The 28 March 2025 Myanmar Earthquake: A Regional Seismic Disaster

1. Earthquake Overview and Regional Consequences

On 28 March 2025, at 12:50 PM local time (06:20 UTC), a magnitude 7.7 earthquake struck central Myanmar, with the epicenter located west of Mandalay, along the Sagaing Fault Zone which is a major transform boundary between the Indian and Sunda plates. This strike-slip event, one of the most severe in recent Southeast Asian history, generated strong ground motions across Myanmar and reached as far as Thailand, Laos, Vietnam, Bangladesh, northeastern India, and southern China.

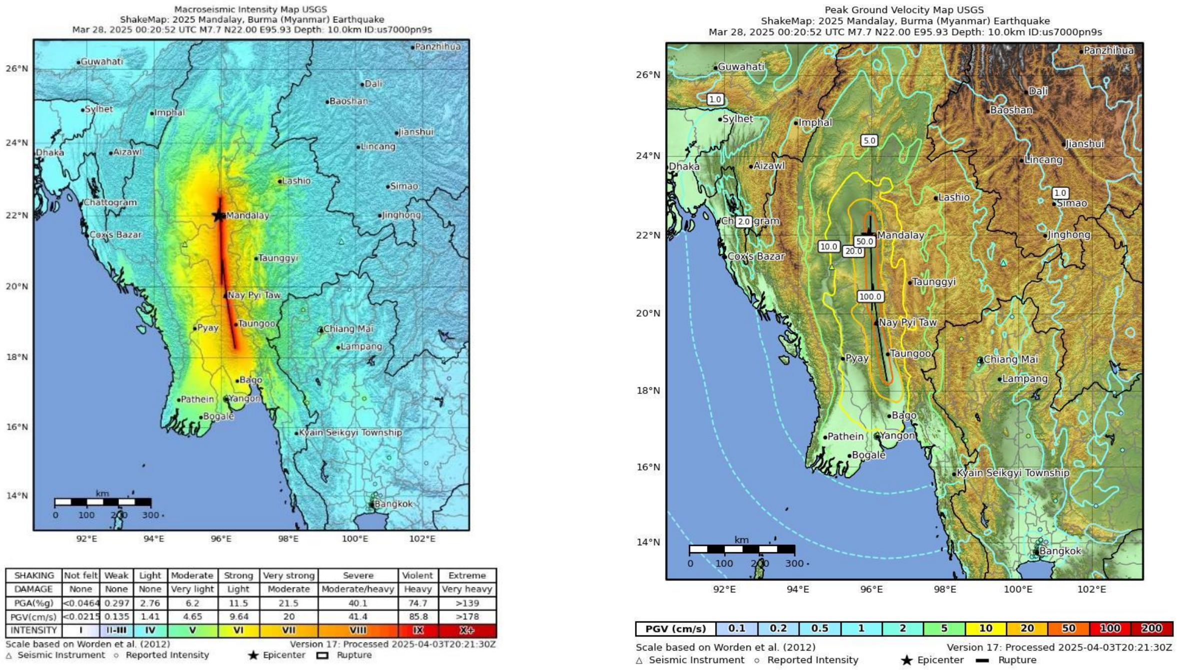
Recorded ground motion parameters indicate PGA values exceeding 0.6g and PGV values above 50 cm/s in the vicinity of ruptured fault, levels known to cause significant structural and nonstructural damage in buildings not designed for high seismic demands.

The earthquake caused over 3,500 deaths and 5,000 injuries, with widespread structural damage reported across central Myanmar, particularly in Mandalay, Myingyan, and surrounding districts. Thousands of buildings including schools, hospitals, bridges, and government facilities suffered partial or total collapse. Damage was especially severe in older reinforced concrete buildings lacking seismic detailing, where common failure modes included soft-story collapse, infill wall failure, and brittle column shear. Remarkably, a high-rise under construction in Bangkok, approximately 700 kilometers from the epicenter, also collapsed, demonstrating how long-period ground motions can significantly affect poorly engineered tall buildings even if they are located at far distances from the causative fault.

2. Rupture Characteristics and Ground Motion Distribution

The earthquake involved the rupture of a segment of the Sagaing Fault, with an estimated rupture length of approximately 150–170 km. Field observations and geodetic data indicate seismic surface displacements reaching up to 2 meters. The faulting mechanism was predominantly right-lateral strike-slip, aligning with the known kinematics of the Indian–Sunda plate boundary and the regional tectonic regime of central Myanmar.

