over 10,885.18 miles of highways, 10,902 bridges, 226,889.89 miles of pipes.

**Table 1: Transportation System Lifeline Inventory**

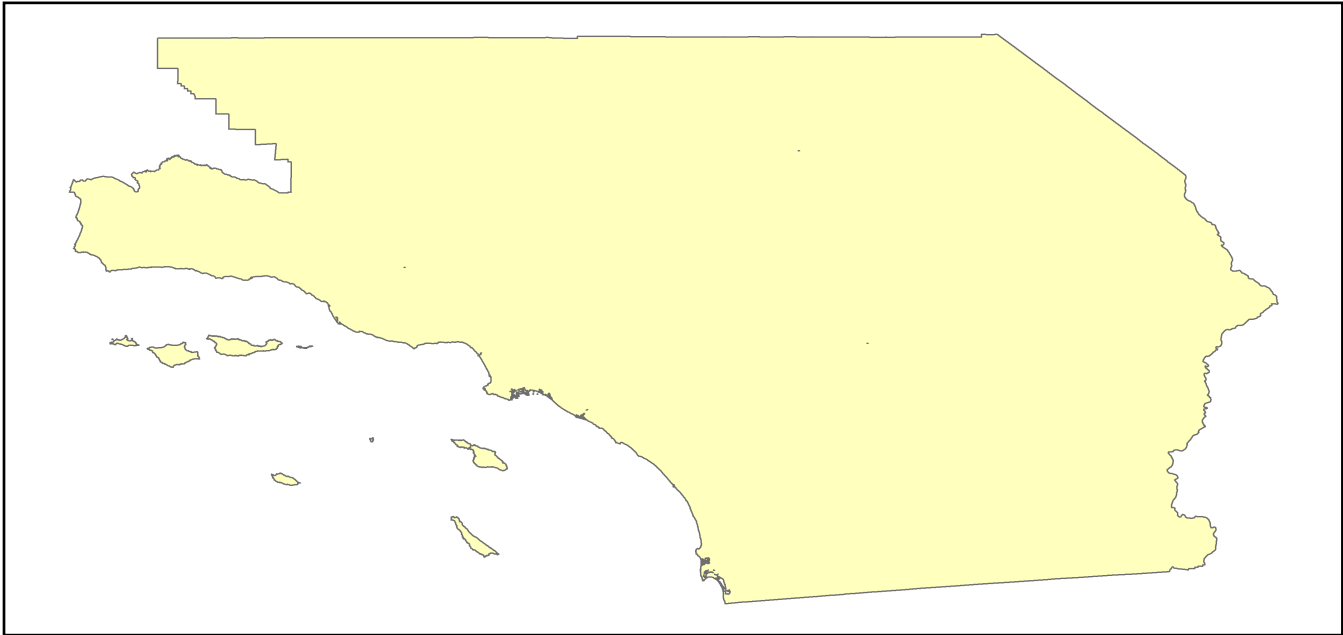
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
<b>Highway</b>	Bridges	10,902	65710.7145
	Segments	9,618	115510.3125
	Tunnels	62	553.5147
	<b>Subtotal</b>		<b>181774.5417</b>
<b>Railways</b>	Bridges	2,016	11471.0400
	Facilities	108	287.6040
	Segments	1,839	62113.0193
	Tunnels	0	0.0000
	<b>Subtotal</b>		<b>73871.6633</b>
<b>Light Rail</b>	Bridges	51	13.2750
	Facilities	149	3200.8000
	Segments	8	5399.1047
	Tunnels	0	0.0000
	<b>Subtotal</b>		<b>8613.1797</b>
<b>Bus</b>	Facilities	37	80.0981
	<b>Subtotal</b>		<b>80.0981</b>
<b>Ferry</b>	Facilities	22	29.2820
	<b>Subtotal</b>		<b>29.2820</b>
<b>Port</b>	Facilities	346	1318.8983
	<b>Subtotal</b>		<b>1318.8983</b>
<b>Airport</b>	Facilities	145	4691.6758
	Runways	161	1887.4908
	<b>Subtotal</b>		<b>6579.1666</b>
		<b>Total</b>	<b>272,266.80</b>

