AIR Workers' Compensation Model for Earthquakes and Terrorism

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www.air-worldwide.com

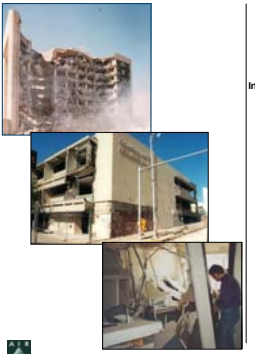
https://www.casact.org/education/reinsure/2008/handouts/seaquist2.pdf (retrieved 25 October 2015)

Building Physical Damage Outcome Largely Determines Distribution of Injury Severity Levels

Workers' Compensation Modeling

- Provides loss analyses for workers' compensation, and also group life, accident, short-term disability, long-term disability lines
- Input data needed for modeling
  - Location details – address, construction type
  - Employees or payroll and average wage
  - Costs of injuries by type
  - Distribution of employees by shift
- Ability to view monetary losses and injuries by type
- Probabilistic and deterministic (defined scenario) modes

Building Physical Damage Affects Resulting Injury Severity Levels

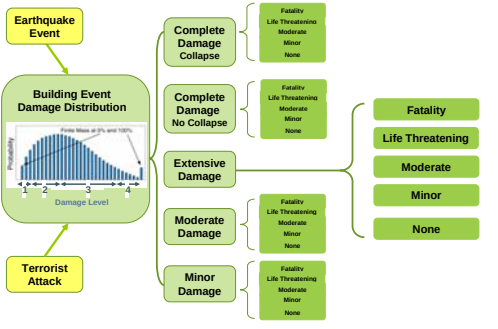


Injury Severity Levels

Injury Severity Level	Injury Description
Severity 1: Minor	Injuries requiring basic medical aid without requiring hospitalization
Severity 2: Moderate	Injuries requiring a greater degree of medical care and hospitalization, but not expected to progress to a life threatening status
Severity 3: Life Threatening	Injuries that pose an immediate life threatening condition if not treated adequately and expeditiously. The majority of these injuries are the result of structural collapse and subsequent entrapment or impairment of the occupants.
Severity 4: Fatality	Instantaneously killed or mortally wounded

Source: HAZUS®

Modeling the Full Range of Possible Damage States and Resulting Injuries at Each Building



Default Injury Costs Assumptions for Workers' Compensation

- Users can enter mean (distribution applied automatically) or use AIR defaults
- AIR default workers' compensation injury costs
  - Include medical and indemnity costs
  - Vary by state and injury type
  - Derived from latest 3 years of claims data obtained from the NCCI
  - NCCI experience data brought to current benefit levels
  - Trended for medical and wage inflation
  - Adjusted to incorporate mental stress of catastrophic events

Default Injury Costs for Workers' Compensation

NCCI Injury Category	HAZUS Category	Range of State Averages
Laceration	Minor	$800 - $1,750
Contusion		
Sprain		
Fracture	Moderate	$70,000 - $160,000
Burn		
Inhalation		
Crush	Life Threatening	$650,000 - $1,610,000
Closed head injury		
Harmful substances		
Fatality	Fatality	$225,000 - $515,000

Earthquake Damage for Commercial Properties

American Insurance Consultants building in Sherman Oaks (1994 Northridge Earthquake) – Joints in moment frame fractured

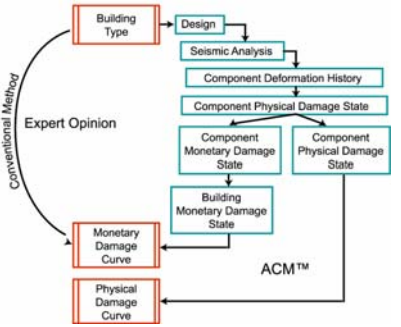
Veterans Administration Medical Center in Sepulveda (1994 Northridge Earthquake)

