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A Study on the Construction and Institutionalization of Building Safety Management System

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SUMMARY

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Chapter 1 Introduction

This study was conducted in the stage of building and management to prepared reasonable safety management methods that fit the characteristics and conditions of buildings. The present building safety law system has the same direction of safety management based on the use and size, but it also reflects the purpose of use of buildings and various factors affecting the building safety such as users, land, roads, and surrounding environments, and determines the potential risk level of buildings themselves, and proposes a safety management method corresponding to them. In this respect, the purpose of this study is to prepare an institutionalization plan for the development and implementation of risk assessment and safety determining tool (RAST), which is a direct tool of safety management.

The components and management plans of the safety management system of this study were derived through the main contents of the current related legal system, previous studies, and analysis of domestic and overseas associated systems. The implications of the system for securing structural safety for fire safety and earthquake-resistant were examined in the United States and Japan. The indexing of indicators for building risk assessment, rating calculation, and safety management direction was determined through surveys of experts in related fields, AHP analysis, and risk simulation. Finally, the institutionalization direction for the application of the safety management system in this study suggested.

Chapter 2 The Act on Building Safety Management and the Current Status of Buildings to be Management

Domestic building safety management standards are operated through related laws such as fire fighting and electricity, centering on the "Architecture Law", a construction plan and management standard. The Building Act defines the planning criteria for determining the space and shape of the structure. In particular, it represents the spatial structure (e.g., evacuation path) that is easy to evacuate in the event of an accident, the matters related to the firewall for fireproof, fire door, finishing material, and the structural safety such as seismic design and structural strength. Unlike securing the safety of the architectural planning stage, the management law will be transferred to the "Building Management Act" to be implemented from 2020, and the management plan and various inspections will be operated mainly by the law. The Fire Protection Facility Act of the Building stipulates matters related to fire prevention, installation and maintenance of fire fighting facilities, and details on fire extinguishing facilities and evacuation facilities. Specific laws, which are multi-use building laws, high-rise disaster management laws, housing laws, etc., are implemented to prevent accidents and minimize damage. Basic building management is required to be done through building permits (approving a business plan for apartment houses) and construction supervision in the building stage, and to cooperate with experts in each field in the licensing process or to be agreed by administrative agencies. In the process of use, if the existing facility changes occur, it is managed through a review of compliance with current planning standards. Besides, during the building use process, various inspections, inspections, and diagnoses are carried out according to the use, size, and other particular environments, thereby preparing for building safety performance management, accident prevention and risk.

The safety management targets defined in the related laws such as the Building Act, the Fire Protection Facilities Act, and the Multi-use Facilities Act are licensed and can be explained as multi-use facilities and multi-use facilities, specific fire-fighting buildings, large-scale buildings affecting the surroundings, hazardous materials related facilities, and national infrastructure based on all buildings. With the enactment of the Building Management Act, the scope of the system has also come to the extent that management is urgently required among small buildings. Also, considering the importance of safety management in previous studies and policies, small buildings, buildings for the vulnerable, and small old buildings are included.

On the other hand, in case of safety management standards, the management standards for each building characteristics were added based on the 「Building Act」, 「Fire Service Act」, and other related laws that defined the safety management items of building planning, construction, and use stages. First, 23 building planning standards (permission criteria), four maintenance inspection items, building coverage rate, floor area ratio, a notice of the site, and corridor were added to draw the first standard by combining the building planning standards (permission criteria), supervision criteria, and maintenance inspection criteria. In addition to the architectural planning and management standards, the standards related to fire fighting facilities be made up reflecting standards which are the fire fighting facility, building maintenance, fire fighting facilities, alarm facilities, fire fighting water facilities, fire fighting facilities, fire door, fireproof shutter, evacuation equipment, lifesaving equipment, guidance light, guidance sign, emergency lighting, portable emergency lighting. Finally, the factors of the land, roof, and evacuation area were derived by reflecting the standards of building safety management related field and use.

Small buildings less than 500㎡ out of about 720 million buildings account for 85.1% in Korea. Of these, 66.7% of buildings less than 200㎡ can be applied to seismic design standards. It is a very high number. For buildings over 1,000㎡, 6.8% of the total buildings, 3% for over 3,000㎡, and 0.8% for over 10,000㎡. Also, 96.8% of buildings are under 6 floors, and there are about 2,500 high-rise buildings with more than 31 floors, which is close to 0%. When analyzed by structural type, masonry accounted for 36%, and reinforced concrete accounted for 24.7%. In the case of old roads, buildings account for 65% of the total over 21 years.

Based on the general composition status, the proportion of buildings subject to safety management according to the legal system is the highest, with 32.7% of the buildings subject to seismic design and 90% of the area. The buildings subject to maintenance inspection are only 6.8% of the same number even if the minimum floor area of 1,000m2 is applied. Safety inspections and precise safety diagnosis targets are limited to large-scale, so one type accounts for 0.35%, and two types account for 1%. As apartments with 50 floors or more and other buildings with 30 floors or more, specific fire fighting objects are insignificant at a total of 0.033%.

