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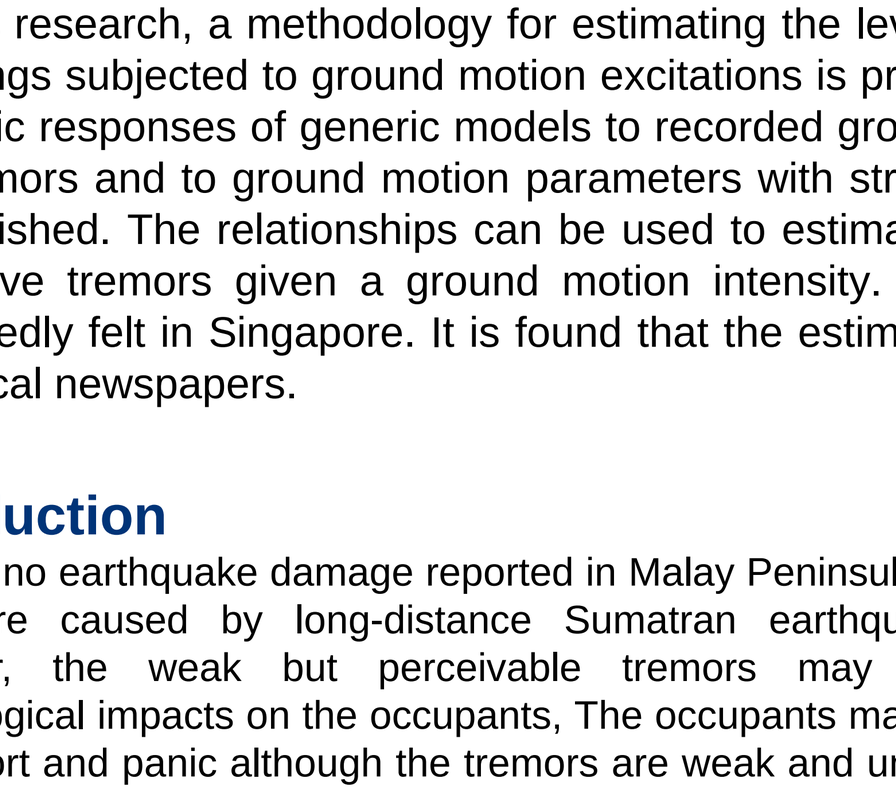
Methodology for Estimating Human Perception to Tremors in High-Rise Buildings

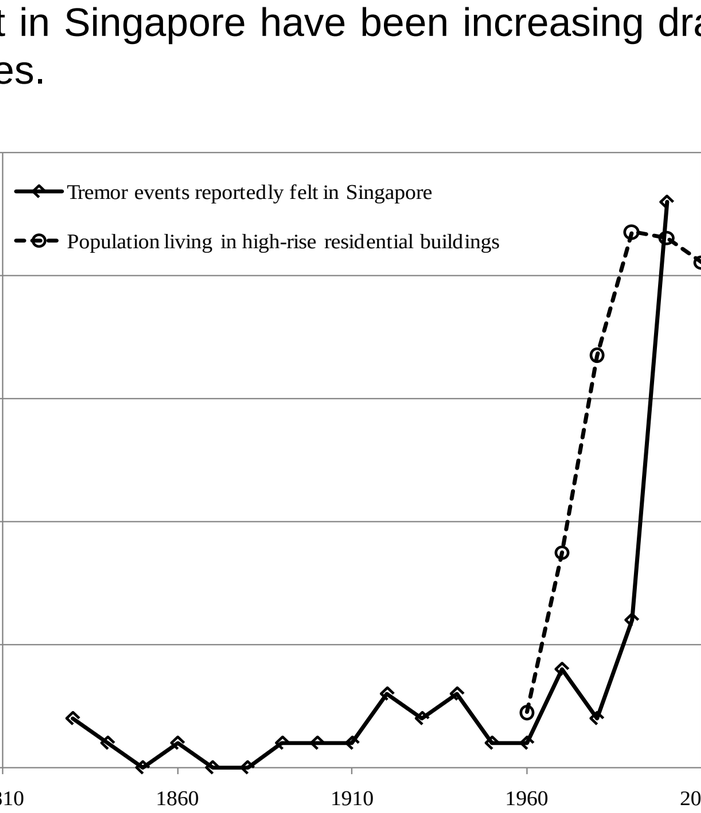
In this research, a methodology for estimating the level of perception to tremors of occupants living in high-rise residential buildings subjected to ground motion excitations is proposed. The methodology is based on statistical analysis of analytical seismic responses of generic models to recorded ground motions. Relationships between the estimated level of perception to tremors and to ground motion parameters with structural response that exceed corresponding perception threshold are established. The relationships can be used to estimate the percentage of occupants living in high-rise buildings who may perceive tremors given a ground motion intensity. The proposed methodology is validated with three tremor events reportedly felt in Singapore. It is found that the estimated results match well with the reports from both the authorities and the local newspapers.

