

Understanding Earthquake Risk in Thailand: Reflections on the 28 March 2025 Event

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1. INTRODUCTION

Bangkok, the capital of Thailand, was significantly affected by the M7.7 Mandalay earthquake, even though it is located about 1000 km from the earthquake epicenter. The city lies on a large, 800 m deep soil basin, which can strongly amplify long-period ground motions. A large number of high-rise buildings with long natural periods were strongly shaken by the resonance effect of these amplified ground motions, causing great panic among building occupants. Several hundred of these buildings suffered minor to severe damage to non-structural components (e.g. partition walls, ceilings, elevators), about ten of them suffered significant damage in structural walls (concrete crushing and buckling of reinforcing bars), and one 30-storey building collapsed completely. This event is the most severe earthquake Bangkok has ever experienced in modern times. Bangkok is indeed prepared for the effects of such distant large earthquakes, as high-rise buildings have been designed and built since 2007 to withstand the expected long-period ground motions. The design spectrum was determined based on a comprehensive study of basin amplification and a probabilistic seismic hazard assessment. During this earthquake, ground motions were recorded at five seismic stations in Bangkok. Although the spectral accelerations of these recorded motions are lower than those of the design-basis earthquake, their impact on high-rise buildings appears to be disproportionately high. Subsequently, an investigation was conducted using the acceleration records at rooftop of two high-rise buildings and the time histories of lateral roof displacements of several high-rise buildings obtained from video clips using a pixel tracking technique. The result shows that the critical damping ratio of the fundamental vibration modes of these buildings is much lower than expected; it is about 1% instead of 2.5%--the value recommended by the Tall Buildings Initiative and adopted by the Thai national standard for earthquake-resistant design. This finding could explain the higher-than-expected impact on high-rise buildings in Bangkok from the distant large earthquake. It could also mean that the seismic design criteria for Bangkok will need to be significantly adjusted in the near future. It also suggests an effective method to suppress the seismic response: increasing the damping level by installing energy-absorbing devices in high-rise buildings.

2. BIOGRAPHY

Pennung Warnitchai received his doctoral degree in Civil Engineering from the University of Tokyo in 1990 and is currently Professor of Structural Engineering at the Asian Institute of Technology (AIT). He has been actively involved in research and practice in the fields of structural dynamics, earthquake engineering, wind effects on structures, bridge engineering and disaster management. Since 2002, he has been leading a long-term research program on "Mitigation of Earthquake Risk in Thailand" funded by the Thai Research Fund and later by the National Research Council of Thailand. More than 30 researchers from ten universities and three government agencies in Thailand have participated in this program. In the professional organizations, he was the chairman of the chapter on the effects of earthquakes and wind loads at the Engineering Institute of Thailand (EIT) from 2002 to 2016. He led a team of experts and professional engineers to develop the first official seismic design standard for buildings and structures in Thailand in 2009. Several of his research team's findings, such as new design spectra for long-period ground motions in the Bangkok basin and a new method for analyzing the seismic response of tall buildings, were translated into code of practice in this seismic standard. He is also currently Thailand's national delegate to the International Association for Earthquake Engineering (IAEE) and founding director of the Earthquake Research Center of Thailand (EARTH).



Figure 1. Prof. Pennung Warnitchai