**Table 2: Utility System Lifeline Inventory**

System	Component	# Locations / Segments	Replacement value (millions of dollars)
<b>Potable Water</b>	Distribution Lines	NA	4499.1310
	Facilities	51	2003.9940
	Pipelines	0	0.0000
		<b>Subtotal</b>	<b>6503.1250</b>
<b>Waste Water</b>	Distribution Lines	NA	2699.4786
	Facilities	125	21493.9750
	Pipelines	0	0.0000
		<b>Subtotal</b>	<b>24193.4536</b>
<b>Natural Gas</b>	Distribution Lines	NA	1799.6524
	Facilities	42	1475.0374
	Pipelines	322	18365.1690
		<b>Subtotal</b>	<b>21639.8588</b>
<b>Oil Systems</b>	Facilities	65	7.6700
	Pipelines	0	0.0000
		<b>Subtotal</b>	<b>7.6700</b>
<b>Electrical Power</b>	Facilities	562	126530.2471
		<b>Subtotal</b>	<b>126530.2471</b>
<b>Communication</b>	Facilities	401	47.3180
		<b>Subtotal</b>	<b>47.3180</b>
	<b>Total</b>		<b>178,921.70</b>

## Earthquake Scenario

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



<b>Scenario Name</b>	coronadobankalt2shaw_m7p38_se
<b>Type of Earthquake</b>	User-defined
<b>Fault Name</b>	NA
<b>Historical Epicenter ID #</b>	NA
<b>Probabilistic Return Period</b>	NA
<b>Longitude of Epicenter</b>	NA
<b>Latitude of Epicenter</b>	NA
<b>Earthquake Magnitude</b>	7.38
<b>Depth (km)</b>	NA
<b>Rupture Length (Km)</b>	NA
<b>Rupture Orientation (degrees)</b>	NA
<b>Attenuation Function</b>	NA

## Direct Earthquake Damage

### Building Damage

Hazus estimates that about 11,063 buildings will be at least moderately damaged. This is over 0.00 % of the buildings in the region. There are an estimated 23 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