Introduction

There is no earthquake damage reported in Malay Peninsula and Singapore caused by long-distance Sumatran earthquakes. However, the weak but perceivable tremors may have psychological impacts on the occupants, The occupants may feel discomfort and panic although the tremors are weak and unlikely to cause structural damages. Furthermore such tremor events reportedly felt in Singapore have been increasing dramatically in recent decades.



Number of tremor events reportedly felt and percentage of population living in high-rise residential buildings in Singapore

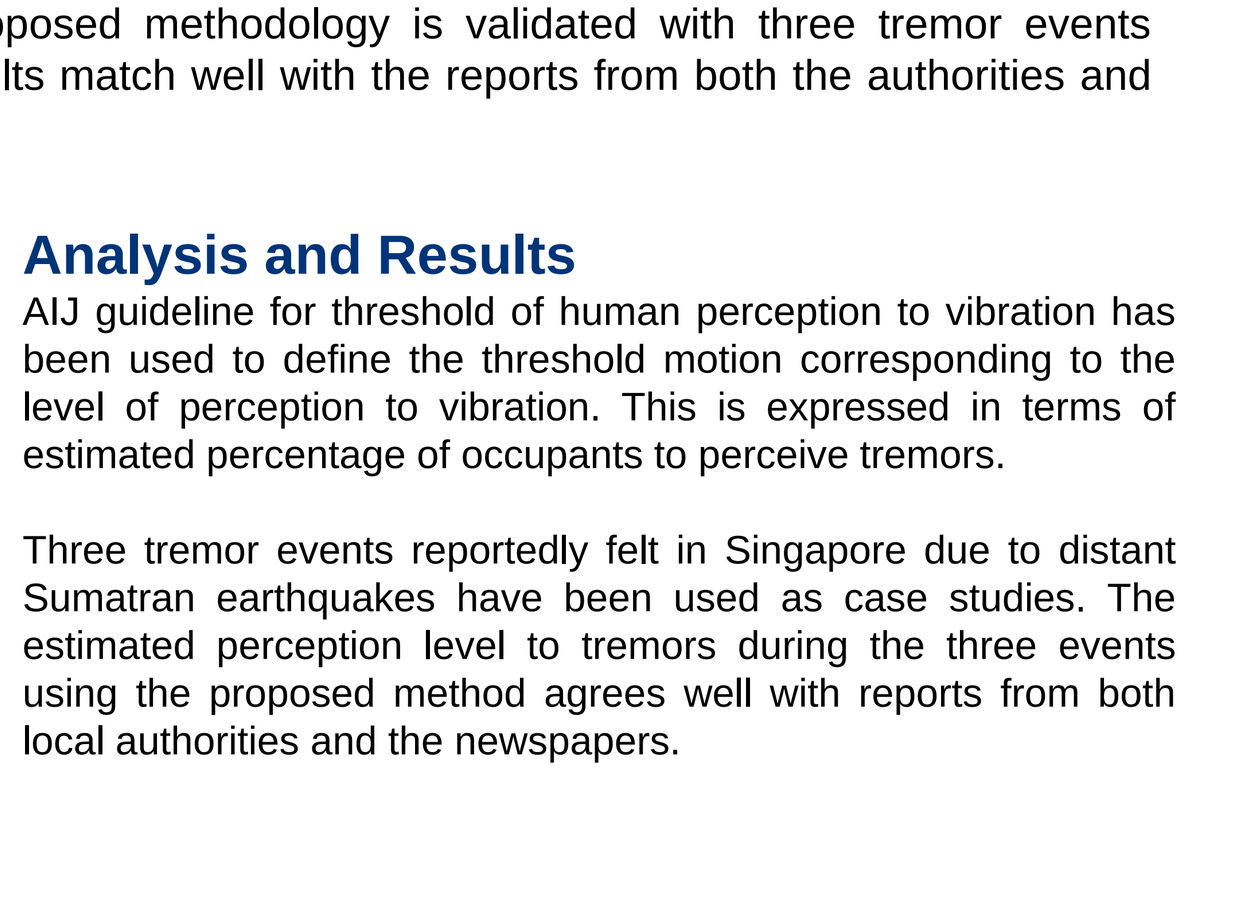


Summary of human perception threshold to vibration specified by AIJ-GEH-2004

Analysis and Results

AIJ guideline for threshold of human perception to vibration has been used to define the threshold motion corresponding to the level of perception to vibration. This is expressed in terms of estimated percentage of occupants to perceive tremors.

Three tremor events reportedly felt in Singapore due to distant Sumatran earthquakes have been used as case studies. The estimated perception level to tremors during the three events using the proposed method agrees well with reports from both local authorities and the newspapers.



The surface geology of Singapore (DSTA, 2009) overlaid with the location of tremors reportedly felt in Singapore during December 26th, 2004, March 28th, 2005 and September 30th, 2009 Sumatran earthquake events