Source: EERI

Modeling Workers' Compensation Losses Resulting from U.S. Earthquakes

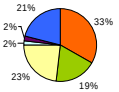
- Injury severity is a function of the severity and nature of the damage sustained by buildings
- Injuries in workplace buildings are caused by
  - Failure of structural elements – beams and columns
  - Damage to non-structural elements – ceilings and windows
  - Contents displacement
- Collapsed buildings cause the most severe injuries, particularly if the construction includes heavy structural elements as in concrete buildings

AIR's Advanced Component Method™ (ACM™) Computes Physical Damage at the Component Level

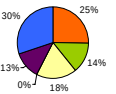


Distribution of Non-fatal Injuries for Moderate Earthquakes in California

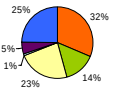
Santa Barbara M5.7 (1978)



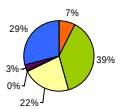
Imperial County M6.4 (1979)

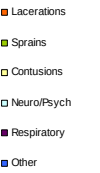


Coalinga M6.7 (1983)

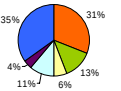


Loma Prieta M6.9 (1989)





Northridge M6.7 (1994)
167 WC Claims
$2.9 Million paid initially



Collapse Probability Varies by Construction Type

Construction Class	Probability of Collapse Given a Complete Damage State (%)
Wood Frame	5
Masonry Veneer	5
Unreinforced Masonry	25
Reinforced Masonry	20
Reinforced Concrete Shear Wall - Mid Rise	15
Reinforced Concrete MRF - Ductile - Mid Rise	15
Reinforced Concrete MRF - Non-Ductile - Mid Rise	20
Tilt - Up	25
Precast Concrete - Mid Rise	20
Light Metal	25
Braced Steel Frame - Low Rise	20
Steel MRF - Perimeter - Mid Rise	15
Steel MRF - Distributed - High Rise	10

Regional Differences are Significant

- Building construction practices and local code enforcement strongly influence casualty rates
- International casualty experience is not the same as U.S.
  - Kobe, Japan, 5:46 am, 1995 – more than 5,000 fatalities
  - Northridge, CA, 4:30 am, 1994 – 57 fatalities
- AIR damage curves in ACM™ reflect regional differences in building vulnerability – e.g., New Madrid Seismic Zone has higher damageability than California
- AIR uses HAZUS injury rates, tied to physical damage states from ACM

Modeled vs. Historical Losses for the Loma Prieta and Northridge Earthquakes

Loma Prieta Earthquake – Commute Time Event

Injury Severity	Model Counts (Employees Only)	Estimated Number of Actual Injuries and Fatalities that Occurred at the Workplace
Minor	852	
Moderate	160	
Life Threatening	49	
Total Non-fatal Injuries	1,061	657
Total Fatalities	49	11
All Injuries	**1,110**	**668**
Loss	**$64.2 million***	**NA**

* At current benefits

Northridge Earthquake – Nighttime event

Injury Severity	Model Counts (Employees Only)	Actual Workers' Compensation Claims (Source CA DOI)
Minor	186	
Moderate	42	
Life Threatening	15	
Total Non-fatal Injuries	243	
Total Fatalities	15	
All Injuries	**258**	**167**
Loss	**$19.1 million***	**$2.9 million****

* At current benefits
**Partially developed as of March, 1995

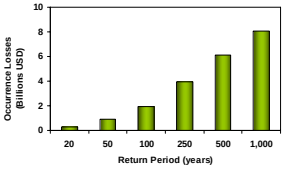
Significant Workers' Compensation Losses Have Not Occurred Over the Past 40 Years

