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ANALYSIS OF HEAVY-WEIGHT IMPACT SOUND PERFORMANCE OF FRAME STRUCTURED RESIDENTIAL BUILDING

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ABSTRACT

The heavy-weight impact sound of residential buildings constructed in the frame structure and the deviation of the performance were evaluated in this study. A total of 31 units were measured, all of which had identical floor plans. As a preliminary analysis to determine whether the spatial distribution of the measured units had an impact on their sound insulation performance, we conducted cluster analysis based on the impact sound insulation data. The findings from the cluster analysis suggest that differences in sound insulation performance were observed in the higher frequency range.

Keywords: *Frame Structure, Residential building, Heavy-weight impact sound*

1. INTRODUCTION

In Korea, it is known that the majority of multi-unit housing complexes constructed with box frame structures have poor floor impact sound. Box frame structure is a form where the load of a building is supported by the walls.
In contrast, A frame structure is a form where the load of a building is shared between beams and columns. And it is known that the performance of frame structures is superior.
However, there is a lack of research on the performance of frame structures in multi-unit housing complexes, as there are few buildings constructed using this method and no available measurement data. Shin et al. analyzed the distribution of weighted impact sound according to the location of 59 units in a frame structure building (Figure. 1), and found that units located on the same floor have a high similarity in heavy-weight impact sound[1].
In this study, we aim to analyze the heavy-weight impact sound performance and performance variation of a frame structure in a multi-unit housing complex through measurements taken from 31 units within one building.

2. METHODOLOGY

The residential building that was measured has 5 floors, with 8 units per floor. The floor plan of each unit was identical, and the measurements were taken in the living room. The living room had an area of 16.7 m² and a ceiling height of 2.3 m. The impact sound was generated in the upper units using a rubber ball (YI-01, RION), while measurement was conducted in the lower units using a frequency analyzer (SA-02, RION). The measurement results were evaluated according to ISO 16283-2 [2].
To analyze the performance deviation, cluster analysis was performed based on the sound insulation performance. The similarity between 31 units' measured results was evaluated using Euclidean distance. The clusters were divided based on the Euclidean distance.

Floor	Line							
5	501	502	503	504	505	506	507	508
4	401	402	403	404	405	406	407	408
3	301	302	303	304	305	306	307	308
2	201	202	203	204	205	206	207	208
1	101	102	103	104	105	106	107	108
	1	2	3	4	5	6	7	8

Figure 1. Facade of the measured building with shaded units representing the measured units.

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3. RESULTS

A similarity evaluation was conducted on the performance of 31 units in a residential building with a frame structure, focusing on the frequency range of 50-630Hz. The mean value of heavy-weight impact sound, when clustered into three groups, are shown in Figure 2. The performance differences between the clusters were not significant in the 50-80 Hz frequency range, but differences began to appear as the frequency range increased above 100 Hz, generally indicating that the performance differences increased as the frequency range became higher.

Cluster 1 had 11 units, Cluster 2 had 7 units, and Cluster 3 had 7 units. An analysis will be conducted to determine whether the cluster varies depending on the location of the unit.

Although the experiment analyzed the whole frequency range of heavy-weight impact sound (50-630 Hz), the high-frequency range can be affected by background noise and may vary depending on the finishing materials. Therefore, it is necessary to consider whether the clustering varies depending on how the analysis frequency is set.

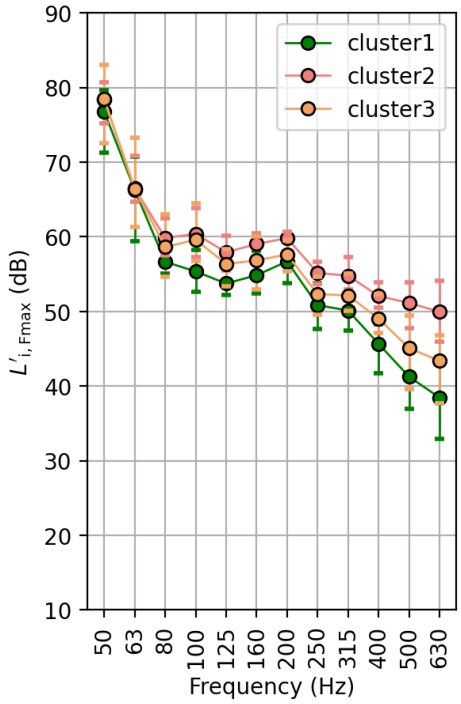

Figure 2. The clusters based on heavy-weight impact sound insulation performance

4. CONCLUSION

In this study, the heavy-weight impact sound of 31 units in a frame structure residential building was measured, and performance deviation was analyzed. Cluster analysis was performed based on sound pressure levels in whole frequency bands of heavy-weight impact sound, and three clusters were identified. The mean values of the clusters did not differ significantly in the 50-80 Hz frequency band, but larger variations were observed in the higher frequency bands. In future research, the locations of the units will be analyzed according to the identified clusters, and the impact of these locations on performance variations will be examined. These findings could serve as basic data for designing the sound insulation performance of frame structure housing.

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