The Risk Manager

The Latest News on Managing Your Risk

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Would You Be Ready for an M8 Earthquake?

While recent earthquakes and other natural disasters have prompted awareness and preparedness, there is still much more to be done to make sure that your staff, your operations, and your buildings are protected.

Recovery from large scale earthquakes and other natural disasters can take a long time, during which your entity may suffer or be completely unable to operate. Your insurance program should provide for losses caused by an earthquake.

If your operations are located in an area which could be susceptible to large earthquakes, it is important to evaluate the proper earthquake limits for your operation.

MRP Engineering is a structural engineering and risk analysis firm that has provided the attached material for your educational assistance. They specialize in preparing for and recovering from natural hazards by providing risk analysis, damage investigation, and upgrade design.

Considerations

- The Cascadia Subduction Zone, capable of producing M9 earthquakes, runs along the Pacific Northwest coastline endangering Portland, Seattle, and Vancouver B.C.
- Do you have earthquake coverage? When was it last evaluated?
- Structures that sustain little structural damage in a quake can experience large scale nonstructural damage that can be costly to repair.
- Buildings built to code are still likely to sustain structural and nonstructural damage, in the event of a major earthquake.
- With the proper guidance, it is possible to upgrade your building, making it safer for your staff and your equipment.
- Beecher Carlson can provide detailed earthquake "Probable Maximum Loss" studies to analyze the adequacy of your insurance limits.

If you have any questions, please contact your agent at Beecher Carlson, or our Risk Management Department, at 503.222.1831

LESSONS FROM CHILE
FOLLOWING THE 2010 M8.8 MAULE EARTHQUAKE

The M8.8 subduction earthquake of February 27, 2010 that affected central Chile and the capital of Santiago offers highly relevant lessons to other nations (including the United States and Canada) with modern urban areas located in seismically active regions. MRP Engineering visited Chile following the earthquake to investigate the damage and in June 2010 to observe the post-event recovery. Our findings indicate that:

- Subduction type earthquakes can impact relatively distant population centers. Modern buildings in metropolitan Santiago (population 5.5 million and 300+ kilometers from the epicenter) experienced significant structural damage, leading to prolonged loss of use and expensive repairs.
- Damage to reinforced concrete buildings was related to structural wall discontinuities (tuck-under parking, irregular building geometry, at-grade wall offsets) and limited reinforcement at structural wall boundaries.
- Soil response (liquefaction, settlement, and ground shaking amplification) strongly influenced seismic performance of buildings, bridges, and buried utilities.
- The long duration of strong ground shaking caused damage to nonstructural components (exterior cladding, partitions, suspended ceilings, and contents) in buildings with relatively limited structural damage.
- In the days and weeks following the event, industry recovery was hampered by damage to external infrastructure (electricity, water, and transportation), damaged internal utilities, or interruption of raw materials.
- As exemplified by the accompanying photos from June 2010, rebuilding and recovery from mega-events, such as subduction zone earthquakes, may take many months to complete, resulting in significant downtime and loss-of-occupancy for damaged facilities.

These observations suggest that organizations with significant operations in earthquake-prone regions should consider proactive steps to understand their risks and address unacceptable exposures before the next earthquake. The following sections discuss earthquake hazards and approaches to managing seismic risks.

SANTIAGO – JUNE 2010 IMAGES:

Bridge repairs (Vespucio Norte Highway)

Damaged modern industrial facility (Lampa)

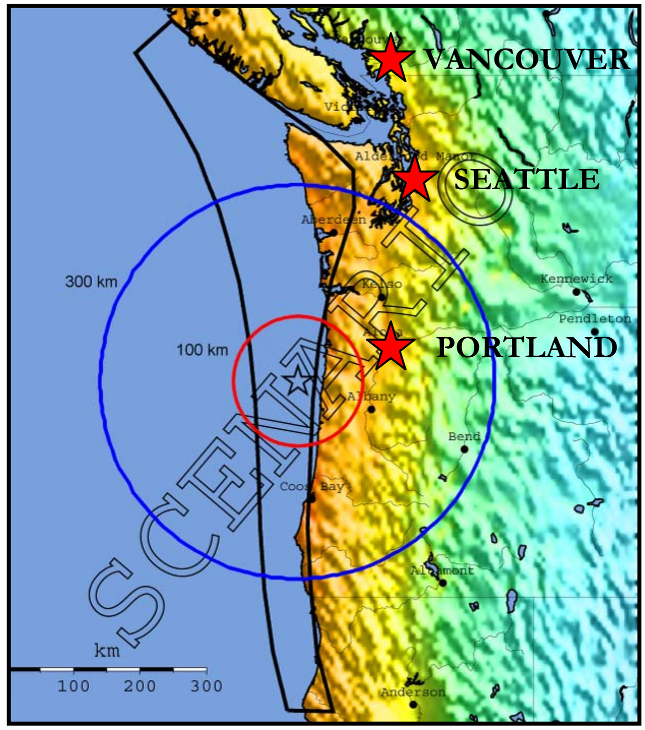
Repairs at a production plant (Lampa)