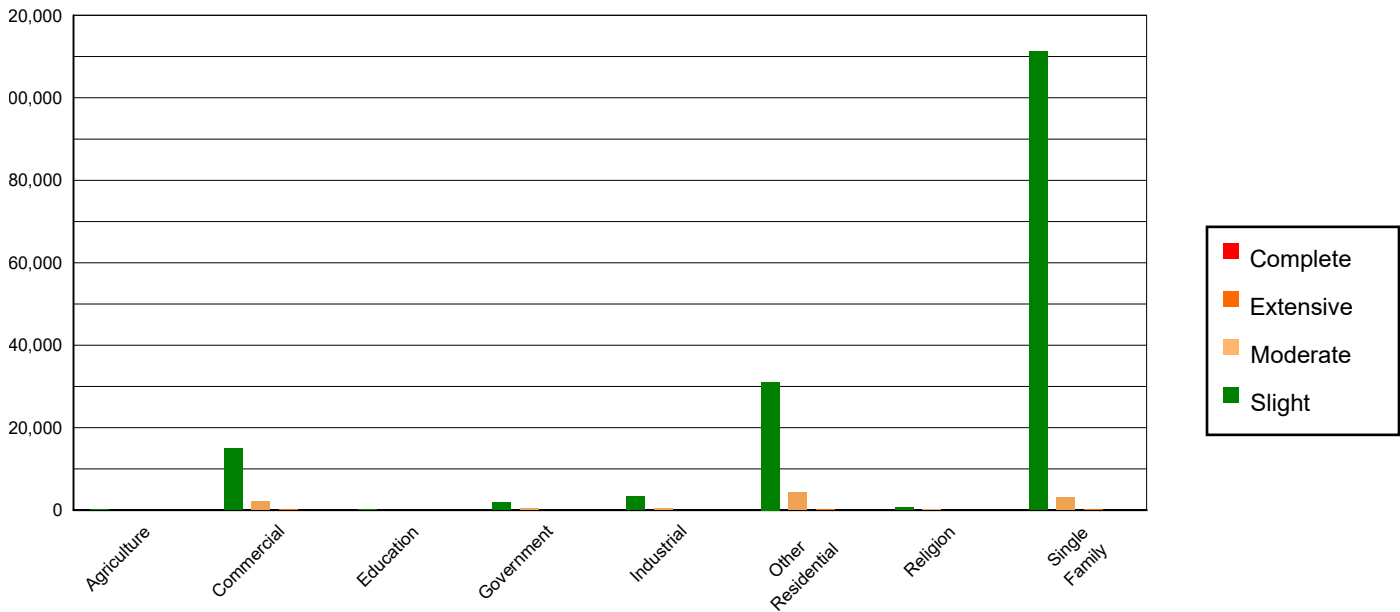


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
<b>Agriculture</b>	14478.42	0.22	222.52	0.14	27.86	0.27	1.19	0.22	0.02	0.07
<b>Commercial</b>	434614.55	6.73	15020.35	9.19	2199.74	20.95	114.55	21.19	4.82	20.77
<b>Education</b>	12453.54	0.19	164.82	0.10	20.60	0.20	1.01	0.19	0.03	0.12
<b>Government</b>	32730.34	0.51	1816.03	1.11	346.17	3.30	10.40	1.92	0.06	0.27
<b>Industrial</b>	113857.66	1.76	3335.02	2.04	472.64	4.50	15.36	2.84	0.32	1.38
<b>Other Residential</b>	993419.92	15.39	31102.35	19.02	4184.55	39.85	170.90	31.61	2.29	9.88
<b>Religion</b>	22234.48	0.34	683.69	0.42	113.89	1.08	4.84	0.89	0.11	0.47
<b>Single Family</b>	4832136.06	74.85	111179.95	67.99	3134.11	29.85	222.34	41.13	15.55	67.05
<b>Total</b>	<b>6,455,925</b>		<b>163,525</b>		<b>10,500</b>		<b>541</b>		<b>23</b>	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
<b>Wood</b>	5668083.21	87.80	131970.26	80.70	2995.65	28.53	2.52	0.47	0.03	0.11
<b>Steel</b>	112875.53	1.75	6290.41	3.85	1795.80	17.10	244.14	45.16	16.83	72.58
<b>Concrete</b>	112769.25	1.75	4558.89	2.79	861.66	8.21	99.35	18.38	2.88	12.43
<b>Precast</b>	52073.36	0.81	2310.51	1.41	401.59	3.82	6.10	1.13	0.03	0.13
<b>RM</b>	291392.72	4.51	6330.38	3.87	1017.68	9.69	10.68	1.98	0.02	0.07
<b>URM</b>	27548.39	0.43	2363.19	1.45	529.69	5.04	52.77	9.76	2.90	12.52
<b>MH</b>	191182.51	2.96	9701.09	5.93	2897.47	27.60	125.02	23.13	0.50	2.15
<b>Total</b>	<b>6,455,925</b>		<b>163,525</b>		<b>10,500</b>		<b>541</b>		<b>23</b>	

\*Note:

