

ELEVATOR PASSENGER ACCELERATIONS DURING EMERGENCY STOPS, NORMAL ELEVATOR TRAVEL, AND EVERYDAY ACTIVITIES

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ABSTRACT

Elevator passengers experience accelerations during normal elevator travel and unexpected elevator stops, but there is limited reporting of this data in the literature. Of interest are the magnitudes and directions of accelerations experienced by elevator passengers, especially when compared to those experienced during activities of daily living. Six volunteers (three male and three female, 5'2"-5'11" and 112-240 lbs.) experienced a series of tests that included activities of daily living, normal elevator travel, and unexpected stops on five passenger elevators. The volunteers were exposed to normal elevator travel and stopping, as well as controlled emergency stops and power interruptions during elevator ascent and descent. The volunteers also performed daily and dynamic activities including squatting, jumping, sitting into a chair, going up and down stairs, and trampoline bouncing.

Triaxial accelerometers were affixed to the head and lumbar spine to measure accelerations; elevator car accelerations were also recorded. Peak resultant head and lumbar accelerations were quantified. Head and lumbar accelerations during unexpected elevator stops were consistently low across different elevators and volunteers; these did not exceed 1.51 g and were comparable to other activities. For example, head and lumbar accelerations for one volunteer were 0.6 and 0.7 g during unexpected elevator stops, 4.3 and 4.3 g during trampoline bouncing, and 0.2 and 0.1 g during normal elevator travel, respectively. The subject accelerations from this study demonstrated that head and lumbar accelerations experienced during normal elevator travel and elevator emergency stops are comparable to those experienced during activities of daily living.

Keywords: elevator travel, elevator stop, volunteer testing, subject accelerations, activities of daily living

INTRODUCTION

Elevator passengers experience accelerations during normal elevator travel and during unexpected elevator stops. However, there is limited reporting of this acceleration data in the literature. A key factor to understanding an elevator passenger's experience during normal elevator travel and unexpected elevator stop scenarios is the ability to compare the magnitudes and directions of their accelerations during these elevator scenarios to those experienced during typically non-injurious activities of daily living.

Previous literature has quantified the head and lumbar accelerations of volunteers while performing various activities of daily living and common driving tasks. For example, sitting or "plopping" into a chair resulted in head accelerations ranging between approximately 2 to 12 g, and lumbar accelerations ranging between 1.1 to 7.6 g [1-5]. Getting into and out of a car resulted in head and lumbar accelerations ranging from 1.4 to 2.8 g and driving over a pothole resulted in head and lumbar accelerations ranging from 2 to 3 g [1-2, 6]. Additionally, subject accelerations during activities of daily living and common driving tasks have been directly compared to experiences during which occupants experience accelerations, such as during low-speed vehicle impacts and while riding roller coasters [1-2, 7-8].