Office building repairs (Ciudad Empresarial)

PACIFIC NORTHWEST SUBDUCTION ZONE EARTHQUAKES

The Pacific Northwest (including coastal British Columbia) is located along the boundary of two tectonic plates, a geological structure known as the Cascadia Subduction Zone, similar to the tectonic interface along the coast of Chile. This source is considered capable of generating M9 events every 300 to 500 years, with long duration ground shaking, multiple aftershocks, and tsunamis. The most recent significant Cascadia event occurred in 1700. Another M9 Cascadia Subduction Zone earthquake would impact the metropolitan areas of Portland, Seattle, and Vancouver, British Columbia, as well as coastal communities and lifelines interconnecting these areas.

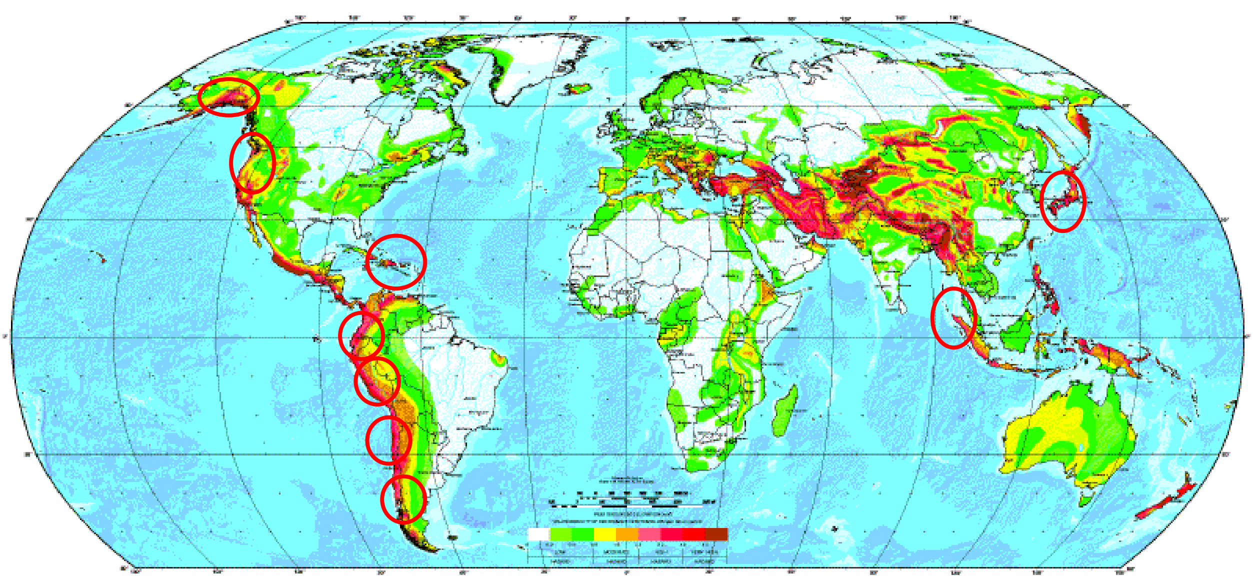
The 2001 M6.8 Nisqually earthquake provided impetus for addressing seismic risks in the Puget Sound region. However, additional steps are required to analyse and upgrade vulnerable buildings, critical services, industrial operations, infrastructure, and in-building equipment.



M9.0 Cascadia Subduction Zone scenario showing potential rupture zone and the major population centers

GLOBAL SEISMIC HAZARD MAP

The following map provides ground-shaking levels for a 475-year earthquake level. Areas in dark red indicate the highest potential seismic hazard (ground shaking). Effects of local soil conditions are not included. Circled areas indicate potential zones of M8+ subduction mega-earthquakes.



