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Experimental Study on Occupant Evacuation in Narrow Seat Aisle

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Abstract:

Narrow seat aisle is an important area in the train car interior due to the large passenger population, however evacuation therein has not gained enough concerns. In this experimental study, the occupant evacuation of the narrow seat aisle area is investigated, with the aisle width of 0.4 - 0.6 m and the evacuation direction of forward and backward. The evacuation behaviors are analyzed based on the video record, and the discussion is carried out in the aspect of evacuation time, crowdedness, evacuation order, and aisle conflicts. The result shows that with the increasing aisle width, total evacuation time and the average specific evacuation rate decrease. The aisle is crowded for some time, with a large linear occupant densities. The evacuation order of each occupant is mainly related to the seat position. Moreover, it is found that the aisle conflicts can be well described by Burstedde's model. This study gives a useful benchmark for evacuation simulation of narrow seat aisle, and provides reference to safety design of seat area in train cars.

Keywords: evacuation behavior; seat aisle; evacuation time; aisle conflict;

1 Introduction

With the growing global demand for the development of high-speed railway, safety issues with respect to train passengers have recently gained increasing concerns. In the event of rail accidents, such as fire and rear-end, it is crucial to guarantee safe evacuation to avoid casualties. Therefore, profound understandings upon safety evacuation process in train cars are critically essential.

Experimental and numerical studies on safe evacuation of train cars have been extensively reported. However, in most of these contributions, attention has been focused on the overall evacuation time and egress rate, considering the effects of different exit configurations and environmental conditions [1-7]. Only a few studies highlighted the effect of structure in train cars on the efficiency of safe evacuation [8, 9]. The seat area, which is the main part of the train car interior, includes one narrow aisle and the seat rows on each side. When evacuation is needed in this area, all passengers have to go through the narrow aisle to egress outside. Under the circumstance of the large population, congestion or injuries may occur [5]. Therefore, the narrow seat aisle area can be one of the bottlenecks of safety evacuation in train cars, thus occupant evacuation behavior in such area needs to be concerned and investigated into.

Present studies on occupant evacuation of seat area were mostly based on audience seats, such as venues, classrooms theaters. [10-14]. In experimental studies, the evacuation time, egress rate, and occupant density were usually concerned about. In numerical studies, the grid model was widely used for evacuation simulation. The seat area in train cars is similar to the audience seats, for they are both composed of seat rows and aisle. In the event of the evacuation, all the occupants should enter