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Structural Monitoring of two Korean Traditional Timber Houses

Yeong-Min Kim[1]

Abstract: In this research, moisture contents and roof deflection of two test-bed Korean traditional timber houses, Hanoks, were monitored. The monitored houses are consisted of two types of Hanoks. One is a one-story traditional Hanok built by traditional construction method, and the other is a two-storied new-styled Hanok built by modernized construction method. The monitoring has been carried out for about thirty months. The moisture contents and roof deflections were analyzed and compared. The moisture contents of the traditional Hanok built by raw wood were somewhat higher than that of the new-styled Hanok built by glued structural wood. The mean vertical deflection of angle rafters of traditional Hanok is about twice more than that of the new-styled Hanok.

Keywords: Hanok, monitoring, moisture contents, roof deflection

I. Introduction

The Korean traditional timber house is generally called Hanok. Hanok's main structure are composed of post and lintel timber frames. The traditional Hanok, which is built by the traditional construction method and traditional material had been built and used for more than 2,000 years, whereas, the new-styled Hanok, which is built by the modernized construction method and modernized material has been built for the last 10 years. The traditional Hanok has more roof weight than the new-styled Hanok, and used raw wood as its main structural member, whereas the new-styled Hanok used glued structural wood as its main structural member. The traditional Hanok uses mortise and tenon joints, whereas, the new-styled Hanok uses steel plate and bolt joints.

As researches on the timber structures, Seo et al.[1] analyzed structural behaviour of Korean traditional timber structure under lateral load, and revealed its nonlinear characteristics. Hwang et al.[2] studied relationship between vibration amplitude and damping ratio of Korean traditional timber structure. Lee et al.[3] evaluated relationship between load carrying capacity and joint types of Korean traditional timber structure. Kang et al.[4] evaluated static performance of mortise and tenon joint in Chinese traditional timber structure. Fang et al.[5] studied load carrying capacity of an ancient Chinese timber structure.

As researches on the new-styled Hanok, Kim [6] evaluated dynamic characteristics of the new-styled Hanok by shaking table tests. Park et al.[7] evaluated distribution patterns of moisture contents in Korean traditional timber structure. Kim [8] studied the relationship among wood types, relative humidity and moisture contents both on the traditional Hanok and new-styled Hanok. And Kim [9] studied roof deflection both on the traditional Hanok and new-styled Hanok.

(a) Traditional Hanok

(b) New-styled Hanok

Fig. 1. Test-bed Hanoks for monitoring built in Myongji University

In this study, as the extension of the previous studies done by the author [8], [9], the surface moisture contents and vertical deflection of both the traditional Hanok and the new-styled Hanok were monitored for about 30 months. The monitored data were analyzed to establish the basic standard for the long-term maintenance and management of Hanok.

Fig. 1 shows a one-story traditional Hanok and a two-storied new-styled Hanok, both were built in Myongji University as test-bed Hanoks. Both Hanoks were built in May 2012, after three months of construction time.

II. Monitored Results

Fig. 2 shows monitoring of roof deflection and surface moisture contents both for the traditional and new-

[1] Associate Professor, College of Architecture, Myongji University, Yongin, Republic of Korea, ymkim@ mju.ac.kr (*Corresponding Author)

styled Hanoks. The monitoring was carried out for about 30 months.

(a) Measuring of roof deflection in traditional Hanok (b) Measuring of moisture contents in new-styled Hanok

Fig. 2. Structural monitoring of Hanoks

Fig. 3 shows mean moisture contents of both the traditional and new-styled Hanoks in south side of both Hanoks. The traditional Hanok with raw wood showed more moisture contents than the new-styled Hanok for most of monitoring period.

Fig. 4 shows deflections of angle rafters for both the traditional and new-styled Hanoks. Although there are small fluctuations in the graph, angle rafters showed gradual deflection. From the regression curves, we can predict the future deflection trends. The angle rafters of traditional Hanok showed about 2 times more deflection than those of the new-styled Hanok. It can be deduced that the difference of deflection is mainly by the difference of the roof weight, that is, the traditional Hanok weigh about 2~3 times more than that of the new-styled Hanok.

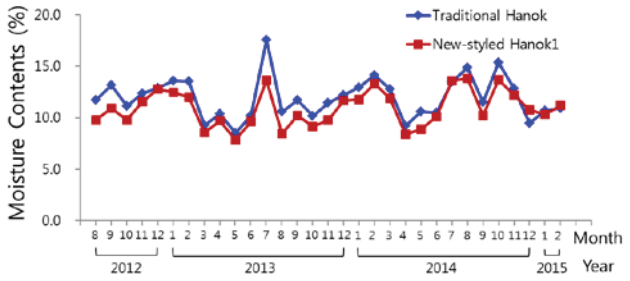
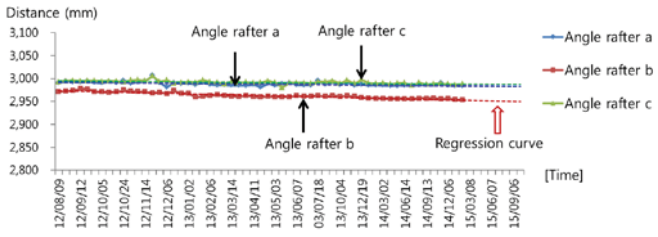
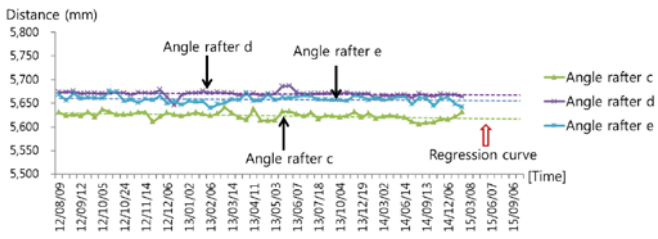


Fig. 3. Moisture contents in southern columns of monitored Hanoks



(a) Deflection of angle rafters of traditional Hanok



(b) Deflection of angle rafters of new-styled Hanok

Fig. 4. Vertical deflection of Hanoks

III. Conclusion

In this study, moisture contents and roof deflection of both the traditional Hanok and new-styled Hanok were monitored and the results were compared. The monitoring was done from August 2012 to February 2015, about 30 months. The moisture contents were analyzed according to column location to the sun and wood types. The vertical deflections of angle rafters were analyzed focused on roof weight.

The columns of the traditional Hanok, which is made of raw wood showed more moisture contents than the new-styled Hanoks made of glued structural wood.

The vertical deflection of angle rafters of the traditional Hanok showed about 2 times more deflection than that of the new-styled Hanok.

I am planning to extend monitoring of these two Hanoks another two years. After four years of total monitoring period, it is expected that the basic data for the maintenance and management of Hanok can be acquired.

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