

Study on Performance Certification System for Interruption Structure against Floor Impact Sound in Apartment House

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ABSTRACT

The number of apartment houses has accounted for more than 50% of all domestic residential types in Korea since 1980s. However, the apartment house has environmentally disadvantageous conditions such as highly residential-density and highly consuming energy. What is worse, as it has the unique feature which both joint residential space and private space exist together there have been lots of troubles among tenants.

Recently, residents have become awakened to the quality of life so there are significant demands from them, desiring an environmentally better residential space. In particular, the problem about the noise between floors in apartment houses has become more serious from day to day. Consequently, institutional aspect measures have desperately been requested. Therefore, the Performance Certification System for Interruption Structure against Floor Impact Sound in apartment houses was devised and has been applied in Korea since 2004. At present, 100 types of Impact Sound Insulation Performance on floor structure have been certified by Certification Associations.

In this study, we aim to suggest some ideas to improve/develop domestic Performance Certification System by analyzing the existing floor structures, which Performance Certification Systems were certified by Certification Associations, and by comparing domestic system with several overseas systems related to the Floor Impact Sound.

Keywords: Floor Impact Sound, Performance Certification System, and Floor Structure

1. Introduction

The new architectural culture called as apartment houses, which a large number of people share the limited space together, was developed because of the centralized urbanization since 1980s in order to supply rapidly increasing demands for housings. At present, these apartment houses account for more than 50% of all domestic residential types in Korea. However, the apartment house has the structural restriction which the walls and floors should be shared by

upper/below and right/left side households, where cause increasing disturbances among residents due to noise and vibrations.

The disputes which National Environmental Dispute Resolution Commission received numbered 1971 in all from July 1991 to March 2007. It is reported that the number of disputes against noise and vibration reached 1408, which accounts for 87%, out of 1622 settled cases.

The Korean government made an amendment of the regulations in Housing Construction Standards in April 2004, in order to resolve the disputes caused by the noises between floors among households. They worked out the minimum standards of performance and specifications against Floor Impact Sound, and introduced/applied the Performance Certification System, which certifies the floor structure securing the interruption performance of Floor Impact Sound between upper and below households through the performance test conducted by nationally authorized organizations.

In this study, we have examined the results of performance evaluations about Interruption Structure (with floor slab in 180mm thick only) against Floor Impact Sound, certified by Korea Institute of Construction Technology from 2007 and 2008 at present, and we have analyzed several overseas systems related to the Floor Impact Sound and domestic performance evaluation system, in order to suggest improvements in domestic certification system.

2. Present State of Floor Impact Sound related Domestic/Overseas Systems

2.1 Korean Performance Certification System

Domestic Performance Certification System of Interruption Structure against Floor Impact Sound in apartment houses shows the institutional minimum standards in order to provide environmentally superior residential spaces. Also, it allows the user or designer can choose the floor structure with more effective interruption performance by classifying the floor structure per Impact Sound Interruption Performance.

In accordance with the Korean Industrial Standards (KS), the Certification and

Management Standards as mentioned above prescribe how to measure/evaluate Light-Weight Impact Sound and Heavy-Weight Floor Impact Noise, conditions of the space for performance test, and how to certify. In particular, the Light-Weight Impact Sound is classified into Grade 1~4 and the Heavy-Weight Floor Impact Noise is also divided into Grade 1~4 in regard to the performance standards. The grade 4 is legally stipulated as the minimum standard.

Those who want to get the certification are limited in those who can manage the quality of the parts of the corresponding structure. The certification association directly confirms whether the quality of composing parts are satisfactorily managed or not and an authorized testing institute carries out a performance evaluation test during the production process.

With the results of performance test, the authorized assessment body, certification association carries out an inspection, and then classifies/allows the grade in certification and performance of the structure.

2.2 Germany

In case of Germany, the German Institution for Technical Approvals in Construction (DIBT: Deutsches Institut für Bautechnik) has produced general management regulations, reflecting the standards about the Light-Weight Impact Sound.