Source: http://www.seismo.ethz.ch/gshap/

Proactive engineering earthquake risk assessments represent the first step in helping organizations understand their risks, act to reduce impacts, and prepare effective responses. The following are commonly asked questions and answers related to earthquake engineering.

1. What causes damage?

Ground shaking and soil failures (fault rupture, landsliding, differential settlement of foundations, soil liquefaction, etc.) can cause excessive movements of structures, leading to damage. Tsunamis and ground elevation changes represent hazards along coastal areas.

2. What is the Modified Mercalli Intensity (MMI)?

The MMI scale is used to measure ground-shaking intensity at a site of interest. Of the scale's twelve discrete levels, levels VI and below denote slight damage. Weak structures can be damaged in MMI VII level shaking. Engineered structures can be damaged at MMI VIII.

3. What is Richter Magnitude?

The Richter Magnitude is the most familiar earthquake descriptor to engineers, geologists, and the general public. It measures earthquake strength or size at its source.

4. What is soil liquefaction?

Liquefaction represents reduction in soil strength and stiffness by earthquake shaking or other rapid loading. Liquefaction occurs in saturated granular soils. Significant damage from liquefaction can occur to supported structures, buried utilities, and waterfront structures.

5. What types of structures tend to be most vulnerable?

Examples of vulnerable structural systems include: unretrofitted unreinforced masonry, pre-1990s tilt-ups, older pre-cast concrete, and nonductile concrete frames.

6. What is a probable maximum loss (PML)?

PML represents potential damage level in the event of an earthquake. It represents a cost to return the structure to the pre-earthquake condition expressed as a percentage of the replacement value. A PML of 20% or less represents minor damage. A PML of 50% suggests a potential for collapse.

7. What does "built to code" mean?

Currently, the code regulating the seismic design of new structures in the United States is the International Building Code (IBC). The basic design philosophy is for structures to resist major earthquakes without collapse, although structural and nonstructural damage is possible. Nevertheless, with existing engineering tools, facility holders can specify and achieve a desired performance level beyond life safety for existing and new construction.

8. Are there methods to reduce earthquake risk?

Managing earthquake risks is possible. The approach begins with an overall engineering risk assessment to identify unacceptable risks. It is then followed by more selective analyses to determine effective methods to resolve earthquake issues. The upgrade design and construction phase completes the process. Benefits are increased safety, lower downtime, and an improved insurable risk.

PERFORMANCE-BASED SEISMIC REHABILITATION

Seismic rehabilitation decisions are often based on the benefit of achieving a desired performance given an earthquake level, versus the cost to attain this objective. An owner's considerations in making this choice include: facility function, occupancy, expected life span, and budget. The structural engineer can assist the owner in making an informed decision by providing practical rehabilitation recommendations for various earthquake levels and performance objectives, with a certain degree of confidence that the objectives will be met.

Until recently, the design practice for new construction in the United States and Canada was nominally based on the use of ground motions associated with events having a 10% probability of non-exceedance in a 50-year period. This event can also be expressed as a 475-year event, which is sometimes rounded to a 500-year event. Insurance-related studies are also generally based on this level of ground motion.

The rehabilitation objective selected as a basis for design will determine the cost, the feasibility of a given rehabilitation project, and the benefit attained (improved safety, reduction in damage, shorter loss of use time) in the event of an earthquake. The following are examples of rehabilitation objectives.

Earthquake Hazard Level	Exceedance Level in 50 Years	Performance Level			
		Operational	Immediate Occupancy	Life Safety	Collapse Prevention
Frequent	50%	X	L	L	L
Occasional	20%	E	X	L	L
Rare	10%	E	E	X	L
Very rare	2%	E	E	E	X

X - Represents basic safety objective intended by building codes for new construction of standard occupancy.
E - Represents an enhanced performance objective, exceeding basic safety objective.
L - Represents a limited performance objective with a lower performance target than the basic safety objective.

MRP ENGINEERING SERVICES

MRP Engineering is a structural engineering and risk analysis firm based in metropolitan Seattle, Washington, and provides proactive risk analysis for natural hazards, damage investigation, and upgrade design. We assist clients to protect their business operations from risks to physical assets resulting from extreme events such as earthquakes and hurricanes. Our philosophy is to listen to your needs and then provide you with practical and economical structural engineering-based risk reduction solutions. Services include:

- Earthquake and wind risk evaluation
- Structural benefit-cost analysis
- Upgrade design
- Independent design review
- Damage (root cause) investigation
- Expert witness and claim support

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