As such, most of the safety management systems except for the recently revised seismic design standards are operated mainly on large-scale buildings with fewer primary management targets. Although the analysis based on the area shows the opposite result, the safety management of the same number unit is inevitable in terms of the individual building users being responsible for the safety of each building. Alternatively, various alternatives, such as a collective management system that can complement the safety management of individual units should be considered.

Chapter 3 presents the present condition of building safety management system and implications of overseas cases

The building safety management system in Korea is operated mainly in the related laws and can point out the limitations in three aspects. First, most of the building safety management system in Korea applies to buildings with a specific use or a certain size or more, and there is no universal tool applicable to all buildings. In the case of FRI, only specific building types such as state-owned facilities, and the performance-oriented design system for firefighting facilities are applied only to some large-scale buildings such as buildings subject to particular fire fighting. More fundamentally, the building safety management system operated under the current legal system has limitations in securing fire and rescue safety of all buildings, so it is necessary to find ways to cover them.

Next, the building safety management system in Korea measures safety based on the installation of individual facility planning elements rather than evaluating safety from a comprehensive perspective. In this case, it is difficult to measure the safety of small buildings with insufficient facility planning standards in the regulations and may cause errors in evaluation results. For example, a facility where a sprinkler is not installed in a fire extinguishing facility and a facility where a fire extinguisher is not installed can be checked with the same score. This evaluation method is difficult to be seen as an objective evaluation method. There are also building safety management systems using relative ranking and quantitative evaluation methods, but the standards are insufficient to evaluate building fire and structural safety.

Lastly, the building safety management system in Korea does not reflect the facility conditions for each building. Even if the building of the same use and size is different from the environment change factors, management status and level during the facility planning and use process, so these individual conditions must be considered in safety evaluation. However, most of the domestic building safety management system is limited to minimum legal standards or cause of accidents, but the facility conditions are excluded.

On the other hand, the present condition of the operation of the safety management system overseas was examined in preparation for the domestic situation, and three implications were derived. First, in the case of overseas safety management systems such as the United States and Japan, safety-related laws and regulations are applied to all buildings to present minimum standards, and facilities that are difficult to apply laws or existing buildings, and facilities that need to apply strengthened standards, are provided with separate systems to minimize blind spots for safety management. Therefore, to establish a universal safety management system in Korea, it is necessary to set up a safety management target in consideration of the blind spot of domestic laws and safety management systems and to establish a safety management system to support the reinforcement of safety risk buildings.

Second, most of the domestic building safety management system is excluded from consideration of facility conditions when evaluating the safety, but overseas, safety management indicators considering safety risk building types and facility conditions are set to evaluate safety. In the US FSES, the safety management index is presented differently by facility use considering the characteristics of the five facility uses. In Japan's structural calculation suitability judgment system, the safety management index is differentiated according to the size of the building and the main structure. Since buildings differ in fire and structural performance depending on the conditions of the facilities, it is necessary to set safety management indicators considering the types of dangerous buildings and facility conditions to measure reliable safety performance.

Third, the safety management system of domestic buildings measures safety based on the installation of individual facility planning elements rather than evaluating safety from a comprehensive perspective. This evaluation method is difficult to measure safety in the case of facilities in blind spots in the law, and there is a limit to the safety performance measurement that can be implemented practically. In the United States, however, the overall fire safety performance (safety of fire compartment, the safety of fire extinguishing, the safety of evacuation movement, and general safety) is measured through weighted and exponential methods, or the priority of fire hazard buildings is grasped by using big data. Also, structural safety is grasped through the structural calculation formula considering the size of the building and the main structural form.

In this way, the safety of buildings is evaluated through quantitative evaluation methods in foreign countries, and the stability is evaluated in a comprehensive aspect considering individual facility conditions rather than measuring the performance through the installation of individual facility planning elements. It is efficient to measure the size of danger, but the quantitative evaluation method is efficient. And it facilitates to decide the priority of the facility reinforcement support.

Chapter 4: Building Safety Management System Construction (Amendment) and Institutionalization

