

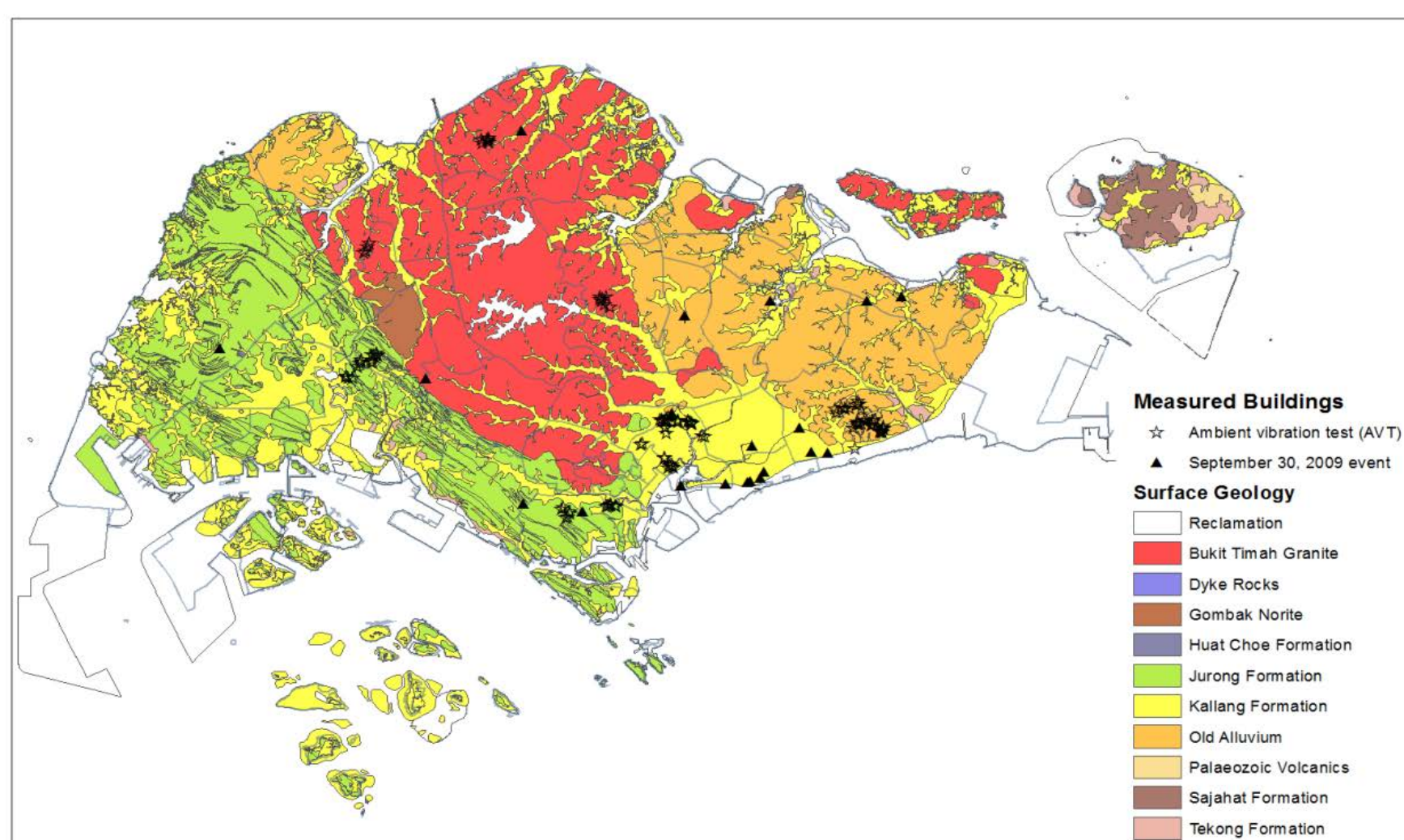


# Empirical Relationships between Natural Vibration Period and Height of Buildings in Singapore

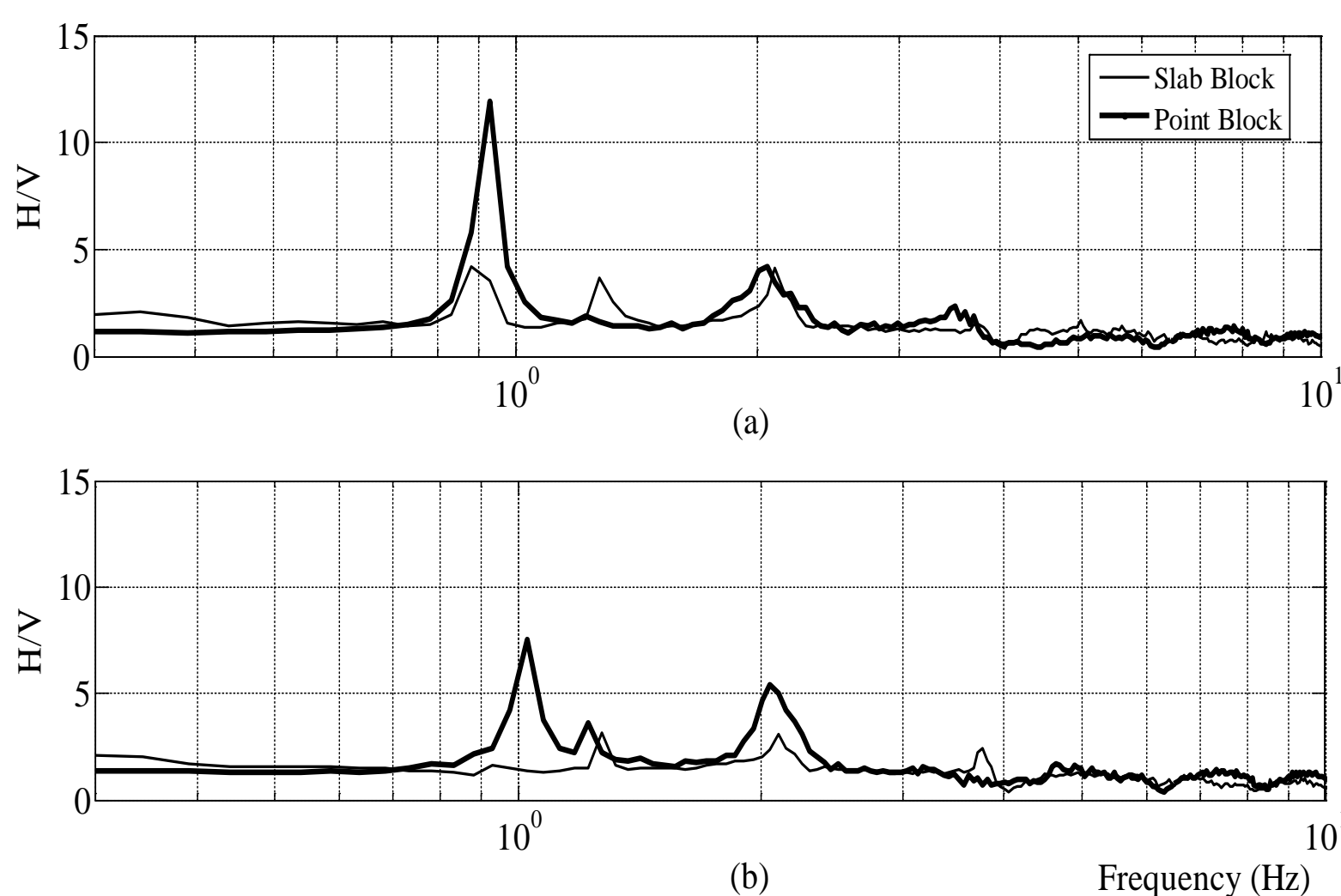
Relationships between the natural vibration period and height of high-rise public residential buildings in Singapore are derived empirically by conducting ambient vibration tests (AVT) on 116 buildings. The measured buildings have a height ranging from 4 to 30 stories. The aspect ratio of buildings in plan is found to be insignificant in affecting the natural vibration period of the 1<sup>st</sup> mode of the buildings. The period-height relationships are derived using regression analysis considering the site properties of a building. It is concluded that the vibration periods estimated from the proposed period-height relationship for buildings located at soft-soil site are about 40% longer than the vibration periods estimated for buildings located at firm-soil site.

## Introduction

In Singapore, where seismic-resistant design is not required for most buildings, Natural vibration period of buildings is thus usually not of key concern. However, as part of the effort to assess the seismic performance of buildings in Singapore subjected to long-distance Sumatran earthquakes, the natural vibration period of residential buildings in Singapore is needed to estimate the response of buildings when subjected to the long-distance earthquakes from Sumatra.



