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Assessment Method for Seismic Vulnerability of Old Masonry Buildings in Sri Lanka

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Abstract

The collapse of unreinforced masonry structures, which are distributed around the earthquake prone areas of the world, is one of the main causes of death in earthquake disasters. Due to improper methods, lack of knowledge for the construction and maintenance, every year thousands of casualties and collapsing masonry houses are reported. Even though, Sri Lanka was believed to have no seismic threats, it is now realized that Sri Lanka can no longer be considered as a country safe from seismic threats following the recent events that occurred in and around the island. Hence the need for evaluating the seismic adequacy of the existing masonry structures has come into focus. For this purpose, an expert system which contains specific knowledge for masonry structures was developed with the collected data from visual inspection survey, numerical calculations and field experiment.

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Keywords: Expert System; Seismic Vulnerability; Seismograph; Unreinforced Masonry Buildings.

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1. Introduction

A developing country like Sri Lanka, majority of residential and public buildings can consider as masonry buildings, especially in rural areas most are adobe masonry buildings. Masonry buildings are popular due to their low cost in construction, construction easiness, and need of less labour skills, eco-friendly and use of locally available materials (Mendis et al. 2014). In the point of durability masonry buildings have a higher probability of failure under earthquake. Hence the existing masonry buildings usually associated to a high seismic vulnerability. It causing injuries or even death of their occupants. But due to economic reasons, masonry building construction is still can considered as the best solution for low income housing in developing countries. Due to the week properties of the materials, geometry, foundations, connections between walls – roofs- floors, stiffness of the horizontal diaphragms or the building condition, gravity load-bearing walls, low flexibility of the floors, high mass of the masonry walls, existing masonry buildings are poor in seismic performance. Furthermore, "non-structural" elements (eg. partition walls) and their connection to the load-bearing walls can also be a reason for poor performance of these buildings. Recent geological studies found convincing evidence for a long suspected geological phenomenon that the Indo-Australian plate is indeed splitting as shown in Figure 1. It is creating an intra-plate just about 400-500km from the southwest coast of Sri Lanka. Hence there is a potential of increasing seismic activities in Sri Lanka and need to consider the design requirement (Pradeep et al. 2016).

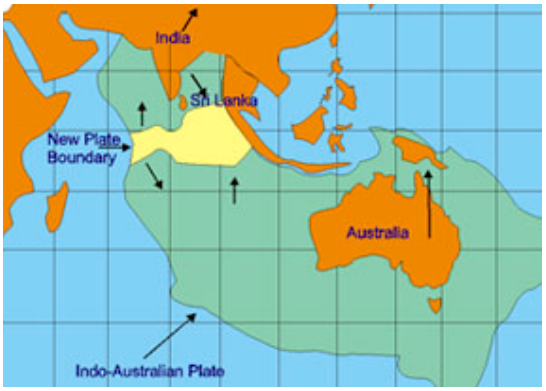

Figure 1. The Indo-Australian seismic plate and the splitting path (C.B. Dissanayake.2010)`

Other than that there are several incidents that local residents have complained about low-scale tremor occurred within last two decades and many damaged houses, especially in Hali-Ela, Haputhale, Badulla, Nuwaraeliya, Ampara, Damana, Mahiyangana areas in Sri Lanka (Panagoda 2012), (Silva 2012). It is observed that the damage caused by such earthquakes tend to be very high due to lack of preparedness against them special on building and relevant infrastructure (Pradeep et al. 2012). It is very much essential to study to control the effects of the earthquake since the most of the building structures in Sri Lanka have not designed to bare the earthquake forces. Though the newly constructed buildings in Colombo area adopted to earthquake building designs, local people in other rural areas build their masonry buildings without considering the seismic resistance. In the case of urban rehabilitation programme this attention may become critical for the designing of future disaster mitigate plan. It is considered being a timely requirement to assess the performance levels of masonry buildings for different return period earthquakes which happens without any advance notification.

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