12th International Conference on Pedestrian and Evacuation Dynamics (PED 2025)
Prague, Czech Republic – September 9-12, 2025

The Lecture Hall Example as a Reference for Evacuation Simulations – An Updated Study

Angelika Kneidl*[1], Burkhard Forell[2], Gerald Grewolls[3], Rainer Könnecke[4], Tim Meyer-König[5], and Andreas Winkens[6]

[1]accu:rate GmbH, Munich, Germany
[2]Fire Safety Engineer, Cologne, Germany
[3]SIMTEGO GmbH, Ulm, Germany
[4]IST GmbH, Frankfurt am Main, Germany
[5]TraffGo HT GmbH, Flensburg, Germany
[6]BPK Ingenieure und Sachverständige für Brandschutz GmbH & Co. KG, Germany

Abstract A comparative study for the evacuation of a lecture hall, using six different microscopic software tools and two macroscopic approaches is presented. Reasons for differences in results, in particular for evacuation times and flow rates are discussed. The purpose of this study is to provide a basis for the definition of benchmarks for evaluating pedestrian dynamics to improve the prediciton quality of simulations.

Keywords Standardisation, crowd simulation, evacuation, fire safety, regulation

1 Introduction

Evacuation simulations play a vital role in ensuring safety during emergencies in complex environments. This study revisits the "Lecture Hall Example," Ref. [1], which was published in 2021 in German. The original study, which compared macroscopic and microscopic evacuation models, revealed deviations of up to 30% in evacuation times between models. These significant discrepancies led the RiMEA association Ref. [2] to form a working group to analyse the causes and propose solutions to improve the consistency of the modeling.

The study examines two evacuation scenarios for a lecture hall with 640 seats and 360 standing places, see Figure 1. Scenario 1 involves a single rear exit, while Scenario 2 includes two front exits. Key findings of the initial analysis revealed differences in geometric interpretations, inconsistencies in input data, and different route allocation among the simulation tools. For example, discrepancies in the modeling of stairs and seating arrangements contributed to varying congestion points and evacuation times. There was no clear pattern that models which predicted longer evacuation times in Scenario 1 do so in Scenario 2. These variations underline the importance of standardizing geometric and population parameters to ensure reliable results.

2 Results

To address these issues, the updated study implemented harmonized input data and repeated simulations with six microscopic tools (Aseri, buildingExodus, crowd:it, FDS+Evac, Pathfinder, PedGo) as well as two macroscopic calculation approaches (Capacity Analysis and Predtetschenski & Milinski). Adjustments included using uniform geometric dimensions based on the CAD file, equal distribution of 640 agents across seating areas, and consistent evacuation routes for outer seating rows. Despite these efforts, evacuation times still exhibited model-specific variations of 27% (Scenario 1) and 26% (Scenario 2) relative to the mean. This highlights the influence of internal algorithms, such as navigation and congestion handling, on the simulation output.

The study also analysed flow rates and their correlation with evacuation times. Sensitivity studies revealed that the assignment of agents to specific routes and the interpretation of geometries, such as stairs and exits, significantly impact evacuation outcomes.

*Email of the corresponding author: ak@accu-rate.de

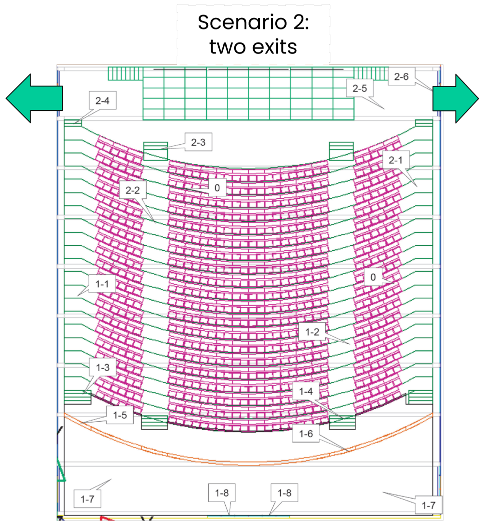

Figure 1: Floor plan of the two scenarios

The findings emphasize the need for robust validation frameworks, such as the RiMEA test cases Ref. [2] or the ISO 20414 Ref. [3], to evaluate model performance under standardized conditions. Sensitivity analyses of parameters such as population size, route allocation, and pre-movement times are recommended to address uncertainties. Furthermore, the study advocates for greater transparency and documentation in modeling decisions to enhance reproducibility and reliability.

3 Conclusion

In conclusion, the updated analysis demonstrates the complexity of evacuation simulations and the importance of harmonizing the input data and the methodologies. By standardizing test cases and conducting comprehensive sensitivity analyses, simulation tools can provide more accurate and actionable insights for safety engineering. This study serves as a critical step toward establishing benchmarks for evaluating pedestrian dynamics and ensuring safe evacuations in diverse environments.

Bibliography

[1] Schneider, V., Forell, B., *Personenstromsimulationen und Evakuierungsberechnungen*, Handbuch Brandschutz 2021.

[2] RiMEA e.V., *Guideline for microscopic evacuation analysis*, v4.0.1, 2024

[3] ISO 20414, *Fire safety engineering - verification and validation protocol for building fire evacuation models*, 2020