Evacuation Dynamics Under Consideration Of Vulnerable Pedestrian Groups

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Introduction & Method

- Safety parameters and strategies for Corresponding to the demographic safe escape are often based on empirical datasets, collected with participants in homogeneous constitutions
- Frequently they do not consider elderly persons or persons with disabilities

Results & Discussion

- Empirical studies often concentrate on unimpeded individual velocity as dependent variable (Fig. 4)
- Modification of the pre-movementtime indicates a relationship between pre-movement-time and timedepending evacuation process
- Relationship not only refers to quantitative numbers (like total evacuation times), it is rather a qualitative interference observed (Fig. 2, 3)

- change, the ratio of severely disabled persons is increasing with age
- We choose the demographic situation in Germany 1950, 2015 and 2050 (medium forecast) for comparison of the influence of characteristic properties of mobility on safety parameters in a simple geometric setup (Fig. 1)



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Fig. 1: Schematic geometric setup.



- Individuals with prevalent long premovement-times affect the evacuation process but not the total evacuation times

Ratio of extended pre-movementtimes in a population increases the total evacuation time as well as the quality of the time depending egress

Fig. 2: N(t)-Curves with variated individual velocity as a result of the three calculated scenarios .



Fig. 3: N(t)-Curves with variated pre-movementtime as a result of the three calculated scenarios.

Conclusions

Pre-movement-times affects the quality of the evacuation process more than individual walking speeds The decreasing individual walking speed has no effect of the total evacuation time; but this study didn't consider mobility impairments or further ageing factors Total evacuation times are not that meaningful to rate the safety of persons because individual constitution and behavior is very influential on the evacuation process FDS+Evac was able to to reproduce the time of egress considering premovement-times and individual walking

Reference	Dependent Variable			Independent Variable						
	Va	tb	Jc	Age	Cultur	Gender	Strata	Disa- bility	Aid	Other
Almejmaj et al. 2014	•				•	•				
Al-Obaidi et al. 2003	•				•					
Bendall et al. 1989	•			•						
Bohannon and Andrews 2011	•			•		•	•			
Boyce et al. 1999	•							•	•	
Chattaraj et al. 2009	•		•		•					
Clark-Carter et al. 1986	•							•		
Fitzpatrick et al. 2007	•			•		•		•		•
Fridolf et al. 2013	•									•
Jiang et al. 2012	•							•	•	
Kholshchevnikov et al. 2012	•			•						
Nogueira et al. 2013	•			•				•		•
Rossier and Wade 2001								•		
Rubadiri et al. 1997		•								
Sharifi et al. 2015	•							•	•	
Shields et al. 1997	•								•	
Shimura et al. 2014	•			•						•
Soong et al. 2000	•							•	•	
Sørensen and Dederichs 2013	•							•		

Fig. 4: Experimental studies (unidirectional, flat movement) on pedestrian parameters with respect to vulnerable and heterogeneous groups.

^a v = individual, unimpeded velocity ^b t = Movement time c J = Flow

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