German National Bureau of Standards (PTB: Physikalisch Technische Bundesanstalt) manages the measurement organizations according to the prescribed DIN Standards. Those measurement organizations are operated in accordance with the ISO/IEC 17025 (General requirement for the competence of testing and calibration laboratories). Particularly, the German government requires master qualifications from site constructors.

Also, the German government is preparing the final version of the regulations about grading the insulation performance against Impact Sound via discussions with the related organizations. Specially, they are differentially classifying the applicable standards according to the purpose of the building, and preparing more detailed standards for each applicable part such as ordinary floor, entrance floor, staircase floor etc.

2.3 Japan

Japanese residential housings are similar to Korean ones. The testing method in the Heavy-Weight Floor Impact Noise is mentioned as the Japan Industrial Standards (JIS). They have prepared the Housing Performance Indicating System through the laws on Housing Quality Assurance which established in 1999 and started to be enforced in 2000. The above laws became effective in new housings and effective in the existing houses in 2002. The Housing Performance Evaluation can be divided into the Designed Housing Performance Evaluation during designing and Constructional Housing Performance Evaluation in real construction process.

According to the evaluating method and standards indicated by the Ministry of Land, Infrastructure, Transport and Tourism, the assessor who is appointed by Housing Performance Evaluation Organization shall carry out an assessment at the design stage. The Designed Housing Performance Evaluation Report will be handed to him/her. If the same assessor inspects the actual site under construction, the Constructional Housing Performance Evaluation Report will be issued.

This System clearly states the assessor qualification standards in details. Some among evaluation factors such as Medium-levelled Impact Sound can be additionally included or excluded.

2.4 France

France Performance Indicating System provides users with the results which the corresponding house performance is evaluated according to the third organization's specific standards. A non-profit corporation, Association Qualitel carries out the related works.

The Association Qualitel offers the results of Performance Evaluation to the users by issuing the Qualitel Label and Quality Certificate. Internal and external noises in a building are included in the evaluation items.

The Performance Evaluation Standards approved by the Commission in the Association Qualitel is mainly composed of the evaluation of design documents and the inspection to inspect whether the performance is satisfactory or not under construction. The design evaluation must be conducted for every case, while the conformity inspection can be carried out as a sampling.

In this system, the applicants are not specifically limited. The assessors consist of the inspectors who work for the association and commission inspectors nominated by the association.

These Performance Evaluation Systems are related to Governmental Housing Development System, but they are not the compulsory conditions. If performance evaluation level in energy is allowed, the rental expenses can be highly settled.

3. Present State of Insulation Structure Certification against Floor Impact Sound & System Analysis

3.1 Present State of Insulation Structure against Floor Impact Sound

The structures, which their Insulation Performance against Floor Impact Sound have been certified by two Certification

Organizations(Korea Institute of Construction Technology and Korea National Housing Corporation), numbered about 120 since 2004 when the system was initially effective.

In this study, we focused on the floor structure applied to the floor slab with 180mm thickness among the structures authorized between 2007 and 2008 at present. Some shock-absorbing material (insulator), Autoclaved Lightweight Concrete, or finishing mortar is applied to the most upper structures of the floor slabs. Sometimes, all of those three materials mentioned above are applied to the floor slab at the same time.

Table1] shows the structure which Shock-absorbing material (insulator) is omitted, securing the Interruption performance against Impact Sound with the capacity of Autoclaved Lightweight Concrete, which is the development product of the applicant. This structure has structural features without separate shock-absorbing material. Although the performance against Light-Weight Impact Sound is relatively less unsatisfactory compared to other certified structures, the Autoclaved Lightweight Concrete accounts for 1/4~1/3 of total slab thickness, which is reasonably significant to secure the interruption effectiveness against the Heavy-Weight Floor Impact Noise.