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

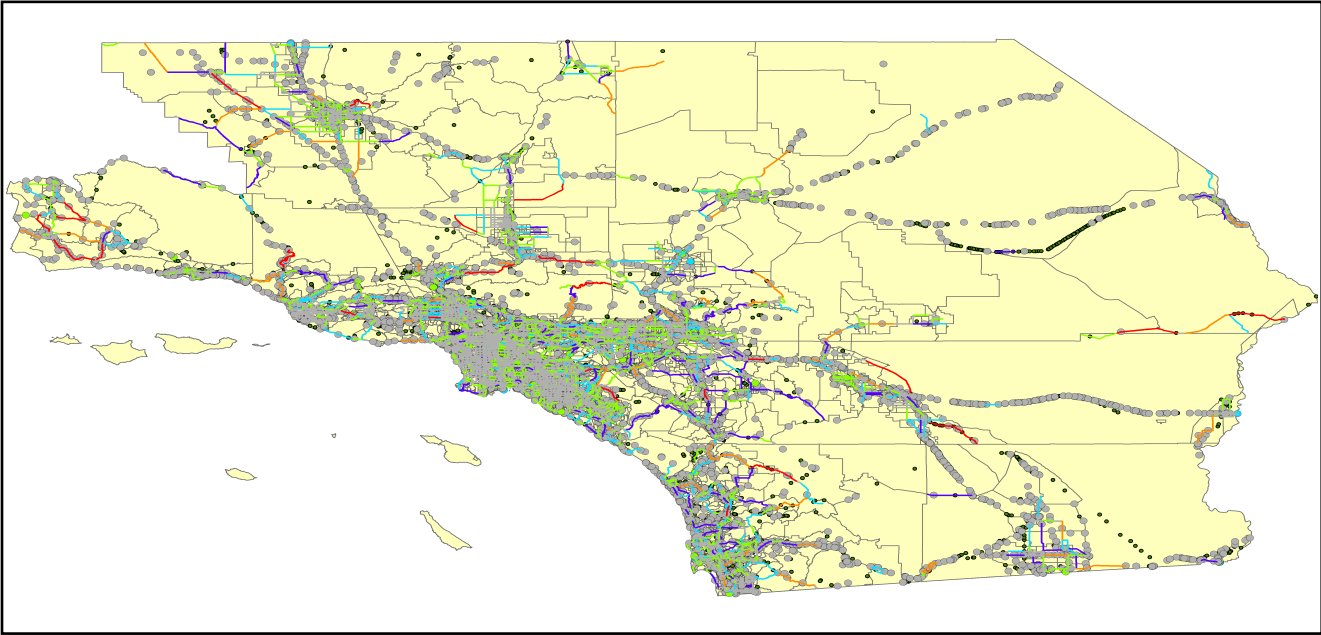
## Essential Facility Damage

Before the earthquake, the region had 59,608 hospital beds available for use. On the day of the earthquake, the model estimates that only 58,117 hospital beds (98.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 99.00% 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	326	0	0	325
Schools	7,402	15	0	7,350
EOCs	117	0	0	116
PoliceStations	430	1	0	426
FireStations	1,275	4	0	1,266

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	9,618	0	0	9,618	9,618
	Bridges	10,902	0	0	10,902	10,902
	Tunnels	62	0	0	62	62
Railways	Segments	1,839	0	0	1,839	1,839
	Bridges	2,016	0	0	2,016	2,016
	Tunnels	0	0	0	0	0
	Facilities	108	0	0	108	108
Light Rail	Segments	8	0	0	8	8
	Bridges	51	0	0	51	51
	Tunnels	0	0	0	0	0
	Facilities	149	0	0	149	149
Bus	Facilities	37	0	0	37	37
Ferry	Facilities	22	0	0	22	22
Port	Facilities	346	0	0	346	346
Airport	Facilities	145	0	0	145	145
	Runways	161	0	0	161	161

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	51	0	0	51	51
Waste Water	125	1	0	109	125
Natural Gas	42	0	0	42	42
Oil Systems	65	0	0	65	65
Electrical Power	562	10	0	557	562
Communication	401	0	0	401	401

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

System	Total Pipelines Length (miles)	Number of Leaks	Number of Breaks
Potable Water	139,781	1573	393
Waste Water	83,869	790	198
Natural Gas	3,240	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	7,846,232	862	189	0	0	0
Electric Power		0	0	0	0	0

