

Cost Estimation of Structural Work for Residential Building with Seismic Design Consideration

H. A. Roslan¹, N. S. Zulhibri¹, Ade Faisal², M. I. Adiyanto^{1*}

¹Faculty of Civil Engineering Technology,
Universiti Malaysia Pahang, 26300 Gambang, Pahang, MALAYSIA

²Program Studi Teknik Sipil,
Universitas Muhammadiyah Sumatera Utara, Medan 20238, INDONESIA

*Corresponding Author

DOI: <https://doi.org/10.30880/ijie.2023.15.02.026>

Received 11 January 2023; Accepted 22 May 2023; Available online 13 September 2023

Abstract: The Sumatra-Andaman earthquakes had triggered local earthquakes in Malaysia by reactivation of ancient inactive faults. Previously on 5th June 2015, Ranau, a region located in Sabah, Malaysia, had experienced a moderate earthquake of $M_w 6.1$. The structural failures occurred because all existing buildings only designed for gravity load without any seismic provision. Recent research work exhibits the seismic designs' impact on the cost of material and its parameters that impact the cost. There are two types reinforced concrete residential buildings called Type 1 and Type 2 for two storey and four storey which had been used as models. This research applied four seismicity levels to the reference peak ground acceleration value, $\alpha_{gR} = 0.07g, 0.10g, 0.13g$ & $0.16g$, and two soil types: Soil Types B and D. The result shows that for two storey reinforced concrete residential buildings on soil types B and D, seismic design increases structural work costs, which is around 0.62% to 1.31% and 0.61% to 2.16%, respectively, for Type 1 model compared to non-seismic design. Besides, model Type 2, the increment is around 0.24% to 1.22% and 0.20% to 1.71%, respectively. Otherwise, for reinforced concrete residential building with four storey on soil types B and D, the result shows that seismic design tends to have a higher structural work's cost around 0.41% to 2.48% and 0.98% to 11.23%, respectively, for Type 1 model. Besides, for model Type 2 the increment is around 1.80% to 2.05% and 2.34% to 8.53%, respectively, compared to non-seismic design.

Keywords: Cost estimation, Eurocode 8, National Annex, seismic design, structural work

1. Introduction

Malaysia has no exemption in encountering earthquakes because it is surrounded by high seismic countries, Indonesia and the Philippines. Aceh earthquake in 2004 is approved that Malaysia also affected by the tragedy of neighboring country. The event triggered a tsunami causing deaths and injuries. The tremors also had been felt in western part of Peninsular Malaysia.

Malaysia, except for Sabah, is considered a low seismicity region. On 5th June 2015, On 5th June 2015, a magnitude 6.1 earthquake occurred in Ranau causing structural and non-structural parts of several structures to be damaged [1-3]. The most damage observed was the X-mark crack on the brickwall because of the shear failure [4]. Despite the Ranau earthquake only being classified as a moderate earthquake, more than 100 aftershocks caused 61 damaged structures, including hospitals, mosques, and schools, and resulted in 18 fatalities [5]. Does not considering seismic design in past construction practice in Malaysia had contributed to the results.

A seismic hazard in Malaysia with low to moderate levels cannot be taken lightly. Hence, especially in Sabah, the seismic design consideration shall be applied for new buildings to reduce the damages and fatalities in the future [6].