Title	Result
Interruption Performance against Light-Weight Impact Sound (Grade)	3
Interruption Performance against Heavy-Weight Floor Impact Noise (Grade)	3
Structure Thickness(mm)	300
Autoclaved Lightweight Concrete Thickness(mm)	70

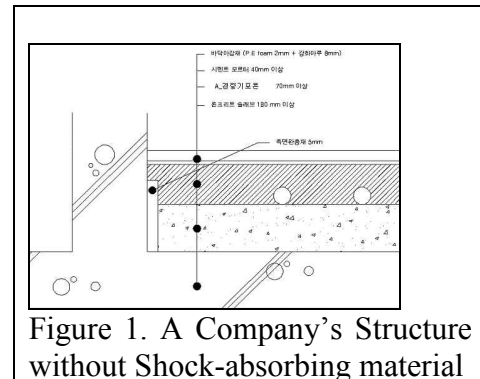


Figure 1. A Company's Structure without Shock-absorbing material

Table1] Interruption Performance of the structure without Shock-absorbing material

Table2] shows the structure without Autoclaved Lightweight Concrete Layer, by applying Shock-absorbing (insulating) product layer with PE, PU, or EVA for Light-weight, Insulation, and Noise-proofing capacity which are the properties of Autoclaved Lightweight Concrete, in order to secure the interruption performance against Impact Sound.

Title	Result
Interruption Performance against Light-Weight Impact Sound (Grade)	1
Interruption Performance against Heavy-Weight Floor Impact Noise (Grade)	4
Structure Thickness(mm)	290~300
Autoclaved Lightweight Concrete Thickness(mm)	Not applicable

Figure2. B Company's Structure with EPS Product and air layer applied.

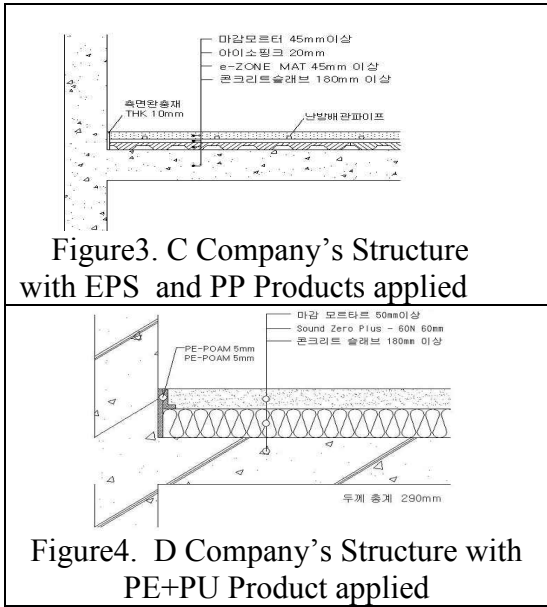


Table2] Shock-absorbing Layer Structure without Lightweight Air Layer

Without Autoclaved Lightweight Concrete, this structure satisfies the minimum standards against Heavy-Weight Floor Impact Noise by using various Shock-absorbing materials (60~75mm) and finishing mortars (40~50mm) against the impact sound. This structure secures Grade 1~2 in the Light-Weight Impact Sound. The most buildings which performances have recently been requested are constructed by this structure method.

The structure shown in the Table3] below describes the structure with Shock-absorbing material and Autoclaved Lightweight Concrete and cement mortar layers. It secures relatively stable performance with the capacity of Shock-absorbing material and noise-absorbing capacity of concrete materials. However, the performance can be different depending on the quality of insulating/shock-absorbing materials and their unique properties. Mostly, this structure secures satisfactory performance more than the minimum standards.

Title	Result
Insulation Performance against Light-Weight Impact Sound (Grade)	1~2
Insulation Performance against Heavy-Weight Floor Impact Noise (Grade)	2~4
Structure Thickness(mm)	290~300
Autoclaved Lightweight Concrete Thickness(mm)	40
Cement Mortar Thickness (mm)	40

Figure5. F Company's Structure with PU Product and Lightweight Air Layer

Figure6. G Company's Structure with EPS+Lightweight Aggregate and Lightweight Air Layer

Figure7. H Company's Structure with EPS product and Lightweight Air Layer

Table3] Structure with both Lightweight Air Layer and Cement Mortar Layer

3.2 Korean Performance Certification System for Interruption Structure against Floor Impact Sound in apartment houses

3.2.1 Regulations on the subjects to be certified

'Performance Certification and Management Standards for Interruption Structure against Floor Impact Sound in Apartment Houses' examined by the Ministry of Land, Transport, and Maritime Affairs prescribes certification organizations, certifiable applicants, how to test the interruption structure performance, and performance evaluation standards.

