



Crowd control for Mecca pilgrimage

Project

Analysis of pedestrian movement at Tawaf area, Mecca

Organisation

Faculty of Engineering
King Abdulaziz
University, Saudi
Arabia

Application

Crowd control,
urban planning

Objectives

Analyse the influence of obstacles, crowd control and area extension on Levels of Service in Tawaf area

Topics

- Simulation analysis of large pedestrian flows
- Detection of bottlenecks
- Recommendations for crowd control

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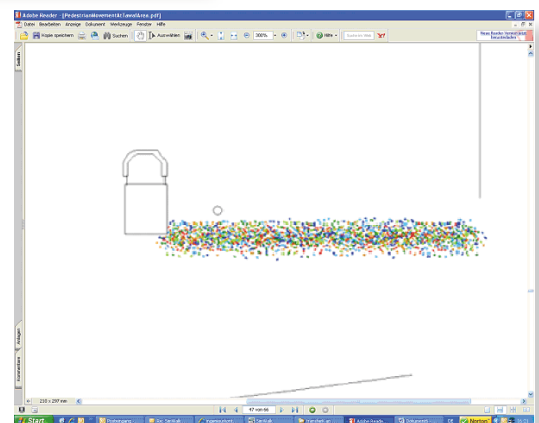
Tawaf is one of the Islamic rituals of pilgrimage. During the Hajj and Umrah, muslims are to circumambulate the Ka'aba (the holiest building in Mecca, Saudi Arabia) seven times, in counter-clockwise direction. This symbolizes the seven times that Muhammad circled the Ka'aba (central shrine) hundreds of years ago. Today, the number of Hajjies (pilgrims) exceeds two millions today. The area around Ka'aba 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 Attiea 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 Hajjies from potential risks
- To define and solve the problems of bottlenecks within 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.