The building safety management system is an objective tool to determine the risk level of buildings and to suggest the safety management direction accordingly. In this study, it was named as RAST (Risk Assessment and Safety determining tool). The safety risk of a building is measured based on the factors that determine the characteristics of the building, namely, the use and size, structure and finishing materials, the environment where the building is located, and the degree of aging. In this study, risk indicators were set up with seven factors that directly or indirectly affect safety risk and 41 detailed items by element based on the current legal system, previous studies, and overseas cases. Safety management index is a planning factor to secure the safety performance of buildings and can be said to be individual management means to prevent the risk of buildings. The safety management index was also derived from the detailed standards of related laws and regulations mentioned above and the main safety management items of overseas cases. It consists of 6 items and 33 items including occupants, building structure, finishing materials, evacuation facilities and space, fire fighting facilities, land, and roads. The risk and safety of each index were measured by using risk indicators and safety management indicators through expert surveys and AHP analysis. The results are as follows. First, as a result of evaluating the risk of buildings, the difference between the importance of each classification was not large, but the use of facilities, old age, and structural type had a relatively high impact on the safety of buildings. Among the uses, risk storage facilities such as gas stations, areas less than 3,000m2 more than 1,000m2, floors more than 21 floors, and aged 41 years or more were the highest, indicating that they did not deviate significantly from the current law management category. As a result of the importance evaluation by large classification, the importance of evacuation facilities, space, fire fighting facilities, and building structure was high, and the importance was high in the order of occupants, finishing materials, land, and roads. Among the whole items, the importance of interior finishing materials for main users and buildings was the highest, and the importance of exterior finishing materials for the fireproof structure was also high. The result is not meaningless because toxic gas, which is pointed out as a direct cause of damage expansion in the event of a fire accident, is directly correlated with finishing materials. After calculating the risk and safety through AHP analysis, the risk was determined to be four sections and four grades by assigning the risk of individual value to about 440,000 buildings in Seoul. As a result of the previous studies in 2016, the safety score by grade was derived by using the safety rate of 4,946 buildings in Seoul. The structure and utilization methods of the safety management system were finally summarized by combining these results, and the institutionalization method was suggested. In the case of the safety management system of this study, it is possible to determine risk grade by building characteristics and to plan more easy and efficient safety management by digitizing safety management index reflecting the importance of detailed planning index and the status evaluation (satisfaction) of the current system. Therefore, Article 23 of the Enforcement Decree of the Building Act, which stipulates the regular inspection of building maintenance, provided detailed regulations on the introduction of the system of this study and proposed the revision of the Asterisk 4. On the other hand, when the "Buildings Management Act" is implemented in 2020, the safety-related regulations of the "Buildings Act" after completion are likely to be transferred to the "Buildings Management Act". The safety management contents of the Building Act are more systematically comprehensively dealt with in the Building Management Act. It is mandatory to manage the management plan for approval of use, regular inspection of existing buildings such as heavy use facilities, and inspection of small old buildings. In particular, Article 11 and Article 6 of the Act as direct matters on safety specify fire and evacuation safety, structural safety, and earthquake-resistant ability. Therefore, it is suggested that the safety management system of this study be used in the 「Architecture Management Act」, and the contents related to the lower laws and rules to be enacted in the future should be added. Also, in the case of regular inspection of Article 13 of the Act and inspection of small-scale old buildings in Article 15, it is not possible to specify details because sub-laws on procedures and methods according to Article 4 are not enacted, but it is expected to be composed of contents similar to regular inspection of the Building Act, assuming that it is the item of operation purpose and paragraphs 1. Therefore, as suggested in the Enforcement Decree of the Building Act, the 「Building Materials Management Act」 proposed the provision of the utilization of the sub-law unit for the utilization of this system. Lastly, Articles 7, 8, 9, and 10 of the Act stipulates that the relevant information should be prepared and stored through the "Buildings Management Act" for the regular inspection of buildings, emergency inspection, an inspection of small old buildings, and safety diagnosis. The risk grade and safety index of buildings using the safety management system of this study were also suggested to be defined as one of the information to be written in the law.

Chapter 5 Conclusion

Based on the research contents that were investigated and analyzed earlier, the results of the study were summarized and future tasks were proposed. The core of this study is to develop a tool that can manage the building safety management systematically and continuously from the initial planning stage, away from the measures such as inspection during the use process, and to prepare an operation plan. In this respect, the safety management system of this study is easy to evaluate the risk level of the building and based on this, the structure and utilization plan of the safety management system is suggested with the goal of establishing a professional management plan, and the linkage plan of the current and future legal system is also prepared. If the results of this study are institutionalized, the management targets can be expanded not only to buildings specified in the current legal system but also to buildings defined as blind spots. And the value is high in that it can be linked to the implementation of the legal system with a more accurate safety management strategy. However, more detailed studies should be followed to improve the effectiveness and utilization of the safety management system in this study. Especially, the building safety management system of this study was designed as a tool that can be used universally in the building construction and use stage, but the actual use was limited to the building use process. To apply this system to the planning stage, a more careful approach to the buildings that have not yet been used is needed. Evaluation and management methods such as the establishment of hierarchy considering the correlation between indicators and indicators affecting the safety of buildings and the weighting calculation accordingly should be elaborated. In particular, direct safety accident data such as cause, damage scale, and damage characteristics should be made into risk indicators and safety management indicators centering on safety accidents in buildings. For this, it is necessary to analyze the DB and draw implications related to building safety accidents established in related organizations such as the Ministry of Public Administration and Security, the Ministry of Land, Transport and Maritime Affairs, and the National Fire Service. Besides, it is necessary to create new data such as verification of effectiveness through actual pilot application and accumulation of cases. Also, if the safety management method of individual buildings is expanded to the area unit considering the current status of 7.2 million buildings in Korea, limitations of current system operation, and demands for efficiency

improvement, the scope of management can be widened and the contents of management can be linked to the aspect of urban management. The future tasks that should be linked with this study are diverse, such as upgrading the structure of the safety management system based on the institutional change of the contents and methods of the safety management of buildings.

Keywords :
Building Safety Management system, Risk Level of Building, Safety Management Index