Year	Location	Magnitude	Injuries	Fatalities
2000	Napa Valley/Sonoma	5.2	25	-
1994	Northridge	6.9	9,000+	57
1992	Landers/Big Bear	5.0	402	1
1992	Petrolia	7.2	356	-
1992	Joshua Tree	6.1	32	-
1991	Sierra Madre	5.8	100	2
1990	Upland	5.4	38	-
1989	Loma Prieta	7.1	3,757	63
1987	Superstition Hills	6.6	94	-
1987	Whittier Narrows	5.9	200	8
1986	Oceanside	5.3	28	1
1986	North Palm Springs	5.8	29	-
1984	Morgan Hill	6.2	27	-
1983	Coalinga	6.7	200	-
1980	Cape Mendocino	7.2	8	-
1980	Mammoth Lakes	6.2	13	-
1980	Livermore	5.8	44	1
1979	Imperial Valley	6.5	91	-
1979	Coyote Lake	5.8	16	-
1978	Santa Barbara	5.1	65	-
1973	Point Mugu	5.3	15	-
1971	San Fernando	6.6	2,000	65
1969	Santa Rosa	5.7	15	-

Source: California DOI, 2003

What Would It Take to Cause Large Workers' Compensation Losses Due to Earthquake?

Return Period Workers' Compensation Losses, All States



$1 Billion Workers' Compensation Loss:

750 Fatalities

28,000 Injuries

$8 Billion Workers' Compensation Loss:

6,000 Fatalities

225,000 Injuries

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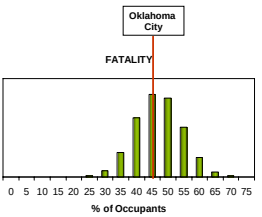
Potential Large Terrorism Event Loss Scenarios
- Workers' Compensation Industry Modeled Losses

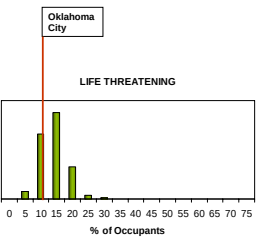
Losses in $ billions

Scenario	New York	Washington	San Francisco	Des Moines
Truck bomb – delivery	$3.5	$2.8	$3.9	$1.5
Chemical – sarin	$313	$72	$51	$22
Biological - anthrax	$484	$127	$88	$31

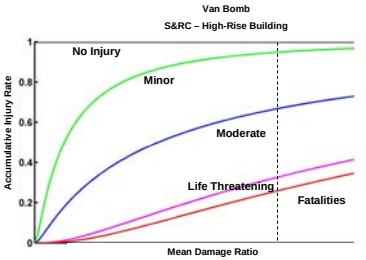


Historical Injury Severity Distributions for Collapsed Buildings

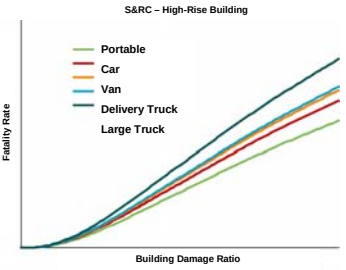




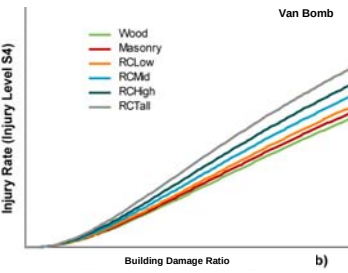
Injury Severity Distribution



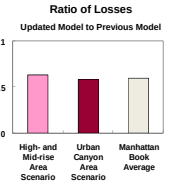
Higher Overpressure from Larger Bombs Amplifies Injury Rates



Taller and Heavier Buildings Cause More Severe Injuries When They Collapse



Impact of Damage and Injury Function Changes on Workers' Compensation Losses Due to Bombing



Summary

- Catastrophe losses in workers' compensation occur when buildings collapse or partially collapse during working hours
- Model-based analysis depends on the availability of detailed exposure data
- Large scale earthquakes have not occurred during business hours
- We have incorporated recent research from the medical community changing the distribution of injury type in terrorist bombing attacks
- Potential losses from terrorist use of CBRN weapons could exceed the P&C industry capital