Figure 1 presents two essential shake map outputs produced by the United States Geological Survey (USGS), providing spatial representations of ground motion intensity and severity associated with the mainshock. The PGV map (Figure 1b) highlights the concentration of strong shaking around Mandalay, with velocities greater than 50 cm/s. These levels correlate with the worst structural damage. The MMI map (Figure 1a) shows that severe to violent shaking (MMI VIII–IX) was felt near the epicenter, while moderate to strong shaking (MMI VI–VII) extended into neighboring countries, consistent with reported nonstructural damage and public alarm.



a) b)

Figure 1. Ground motion maps of the 28 March 2025 earthquake. (a) Modified Mercalli Intensity (MMI) ; (b) Peak Ground Velocity (PGV) . Source: USGS

These maps illustrate the rupture extent and the associated distribution of PGV, highlighting intense shaking concentrated along the fault trace. The highest PGV values (exceeding 50 cm/s) are observed near Mandalay. Ground motion levels in this region correspond closely with areas of severe structural damage

3. Bangkok High-Rise Collapse Due to a Distant Earthquake

Although the epicenter of the 28 March 2025 earthquake was located approximately 700 kilometers from Bangkok, the event induced structural collapse of a 33-story office tower under construction in the Chatuchak District of the city. This failure was not caused by local ground rupture but resulted from the combined effects of seismic wave propagation, site amplification, and structural deficiencies.

Bangkok is situated within a deep, unconsolidated alluvial basin composed of soft clay layers, which exhibit a high potential for amplifying long-period seismic waves. Large-magnitude earthquakes such as the 2025 Myanmar event can generate long-period ground motions, which can travel great distances with limited attenuation. As these waves enter sedimentary basins, they undergo amplification and resonance, leading to increased spectral accelerations at periods corresponding to the natural vibration modes of tall buildings.

In the case of the collapsed high-rise, preliminary investigations identified several critical structural vulnerabilities. The building exhibited torsional irregularity, an off-centered shear core, and slender load-bearing columns that lacked proper confinement and ductility detailing. These features reduced its ability to resist lateral forces and amplified displacements caused by basin-induced ground motion. This incident highlights the importance of implementing performance-based seismic design for tall buildings and incorporating basin amplification effects and long-period ground motion characteristics into seismic hazard assessments for deep sedimentary basins, irrespective of their distance from active fault systems.

The following insights are informed by Dr. Praveen Malhotra's preliminary report on the seismic effects of the 28 March 2025 Myanmar earthquake and its impact in Bangkok.

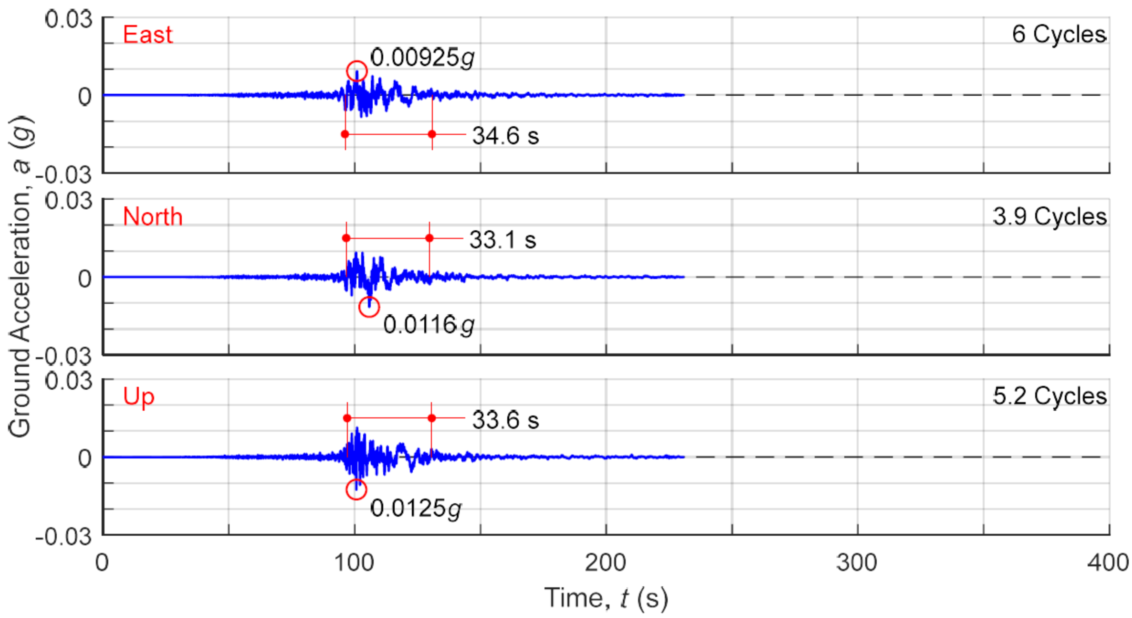


Figure 2. Acceleration records from a rock site in Chiang Mai, approximately 250 km from the rupture.

