Mega Events and Crowd Evacuation at Tourist Attractions: A Case Study of Souq Waqif Using Pedestride® Crowd Simulation Tool

Ali Abdelaal¹, Charitha Dias³, Majid Sarvi², Wael Alhajyaseen¹, Faris Tarlochan¹

¹Qatar Transportation and Traffic Safety Center, Qatar University, Doha, Qatar  
²The Department of Infrastructure Engineering, The University of Melbourne, Melbourne, Australia

Problem statement
- Large crowds are expected at tourist attractions, e.g., Souq Waqif, during special events such as the FIFA World Cup 2022.  
- Understanding crowd dynamics is necessary to ensure safety and efficiency of crowds flow.

Objectives
- To evaluate safety and efficiency of crowd flows at Souq Waqif under normal and emergency situations.  
- To highlight any required design modifications and to recommend and verify crowd management strategies in order to mitigate any unfavorable situations, such as stampeding during any emergency.

Main findings and recommendations
- During normal evacuation, crowds can safely exit the Souq due to the availability of many exit routes.  
- During emergency evacuation and due to herding effect, crowds tend to take the same route which leads to stampeding and increased crowd density.  
- Dynamic exit signage should be implemented to direct the crowds to clear exit routes, even at normal evacuation.

Research limitations
- This is an initial study and the results obtained give an overview of the issue and suggest primary solutions to it.  
- The collection of Souq Waqif layout and visitor demands was not possible.  
- Model calibration and validation for the base models, i.e., the force-based behavior model and the exit choice model, required for local/Qatari conditions.

Case studies
- Pedestride® software was used to understand Souq visitors’ behavior during an evacuation process.  
- Simulation model has been calibrated and validated using empirical data collected through controlled experiments and real-world observations.  
- 1st case study: 500 agents over an area of 2260 m² or pedestrian density of 0.22 p/m².  
- 2nd case study: The density was almost doubled (0.45 p/m²) in the second case study by reducing the simulated area to 1109 m².

Evacuation time
- When the crowd density was increased in the second case study, a change in the trend between normal and emergency evacuation was observed.

Percentage evacuated over time – 0.22 p/m² density

Percentage evacuated over time – 0.45 p/m² density

2nd Case study (0.45 p/m²) - Evacuation at 20 seconds: (a) Normal and (b) emergency