## Induced Earthquake Damage

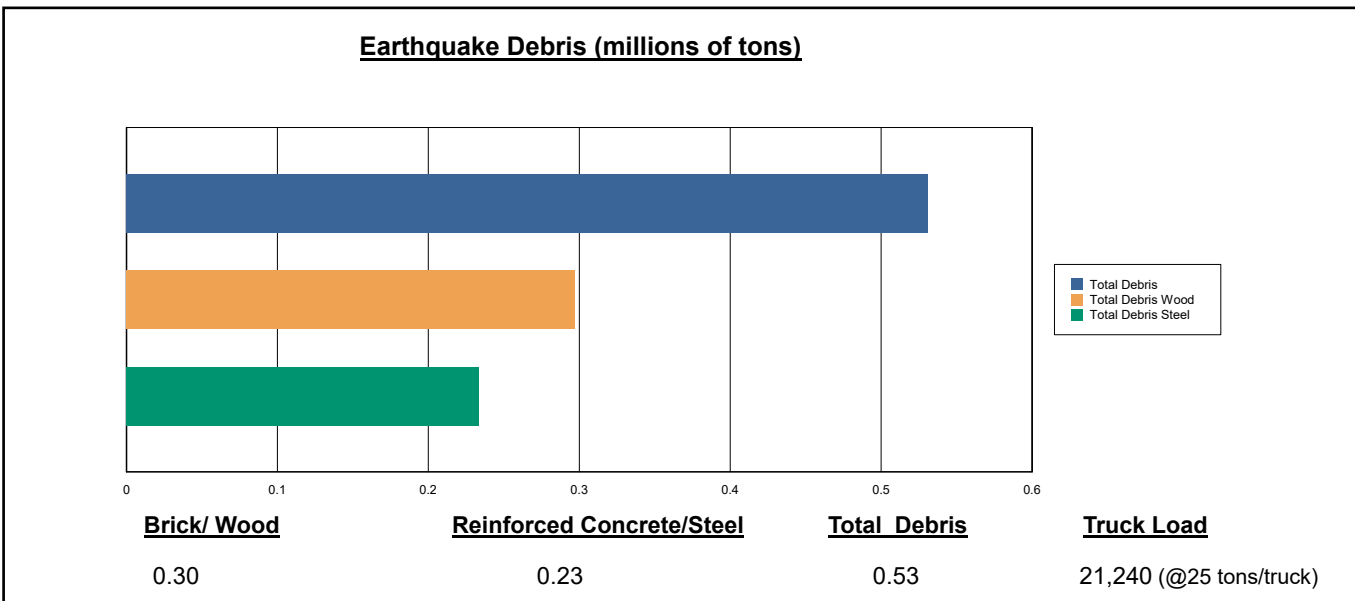
### Fire Following Earthquake

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 30 ignitions that will burn about 0.52 sq. mi (0.00 % of the region's total area.) The model also estimates that the fires will displace about 5,164 people and burn about 524 (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.

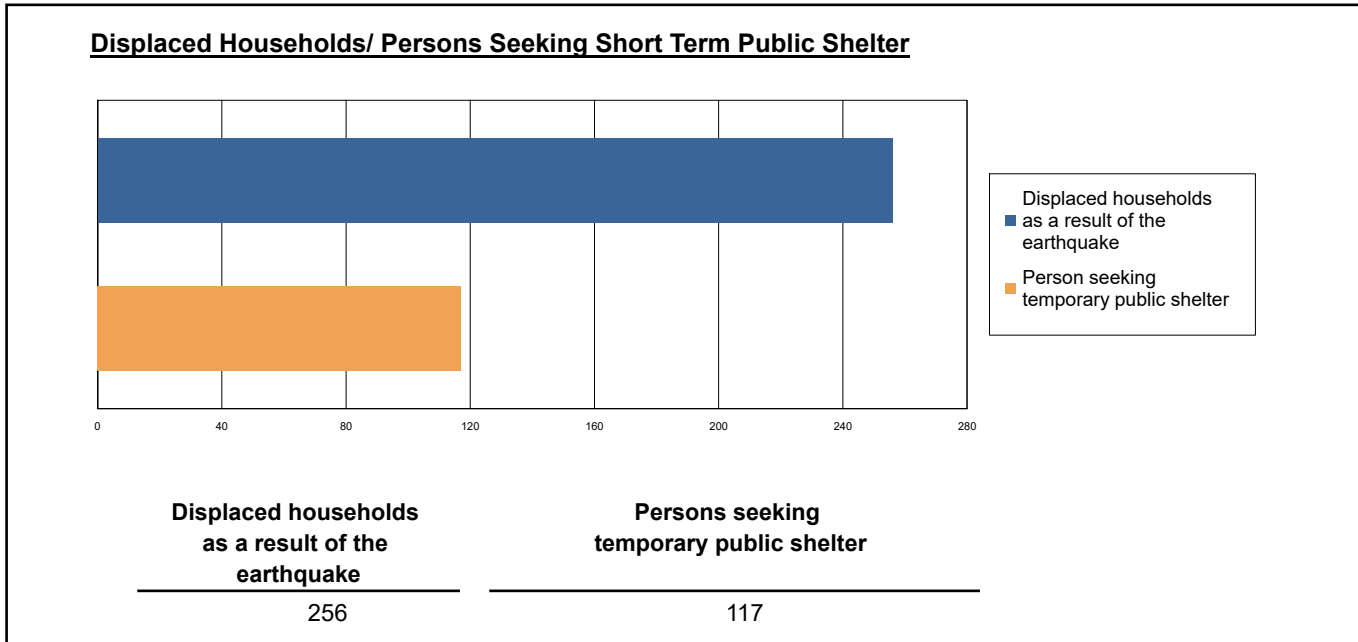
The model estimates that a total of 531,000 tons of debris will be generated. Of the total amount, Brick/Wood comprises 56.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 21,240 truckloads (@25 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 256 households to be displaced due to the earthquake. Of these, 117 people (out of a total population of 23,480,480) 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
<b>2 AM</b>	Commercial	4.56	0.27	0.00	0.01
	Commuting	0.01	0.01	0.03	0.00
	Educational	0.00	0.00	0.00	0.00
	Hotels	0.62	0.05	0.00	0.00
	Industrial	4.00	0.23	0.00	0.01
	Other-Residential	173.24	7.65	0.08	0.13
	Single Family	186.79	3.01	0.05	0.08
	<b>Total</b>	<b>369</b>	<b>11</b>	<b>0</b>	<b>0</b>
<b>2 PM</b>	Commercial	300.91	17.95	0.30	0.51
	Commuting	0.10	0.13	0.23	0.04
	Educational	89.04	4.46	0.03	0.05
	Hotels	0.12	0.01	0.00	0.00
	Industrial	29.06	1.70	0.02	0.04
	Other-Residential	51.31	2.36	0.03	0.04
	Single Family	53.61	0.97	0.02	0.03
	<b>Total</b>	<b>524</b>	<b>28</b>	<b>1</b>	<b>1</b>
<b>5 PM</b>	Commercial	204.31	12.12	0.20	0.33
	Commuting	2.22	2.71	4.87	0.93
	Educational	23.73	1.18	0.00	0.00
	Hotels	0.18	0.01	0.00	0.00
	Industrial	18.16	1.06	0.02	0.03
	Other-Residential	62.57	2.84	0.03	0.05
	Single Family	66.80	1.14	0.02	0.03
	<b>Total</b>	<b>378</b>	<b>21</b>	<b>5</b>	<b>1</b>

