ICCEPM 2022
The 9th International Conference on Construction Engineering and Project Management
Jun. 20-23, 2022, Las Vegas, NV, USA

Development of Detailed Design Automation Technology for AI-based Exterior Wall Panels and its Backframes

HaYoung Kim[1]* and June-Seong Yi[2]

[1*] *Department of Architectural and Urban Systems Engineering, Ewha Womans University, 52, Seoul 03760 South Korea,* E-mail address: gfkdgldd l@gmail.com
[2] *Department of Architectural and Urban Systems Engineering, Ewha Womans University, 52, Seoul 03760 South Korea,* E-mail address: jsyi@ewha.ac.kr

Abstract

The façade, an exterior material of a building, is one of the crucial factors that determine its morphological identity and its functional levels, such as energy performance, earthquake and fire resistance. However, regardless of the type of exterior materials, huge property and human casualties are continuing due to frequent exterior materials dropout accidents. The quality of the building envelope depends on the detailed design and is closely related to the back frames that support the exterior material. Detailed design means the creation of a shop drawing, which is the stage of developing the basic design to a level where construction is possible by specifying the exact necessary details. However, due to chronic problems in the construction industry, such as reducing working hours and the lack of design personnel, detailed design is not being appropriately implemented. Considering these characteristics, it is necessary to develop the detailed design process of exterior materials and works based on the domain-expert knowledge of the construction industry using artificial intelligence (AI). Therefore, this study aims to establish a detailed design automation algorithm for AI-based condition-responsive exterior wall panels and their back frames. The scope of the study is limited to "detailed design" performed based on the working drawings during the exterior work process and "stone panels" among exterior materials. First, working-level data on stone works is collected to analyze the existing detailed design process. After that, design parameters are derived by analyzing factors that affect the design of the building's exterior wall and back frames, such as structure, floor height, wind load, lift limit, and transportation elements. The relational expression between the derived parameters is derived, and it is algorithmized to implement a rule-based AI design. These algorithms can be applied to detailed designs based on 3D BIM to automatically calculate quantity and unit price. The next goal is to derive the iterative elements that occur in the process and implement a robotic process automation (RPA)-based system to link the entire "Detailed design-Quality calculation-Order process." This study is significant because it expands the design automation research, which has been rather limited to basic and implemented design, to the detailed design area at the beginning of the construction execution and increases the productivity by using AI. In addition, it can help fundamentally improve the working environment of the construction industry through the development of direct and applicable technologies to practice.

Key words: Design automation, Parametric design, Artificial Intelligence, Exterior wall