

Automated Building Internal Layout Design Incorporating Post-Earthquake Evacuation Considerations

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Abstract : Earthquakes pose a significant threat to both structural and non-structural elements in buildings, putting human lives at risk. Effective post-earthquake evacuation is critical for ensuring the safety of building occupants. However, current design practices often neglect the integration of post-earthquake evacuation considerations into the early-stage architectural design process. To address this gap, this paper presents a novel automated internal architectural layout generation tool that optimizes post-earthquake evacuation performance. The tool takes an initial plain floor plan as input, along with specific requirements from the user/architect, such as minimum room dimensions, corridor width, and exit lengths. Based on these inputs, firstly, the tool randomly generates different architectural layouts. Secondly, the human post-earthquake evacuation behaviour will be thoroughly assessed for each generated layout using the advanced Agent-Based Building Earthquake Evacuation Simulation (AB2E2S) model. The AB2E2S prototype is a post-earthquake evacuation simulation tool that incorporates variables related to earthquake intensity, architectural layout, and human factors. It leverages a hierarchical agent-based simulation approach, incorporating reinforcement learning to mimic human behaviour during evacuation. The model evaluates different layout options and provides feedback on evacuation flow, time, and possible casualties due to earthquake non-structural damage. By integrating the AB2E2S model into the automated layout generation tool, architects and designers can obtain optimized architectural layouts that prioritize post-earthquake evacuation performance. Through the use of the tool, architects and designers can explore various design alternatives, considering different minimum room requirements, corridor widths, and exit lengths. This approach ensures that evacuation considerations are embedded in the early stages of the design process. In conclusion, this research presents an innovative automated internal architectural layout generation tool that integrates post-earthquake evacuation simulation. By incorporating evacuation considerations into the early-stage design process, architects and designers can optimize building layouts for improved post-earthquake evacuation performance. This tool empowers professionals to create resilient designs that prioritize the safety of building occupants in the face of seismic events.

Keywords : agent-based simulation, automation in design, architectural layout, post-earthquake evacuation behavior

Conference Title : ICCEAM 2024 : International Conference on Civil Engineering and Applied Mechanics

Conference Location : Paris, France

Conference Dates : April 11-12, 2024