Pedestrian evacuation model of an air-supported membrane structure under emergency

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Abstract

With the development of social economy and the progress of building technology, more and more buildings with large span and space are emerging, such as the air-supported membrane structure , which is used in tennis court or exhibition building usually with high density crowds, due to its excellent three-dimensional mechanical properties and seismic performance. The air-supported structure may suffer from endanger of deflation caused by opening of exit or failure of inflation system, which is significant for pedestrians evacuation under emergency. Pedestrians evacuation efficiency will be affected to some extent if the height of membrane is lower than the pedestrian in evacuation area during the dynamic deflation process, which mainly occurs near the boundary of the air-supported membrane structure. This paper presents a pedestrian evacuation model in the air-supported structure subjected to emergency deflation. The cellular automaton model is employed to describe the pedestrians evacuation procedure with special consideration on the effect of the changing membrane profile during dynamic deflation process, since it determine pedestrians choice of evacuation route. The changing profile is calculated by employing an explicit numerical model[1] in SMCAD developed by Gong[2], and then imported to the pedestrian evacuation model to change the evacuation field that determines the moving direction of pedestrian.

Simulation results show that pedestrians avoid approaching the structure boundary during evacuation. An interesting phenomenon is also found that the depression of the height of membrane has influence on the evacuation time by slowing down the speed of pedestrians and altering pedestrians moving direction. This work is expected to give some advices in the designing of air-supported membrane structures, and the evacuation model will be further used to predict pedestrians evacuation route and total evacuation time in air-supported membrane structures under emergency to guide their evacuation.

References

[1] Q. Qiang, S. Shen, and J. Gong, “Deflation behavior and related safety assessment of an air-supported membrane structure,” *Thin-Walled Struct.*, vol. 129, pp. 225–236, 2018.

[2] J.H. Gong, SMCAD User’s Manual, 4.0 ed., Shanghai Jiao Tong University, Shanghai, China, 2012.