

Crowd and Pilgrimage Control in Mecca, Saudi Arabia.

Tawaf is one of the Islamic rituals of pilgrimage. During the Hajj and Umrah, Muslims are to circumambulate the Ka'aba (the holiest building in Mecca, Saudi Arabia) seven times, in counter-clockwise direction. This symbolizes the seven times that Muhammad circled the Ka'aba (central shrine) hundreds of years ago. Today, the number of Hajjis (pilgrims) exceeds two millions.

The area around Kaaba gets very crowded at Hajj and Umrah, raising the need for improvements through crowd control and design modifications.

Pedestrian simulation is one means to analyze these large flows and evaluate respective design modifications. Eng. Yasser Talal Matbouli and Eng. Majed Attia Al-Zahrani of the Industrial Engineering Department, King Abdulaziz University, Jeddah, conducted a simulation study of Tawaf area with SimWalk simulation software. Among others, the study included the following objectives:

- To protect and prevent Hajjis from potential risks
- To define and solve the problems of bottlenecks within the Tawaf area
- To minimize the time needed to perform Tawaf
- To shorten the paths in and out of Tawaf area
- In the simulation study, there were mainly conducted three different experiments:
 1. Influence of nearby obstacles (Maqam Ibrahim) on pedestrian flows
 2. Influence of crowd behavior control (e.g. avoiding opposing flows etc.)
 3. Investigation of area capacity

All Tawaf simulation scenarios were validated by observation, comparing simulation and reality circulation times and travel distances, and generated accurate results. Finally, it was found that Maqam as an obstacle has no significant impact on pedestrian speed. It was also found that Crowd Management is the most significant factor on pedestrian speed during Tawaf.

Summary

During the Hajj in Mecca, Saudi Arabia, the number of pilgrims exceeds two millions. Two engineers from the King Abdulaziz University conducted simulation studies to prevent potential risks and improve performance. The results were validated later and proved to be accurate.



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