



Elevator Passenger Accelerations Study

The Situation

Elevator emergency stops are often surprising events. Of interest is a scientific way to evaluate the actual accelerations experienced by passengers of those elevators.

To address this, consultants at ESi conducted controlled human-subject studies designed to measure passenger accelerations during both normal elevator travel and unexpected stops, and to compare those events directly to common, non-injurious everyday activities.

Six adult volunteers of varying ages, sizes, and genders participated in the structured testing that evaluated their physical responses not only in elevators, but also during routine and dynamic activities representative of daily life.

Our Approach

Each volunteer was instrumented with tri-axial accelerometers secured to the head and near the lumbar spine (L3-L4 region). Data was collected at high sampling rates and processed in accordance with SAE J211 standards for accurate and biomechanically meaningful measurements.

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Services Utilized:

- Accident Reconstruction
- Safety Investigations

Our Approach *cont.*

Testing was conducted across five passenger elevators. Subjects were unaware of the timing of each stop and were instructed not to hold handrails or walls, allowing natural body mechanics to respond to elevator motion. Volunteers experienced:

- Normal ascents and descents
- Unexpected stops during various travel phases (i.e. ascent, descent, leveling-speed, acceleration phase)
- Controlled emergency stops
- Controlled electrical stops
- Power interruption scenarios

To contextualize the elevator data, the volunteers also performed common daily and recreational activities. These activities provided a real-world benchmark for interpreting elevator-induced body accelerations compared to the body accelerations experienced by those same volunteers in normal life. The activities included:

- Walking and running
- Sitting into a chair (normal and abrupt)
- Climbing and descending stairs
- Squatting and hopping off steps
- Jumping and trampoline activity

The Outcome

The measured accelerations were almost exclusively vertical, consistent with elevator motion. Video documentation confirmed that subjects maintained balance during all trials. Body response was primarily limited to mild knee flexion, with no significant lateral sway, stumbling, or destabilization.

Comparison to Common Daily Activities

For context, the measured elevator accelerations were compared to accelerations recorded in the same volunteer while performing common daily and dynamic activities. When compared to common

everyday activities, elevator accelerations were similar or substantially lower.

Across subjects, many daily activities produced peak resultant head and lumbar accelerations that were similar to or greater than those measured during both normal elevator travel and unexpected stop events. These measurements provide quantitative biomechanical context for interpreting passenger accelerations during elevator operations by directly comparing them to accelerations experienced during routine movements.

Results and Significance

This case study highlights the value of controlled experimental testing in evaluating real-world mechanical events. By instrumenting six human subject volunteers and measuring responses across five passenger elevators under multiple operating and stopping conditions, ESI quantified passenger accelerations during both normal travel and unexpected stop scenarios.

Across elevators, subjects, and stop conditions, the measured accelerations were consistent in magnitude and direction. Peak resultant head and lumbar accelerations during unexpected emergency stops, including power interruptions, were generally similar to those measured during common daily activities performed by the same subject. When compared directly to activities such as stair descent, sitting, jumping, and jogging, the elevator-related accelerations were comparable to or lower than those experienced during many routine movements.

This study adds controlled human-subject data to the published literature addressing passenger accelerations during elevator travel and stopping events. The results provide biomechanical context for understanding elevator passenger experiences through direct comparison to common daily activities.

See test result examples on following page



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Test Result Examples

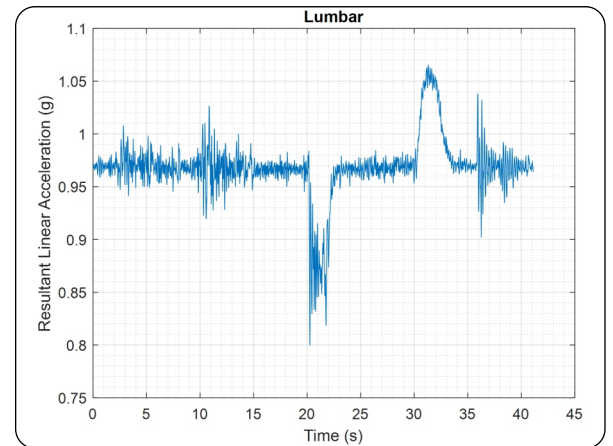
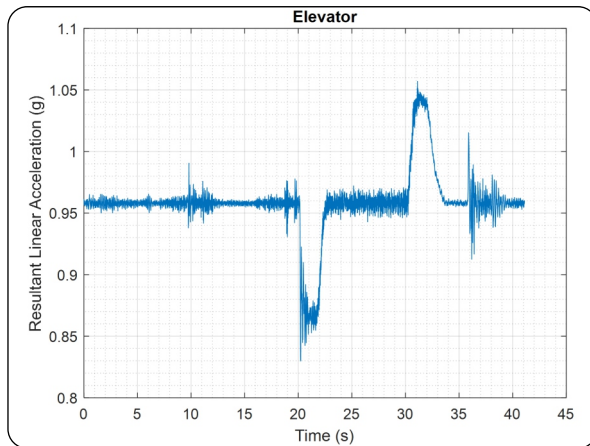


Test 5

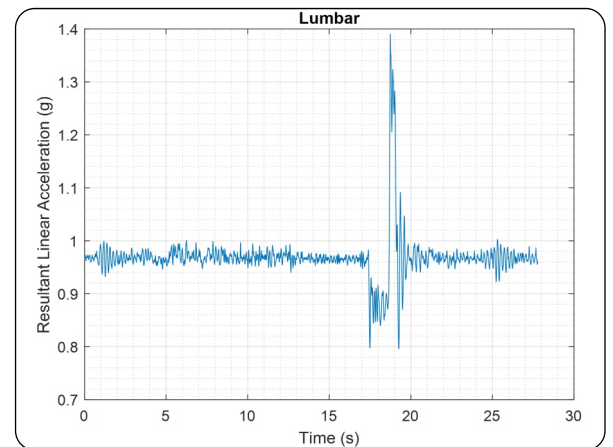
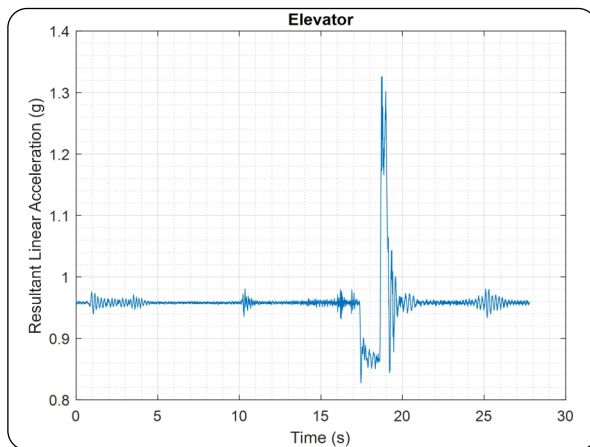
Unexpected Elevator Stop -
Image showing knee flexion



**Example:
Normal
Elevator
Descent**



**Example:
Unexpected
Elevator
Stop**



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