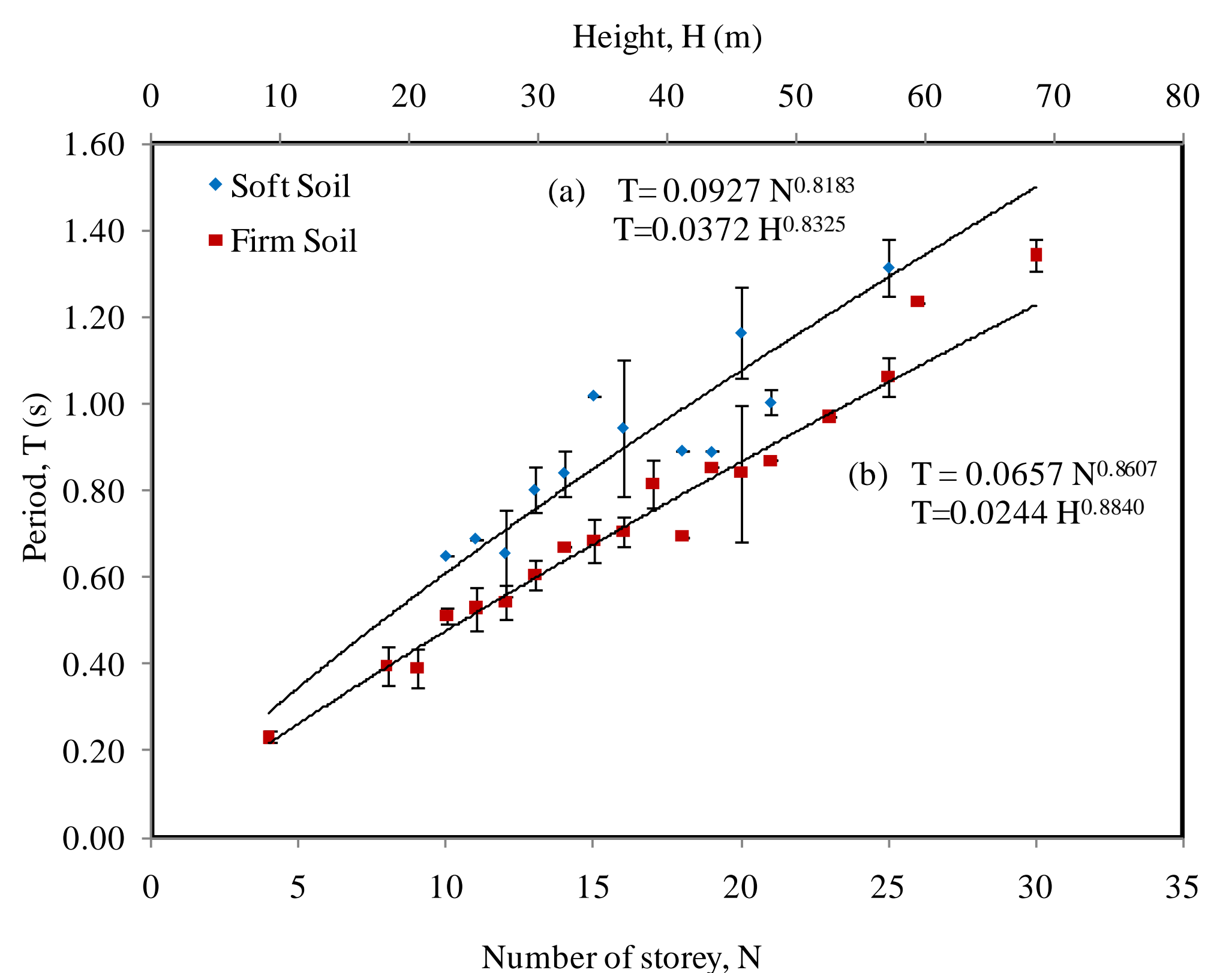
Geological map of Singapore overlaid with the location of the measured buildings



Comparison between the HVSR plots of measurements conducted at top of 20-story rectangular plan (slab block) and square plan (point block) buildings

## Results

Regression analysis is carried out for buildings located at firm-soil site (Bukit Timah Granite, Jurong Formation and Old Alluvium) and soft-soil site (Kallang Formation). It is noticeable that the natural vibration period estimated from period-height relationship for buildings located at soft-soil site is about 40% longer than that estimated using relationship for buildings located at firm-soil site.



Plot of mean and standard deviation for buildings at (a) soft-soil site; (b) firm-soil site

## Conclusions

- The plan aspect ratio of the measured buildings has been found to be insignificant in affecting the natural vibration period of 1<sup>st</sup> mode of the buildings.
- The natural vibration periods estimated using the proposed period-height relationship for buildings located at soft-soil site is found to be about 40% longer than those estimated using the relationship for buildings located at firm-soil site.