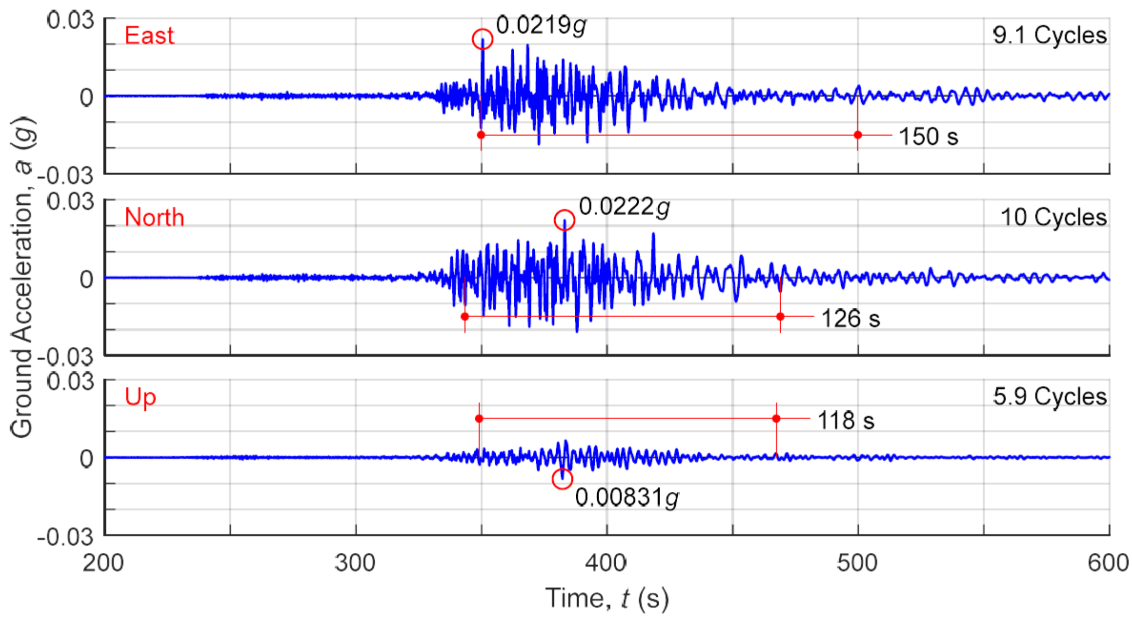
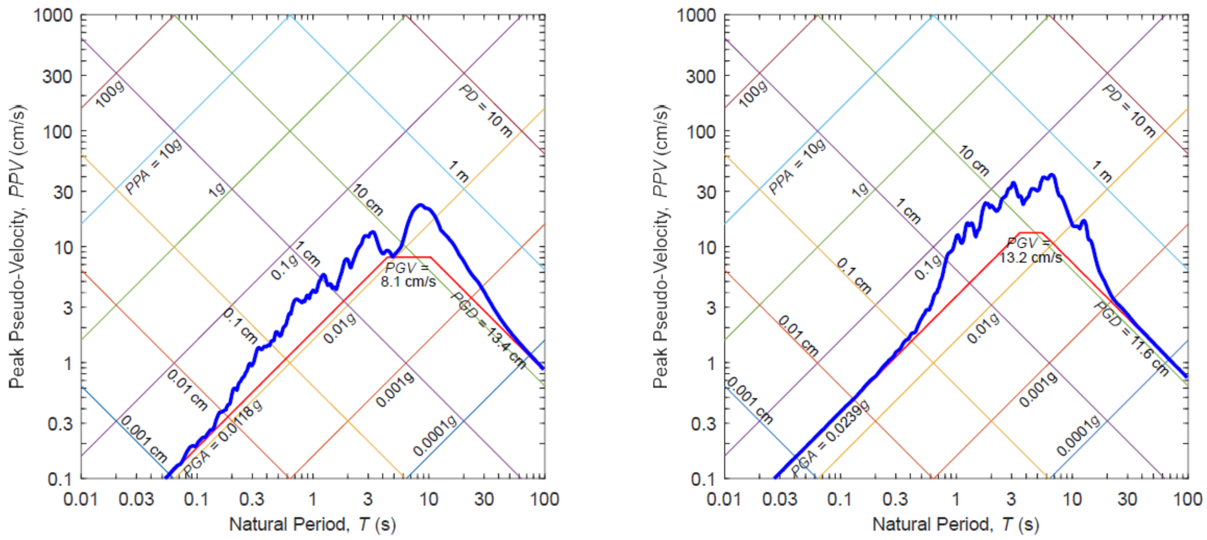


Figure 3. Acceleration time histories recorded at a soft soil site in Bangkok, approximately 700 km from the rupture zone.



a) *b)*

Figure 4. Response spectra of maximum horizontal ground motion recorded at (a) a rock site and (b) a soft soil site in Bangkok.

A comparative analysis of ground motion records from a rock site in Chiang Mai, approximately 250 kilometers from the rupture (Figure 2), and a soft soil site in Bangkok, approximately 700 kilometers away (Figure 3), highlights the influence of local site conditions on the amplification of long-period seismic waves. Although the PGA recorded in Bangkok was relatively low, approximately 0.012g, both PGV and spectral amplitudes, particularly within the long-period range, were substantially elevated due to site response effects. Response spectral analysis (Figure 4) reveals that the soft soil site in Bangkok exhibited pronounced amplification in the 2 to 5 second period range, which aligns with the fundamental period of many high-rise structures. The increased long-period spectral content induced resonance effects and amplified lateral displacement demands. Despite the low acceleration levels, amplified long-period ground motions had a critical influence on the dynamic response of the structure. In conjunction with pre-existing structural vulnerabilities such as torsional irregularity and insufficient ductile detailing, these seismic demand characteristics contributed significantly to the collapse of the high-rise building.

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References

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