

Dynamic properties of traditional timber buildings

Jeong, Gi Young

Department of Wood Science & Engineering, Chonnam National University, 77 Yongbong-ro, Buk-gu, Gwangju, 61186, South Korea

INTRODUCTION

The goal of this study is to analyze the dynamic properties of traditional timber buildings in South Korea. To calibrate the ambient vibration test for traditional timber buildings, a timber frame building was constructed. The column composed of four columns in the front and two columns in the left and right. Hand-pushing excitation was applied to create the vibration of building in X-direction and Y-direction. Three different modal shapes of buildings were obtained in the experimental test. From the calibration of the methodologies, dynamic properties of three different traditional timber buildings in South Korea (Bulhoesa Daewoongjeon, Muwisa Geukrakjeon, Seonunsa Deawoongjeon) were investigated.

MATERIALS & METHODS



a) Bulhoesa

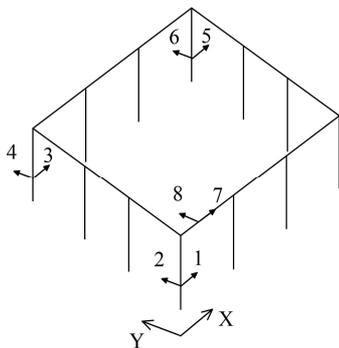


b) Muwisa

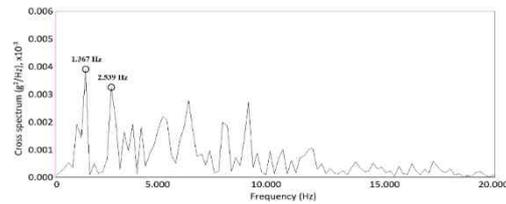


c) Seonunsa

Fig. 1. Three different traditional timber buildings in South Korea



Acc. no.1 & 2



Natural frequency of three buildings ranged from 1 to 3 Hz. The highest natural frequency of 2.14 Hz of mode 1 was obtained from Muwisa Geukrakjeon and the lowest natural frequency of 1.36 Hz at mode 1 was obtained from Bulhoesa Daewoongjeon was obtained.

Fig. 2. Locations of 8 accelerometers attached to the column and beam in Naju Bulhoesa

Natural frequencies of three different traditional timber buildings

Traditional timber buildings	Natural frequency	
	Mode 1	Mode 2
Bulhoesa Daeungjeon	1.367	2.539
Muwisa Geungnakbojeon	2.148	2.930
Seonunsa Daeungjeon	1.758	2.734

RESULTS & DISCUSSION

The natural frequencies of traditional timber buildings were determined using the cross spectral analysis. The cross spectrum were calculated using time segments of 1024 points. The identified peaks represent the predominant frequencies of structures.

With the one segment of 10000 milliseconds of chanel No. 7, the maximum accelerometer value is recorded approximately 0.05 g. Based on the cross spectral analysis, the first two modes of Bulhoesa Daewoongjeon were identified including 1.36 Hz and 2.53 Hz.

The natural frequencies of three different structures are shown in Table 1. The natural frequencies of traditional timber buildings ranged from 1 to 3 Hz. The lowest frequency of 1.36 Hz was found from Muwisa Geungnakbojeon, whereas the highest frequency of 2.93 Hz was observed from Bulhoesa Daewoongjeon.

CONCLUSIONS

The first two vibration modes from three different traditional timber buildings in South Korea were found using ambient vibration tests

The results indicated that the natural frequency of the traditional timber buildings were independent upon the size of buildings.

Acknowledgments

This research supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education. (No. 2017R1D1A1B04033518).