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Systematic analysis and modeling for safety control in building demolition: A case study in South Korea

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Abstract: As the proportion of aging buildings has been rapidly increasing nationwide in South Korea, issues related to the structural safety of buildings and social citizen safety have arisen. The Building Act stipulates that if aging buildings have structural issues, they should undergo reconstruction. Similarly, the Special Act on Promotion of and Support for Urban Regeneration regulates the reconstruction of buildings to improve the urban landscape and residential environment. Therefore, demolition work through urban redevelopment is on the rise. Demolition collapse accidents are one of the risks associated with construction sites. Thus, the analysis of actual demolition collapse accidents demonstrated that technical issues, relevant regulations, government policies, and the relationships among stakeholders such as involved parties both external and internal to the site can have an impact on the safety of demolition work from the permit stage. In this study, the construction processes of two major accidents (i.e., Jamwon-dong collapse accident and Gwangju Hak-dong collapse accident) were investigated to propose a safety control structure model that can estimate the safety interaction between stakeholders. In this study, the STAMP CAST analysis, which are systematic accident analysis methods, was used to investigate the risk factors and safety control measures that may occur during demolition work. Then, a safety control structure model of the demolition work system was developed through STAMP STPA analysis. However, it was difficult to reflect on all of the stakeholders' opinions, and the site characteristics as the developed safety control structure model was based on accident cases. Therefore, a legal safety control structure model was derived by referring to major laws related to demolition work, such as but not limited to the Building Management Act, Occupational Safety and Health Act, and Construction Waste Recycling Promotion Act in South Korea. The exploratory analysis showed that the occurrence of demolition collapse accidents was not only due to technical issues but also due to insufficient safety control measures among various stakeholders, including the permitting agency, the demolition supervisors, and the contractee. The permitting agency was found to have an overall impact on the demolition work system from reviewing the demolition plan to implementing the demolition work, and the role of supervisors-who directly affect the safety of demolition work by checking safety measures and taking corrective actions, was also considered significant. Therefore, in a collective effort to prevent demolition collapse accidents, safety control measures by various stakeholders should be appropriately implemented, as well as systematic methods such as safety control structure models that derive safety analysis and prevention measures. These research results can contribute to improving policies and systems, which will prevent future safety accidents in the demolition construction sector.

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