Earthquake Risk in South East Asia

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Plate Tectonics of Southeast Asia

ASIA’S RESTLESS EARTH

The fault that triggered the Dec. 26, 2004, earthquake remains one of the most volatile in the world.

Volcanoes

Sparking an Eruption

Earthquakes can also trigger volcanic eruptions and gas emissions. Less than a month after the March 28, 2005, earthquake, Mt. Talang on Sumatra erupted. No one was hurt, but 25,000 people were forced from their homes. The magma in volcanoes in subduction zones is more viscous than in other types of volcanoes. Volcanoes like Mt. Talang, therefore, can withstand greater pressures before they erupt. But this means when they do blow, they are more destructive. Mount St. Helens in the U.S. is an example of a subduction-zone volcano.
Seismic setting

- Located within stable Sunda plate, sandwiched between Java trench to W and S Philippine plate and trench to E.
- No large historic quakes in Singapore, 5 quakes with M>5 in Sunda plate between 1964-2000
- Largest seismic threat - Java trench and Sumatra fault 300-400 km to the SW, last quake on section directly adjacent in 1861 (M8.5)

*Petersen et al., Tectonophysics, 2005*
USGS Community Internet Intensity Map (32 miles NNE of Padang, Sumatera, Indonesia)

ID: 2007pah 03:49:39 GMT MAR 06 2007 Mag=6.4 Latitude=50.51 Longitude=E100.52

Did You Feel It?

http://earthquake.usgs.gov
Singapore earthquake risk

- A large event (M>7.8) on Sumatran subduction zone or a M7.5+ eq on Sumatra Fault at distance of ~300 km could generate destructive ground motions in Singapore.

- Current building design codes based on BS8110 code—no provision for seismic loading.

- High rise structures most at risk from long period ground motion due to large distant quakes.
Major earthquake source zones - Global Strain Rate Map Project

Dr. William Holt, State University of New York, Stony Brook
http://www.unavco.org/research_science/
Population Density
Hazard exposure (weighted by area affected)

From Munich Re NATHAN web site
Hazard exposure (weighted by area affected)

Countries (order by GDP per capita)

From Munich Re NATHAN web site

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Seismic Hazard with historic events M>7
USGS/NEIC (PDE) 1973 - Present 

Rectangular Grid Search
Latitude Range: -11 to 45
Longitude Range: 67 to 152
Magnitude Range: 7 to 10
Depth Range: 0 to 100
Number of Earthquakes: 161
Significant Worldwide Earthquakes
(2150 B.C. - 1994 A.D.)

Rectangular Grid Search
Latitude Range: -11 to 45
Longitude Range: 67 to 152
Magnitude Range: 7 to 10
Depth Range: 0 to 100
Number of Earthquakes: 238

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Global Seismic Hazard Program (GSHAP)
Population Density
Predicted fatalities - 10% in 50 yrs hazard

Countries (sorted by GDP per capita)

Number of fatalities (for India style construction)

Fatalities for 10% in 50 yrs ***
Predicted fatalities per capita

Countries (sorted by GDP per capita)

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Earthquake Risk - Other Hazards

- Triggered fires – Fire following earthquake,
  - 1906 San Francisco “Firestorm”, densely packed woodframe buildings, failure of water system due to liquefaction
- Liquefaction – water-saturated sandy soils, particularly land fill, ground turns to “quicksand”
  - ports, coastal roadways, airports
- Landslides – strong shaking trigger for near unstable slopes
- Tsunamis hazard
25 December, 2005
Tsunamis Hazard

**High Hazard**

Return Period: Less than 500 years

Characteristics: Adjacent to zones with vertical fault displacements and high earthquake hazard, mostly in very active subduction zones

**Moderate Hazard**

Return Period: 500 to 2,000 years

Characteristics: Adjacent to active continental faulting with slow or distributed plate boundary collision zones, or in regions at moderate distances from subduction zones capable of large (M9.0) earthquakes

**Low Hazard**

Return Period: 2,000+ years

Characteristics: Coastal areas subject to effects of mega-tsunamis from submarine slides, large volcanic landslides, or infrequent but large earthquakes

**Negligible Hazard**

Return Period: Tens to hundreds of thousands of years

Characteristics: No known source capable of causing tsunamis higher than 5 m (16 ft); hazard dominated by extreme events such as asteroid impacts
**USGS SHAKECAST**

May 27, 2006

- 5782 dead
- 36,000 injured
- 358,000 houses damaged
- Almost all larger hotels affected, many closed temporarily

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