## Economic Loss

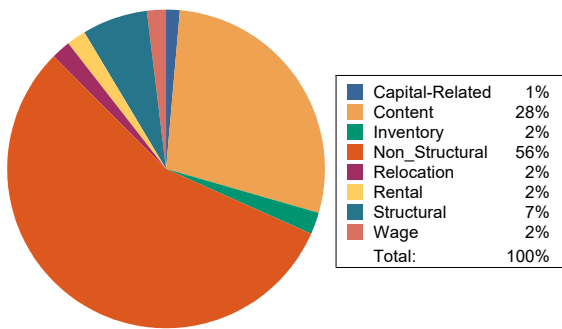
The total economic loss estimated for the earthquake is 11,375.03 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

## Building-Related Losses

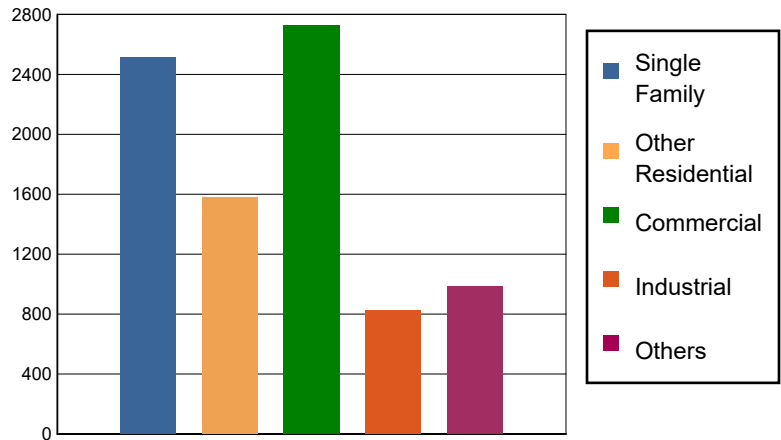
The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability 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 8,625.45 (millions of dollars); 7 % 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 47 % 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
<b>Income Losses</b>							
	Wage	0.0000	14.8842	115.9343	3.2516	28.9545	163.0246
	Capital-Related	0.0000	6.3202	109.7916	2.0720	5.1954	123.3792
	Rental	12.3148	54.1450	79.1599	2.2966	10.8272	158.7435
	Relocation	20.9893	21.5086	70.5223	8.9513	41.2394	163.2109
	<b>Subtotal</b>	<b>33.3041</b>	<b>96.8580</b>	<b>375.4081</b>	<b>16.5715</b>	<b>86.2165</b>	<b>608.3582</b>
<b>Capital Stock Losses</b>							
	Structural	218.0953	100.1980	177.5699	40.5079	49.5736	585.9447
	Non_Structural	1615.5480	1045.8719	1225.4642	420.4555	506.3675	4,813.7071
	Content	645.1180	334.1420	800.5310	301.0650	339.2359	2,420.0919
	Inventory	0.0000	0.0000	147.4175	44.6790	5.2471	197.3436
	<b>Subtotal</b>	<b>2478.7613</b>	<b>1480.2119</b>	<b>2350.9826</b>	<b>806.7074</b>	<b>900.4241</b>	<b>8017.0873</b>
	<b>Total</b>	<b>2512.07</b>	<b>1577.07</b>	<b>2726.39</b>	<b>823.28</b>	<b>986.64</b>	<b>8625.45</b>