While the certification applicant is defined as those who manufacture the products to be certified by several domestic certification systems including the certification and management standards of fire-resistance structure and wall insulation structure, those who want the performance of interruption structure against floor impact sound to be certified can get the Performance Certification of interruption structure against floor Impact Sound although they do not manufacture the product and can inspect the results of quality management.

Differently from overseas certification applicants such as French and Japanese who do not have to offer additional requirements, Korean certification applicant shall directly manage the product quality as most components are produced by Original Equipment Manufacturer (OEM production) System.

German Standards (DIN: Deutsche Industry Norman) states the performance standards and prescribes that the related government official organizations shall follow these standards. The authorized certification organization evaluates/certifies whether the product quality meets to the German Standards.

3.2.2 Testing and Inspecting Organizations for Certification

In case of Germany, Deutsche Industry Norman (DIN) manages whether the performance evaluation is managed/measured in accordance with the ISO/IEC 17025 (General requirement for the competence of testing and calibration laboratories). In Japan, the performance evaluation organizations are nominated by the Ministry of Land, Infrastructure, Transport and Tourism. The performance evaluation is carried out in the corresponding organization.

In France, non-profit corporation, Association Qualitel evaluates the Performance of Housing according to the related standards such as European Code and then allows the evaluation grade.

In Korea, the performance evaluation organizations are nominated by the Ministry of Land, Transport, and Maritime Affairs similar to Japan. However, the qualifications of certification organizations have not precised yet.

The duties of a certification organization can be mainly classified into two fields; evaluation process through a performance test and conformity evaluation of the measured results through an inspection. Therefore, the competence requirements of certification organization shall be prescribed so that the process of performance evaluation and the related inspection can be fairly carried out.

3.2.3 Construction Management

If the certified company which Interruption Structure against Floor Impact Sound has been certified by certification organization carry out a construction on the site, the site supervisor shall be responsible for appropriate construction in Korea through Construction Management System.

Overseas certification organizations require the certification of the performance at the design stage and appropriate certification structure during construction as the related regulations. In some countries, a specially qualified inspector shall supervise the site construction.

Therefore, we believe that it is absolutely necessary to supplement the certification system so that the certification or government organization actively manages the products and construction process on the site for satisfactory construction of the certified interruption structure against floor impact sound on the site.

4. Conclusion

4.1 Only some structures, which the performance of Floor Impact Sound Interruption Structure has been certified, apply the Autoclaved Lightweight Concrete Layer. To secure the insulation, noise-resistance, and lightweight capacity which are the properties of Autoclaved Lightweight Concrete layer, most other structures apply various types of Shock-absorbing materials to secure the corresponding performance.

Although it is clear that the Autoclaved Lightweight Concrete Layer needs to be considered for the Impact Sound Interruption Performance, recently the related industries have been trying to develop the product with minimum properties of materials including Dynamic Modulus of Elasticity which can influence on Impact Sound Interruption Performance without using the Autoclaved Lightweight Concrete Layer.

Therefore, Korean Performance Certification System shall reflect particular quality management items which can influence on Impact Sound Insulation Performance and shall analyze the site

conditions in more detail so that satisfactory impact sound interruption performance can be secured on the actual site.

4.2 In the most of overseas performance indicating systems, the certification at design stage and inspection for confirmable construction management at the construction stage are conducted at the same time.

In Korea, it is quite common that the confirmation process for the corresponding product quality is omitted on the real site with regard to the products which Floor Impact Sound Interruption Performance has been certified. Accordingly, it is uncertain that the product has been constructed according to the certified requirements. The Certification Organization shall thoroughly manage the quality of floor structure which Interruption Performance of Floor Impact Sound has been certified at the site construction stage.

4.3 As our domestic Performance Certification System for Interruption Structure of Floor Impact Sound in apartment houses is at the first stage of enforcement, it needs to be continuously improved and developed in order to offer environmentally-friendly residential spaces to the general residents in the apartment houses.

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