Evaluation of Evacuation Time during a Disaster, Study Case: "Assembly Hall of Faculty of Basic Sciences of ASMU"

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Abstract

People emergency evacuation and especially evacuation time in a disastrous condition such as an earthquake and fire are of great importance. Here we observed evacuation behavior of Assembly Hall of Humanities Faculty of Azarbaijan Shahid Madani University (ASMU). Simulations are done by using distinct element method (DEM). In DEM, people are considered as circular elements and analysis can compute the position of each person (element) step by step by solving the equations of motion. Four cases with different number and arrangement of people are considered in which the number of people were ۳٥۰, ٤۰۰, ٤٥۰ and ٥۰۰ for cases ۱ to ٤, respectively. As the evaluation criteria, part three of National Building Regulations of Iran "Building Fire Protection" is adopted in which the nominal evacuation time limit for this kind of confined space is considered to be ۲۰۰ sec. Evacuation simulations are done for considered cases and evacuation behavior and time are calculated quantitatively. Evacuation times are determined to be ۱۷۳, ۱۷٤, ۱۸٤ and ۱۸٤ sec for cases ۱ to ٤, respectively. As results show, in all considered cases, evacuation time is below the code limit and evacuation behavior of the assembly hall by considering this criterion is acceptable.

Keywords: People evacuation, Evacuation simulation, Emergency evacuation, Evacuation time, Distinct element method.

۱. INTRODUCTION

Safety is a primary consideration in any building. There are many risk factors which can cause casualties such as earthquake, fire, flood, terrorism, etc. A building not only should service in normal conditions, but also it should service in emergency situations. People emergency evacuation and especially evacuation time in such disastrous conditions are of great importance. One way to predict the evacuation behavior of people in a place is evacuation simulation.

Here we observed evacuation behavior of the Assembly Hall of Humanities Faculty of Azarbaijan Shahid Madani University (ASMU). Simulations were done by using distinct element method (DEM). DEM is a numerical method which can calculate each element's position by solving equation of motion step by step.

Kiyono et al. (۱۹۹٦) considered circular DEM elements as human beings and investigated behavior of the crowd flow that evacuated from an enclosed space to outside through the passage or the steps. They found that the model they proposed was able to simulate evacuation during a disaster [۱]. Kiyono et al. (۱۹۹۸) used DEM to simulate evacuation behavior during a disaster. They used circular elements and proposed an algorithm in which elements can avoid collision and pass each other naturally. They determined DEM parameters such as spring constants and driving force for human body based on experiments and simulated evacuation behavior for the explosion accident occurred at the underground shopping center near Shizuoka Station in ۱۹۸۰ [۲]. Kiyono et al. (۲۰۰۰) used the same method to simulate the evacuation of an underground mall in Kyoto [۳]. Kiyono and Mori (۲۰۰٤) used elliptic elements to simulate emergency evacuation behavior during a disaster and validated the technique by comparing the simulation results with a real pedestrian flow [٤].