Use of Evacuation Case Studies to Validate a 3D Agent-Based Pedestrian Microscopic Simulation Tool for Egress

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Abstract

This paper will describe how data collected during four observed building evacuations was used to validate the 3D agent-based pedestrian microscopic simulation tool, MassMotion, for egress modeling. MassMotion employs 3D environments, industry accepted speed profiles and behavior preferences to model and analyze emergent pedestrian movements. The behavior profiles enable agents to make choices based on origins and destinations, knowledge of the system, preferred speed and localized congestion, to lead them to their destination.

The research team conducted a series of validation exercises using data collected from evacuation drills held in four different high-rise buildings located New York City and London, representing three different scales of buildings and egress events. Manual counts, floor populations, video and observations from the evacuation drills were used as inputs to the model as well as benchmarks for model calibration. Three of the tower egress events were also compared to precedent Simulation of Transient Evacuation and Pedestrian movements (STEPS) models as a benchmarking exercise. Validation metrics used in this study varied from case to case based on available data, but in each instance modeled evacuation time was compared to observed evacuation time. Other calculated metrics include journey times, speeds and flow rates.

In terms of matching observed metrics, the validation exercises indicate that MassMotion is a suitable application for egress modeling. Overall modeled evacuation times were marginally faster than observed times and individual agent journey times in congested conditions were nearly identical to samples extracted from the video capture. Additionally, general movement patterns and behaviors on stairs, through doors, in crowds and queues were visually validated with modeled agents behaving as would be expected.

Validation of MassMotion for egress modeling aligns transportation and pedestrian planning with fire protection and egress modeling methods, encouraging collaboration between the fields and increased efficiencies in combined use models.