### 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	115510.3125	0.0000	0.00
	Bridges	65710.7145	53.7022	0.08
	Tunnels	553.5147	0.1950	0.04
	<b>Subtotal</b>	<b>181774.5417</b>	<b>53.8972</b>	
Railways	Segments	62113.0193	0.0000	0.00
	Bridges	11471.0400	0.7875	0.01
	Tunnels	0.0000	0.0000	0.00
	Facilities	287.6040	8.6727	3.02
	<b>Subtotal</b>	<b>73871.6633</b>	<b>9.4602</b>	
Light Rail	Segments	5399.1047	0.0000	0.00
	Bridges	13.2750	0.0157	0.12
	Tunnels	0.0000	0.0000	0.00
	Facilities	3200.8000	142.8182	4.46
	<b>Subtotal</b>	<b>8613.1797</b>	<b>142.8339</b>	
Bus	Facilities	80.0981	1.2318	1.54
	<b>Subtotal</b>	<b>80.0981</b>	<b>1.2318</b>	
Ferry	Facilities	29.2820	1.7680	6.04
	<b>Subtotal</b>	<b>29.2820</b>	<b>1.7680</b>	
Port	Facilities	1318.8983	105.5255	8.00
	<b>Subtotal</b>	<b>1318.8983</b>	<b>105.5255</b>	
Airport	Facilities	4691.6758	217.8007	4.64
	Runways	1887.4908	0.0000	0.00
	<b>Subtotal</b>	<b>6579.1666</b>	<b>217.8007</b>	
<b>Total</b>		<b>272,266.83</b>	<b>532.52</b>	

**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	2003.9940	9.5856	0.48
	Distribution Lines	4499.1310	7.0777	0.16
	<b>Subtotal</b>	<b>6503.1250</b>	<b>16.6633</b>	
Waste Water	Pipelines	0.0000	0.0000	0.00
	Facilities	21493.9750	383.2522	1.78
	Distribution Lines	2699.4786	3.5553	0.13
	<b>Subtotal</b>	<b>24193.4536</b>	<b>386.8075</b>	
Natural Gas	Pipelines	18365.1690	0.0000	0.00
	Facilities	1475.0374	2.7712	0.19
	Distribution Lines	1799.6524	1.2180	0.07
	<b>Subtotal</b>	<b>21639.8588</b>	<b>3.9892</b>	
Oil Systems	Pipelines	0.0000	0.0000	0.00
	Facilities	7.6700	0.0525	0.68
	<b>Subtotal</b>	<b>7.6700</b>	<b>0.0525</b>	
Electrical Power	Facilities	126530.2471	1808.9268	1.43
	<b>Subtotal</b>	<b>126530.2471</b>	<b>1808.9268</b>	
Communication	Facilities	47.3180	0.6240	1.32
	<b>Subtotal</b>	<b>47.3180</b>	<b>0.6240</b>	
	<b>Total</b>	<b>178,921.67</b>	<b>2,217.06</b>	

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## Appendix A: County Listing for the Region

Imperial,CA

Kern,CA

Los Angeles,CA

Orange,CA

Riverside,CA

San Bernardino,CA

San Diego,CA

Santa Barbara,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
	Kern	909,235	87,567	59,168	146,736
	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
	Santa Barbara	448,229	49,971	28,481	78,452
	Ventura	843,843	99,299	52,072	151,371
<b>Total Region</b>		<b>23,480,480</b>	<b>2,454,221</b>	<b>1,379,169</b>	<b>3,833,392</b>