

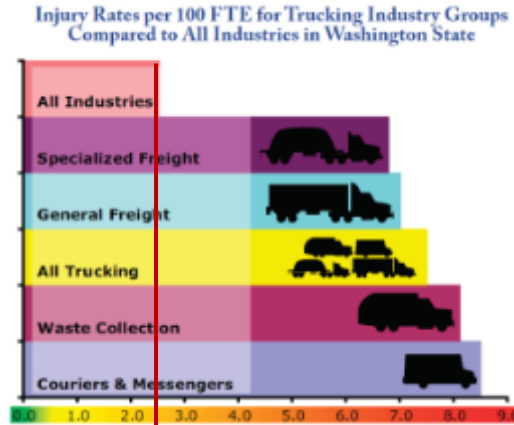
Past and Future Research to Reduce Vehicle Operator Whole Body Vibration Exposures

January 9, 2024

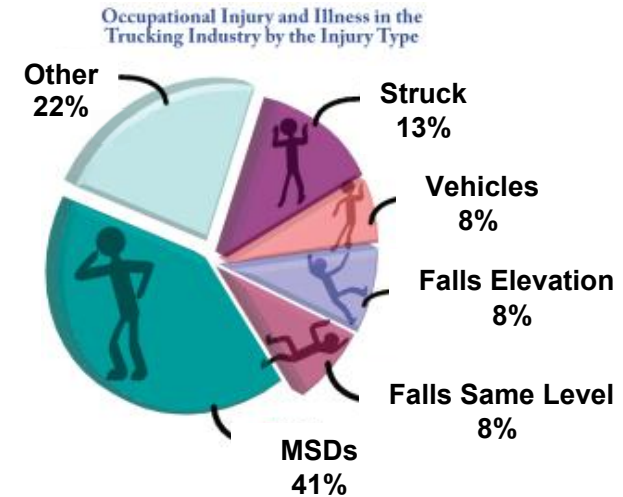
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Whole Body Vibration (WBV), Low Back Pain, and Costs



Injury rates in driving over 3x higher



Musculoskeletal disorders (MSDs) single largest component of claims

- Back injuries are most significant non-lethal medical condition affecting the North American workforce - costing Billions annually
- Average back claim cost with days away from work ~\$40,000

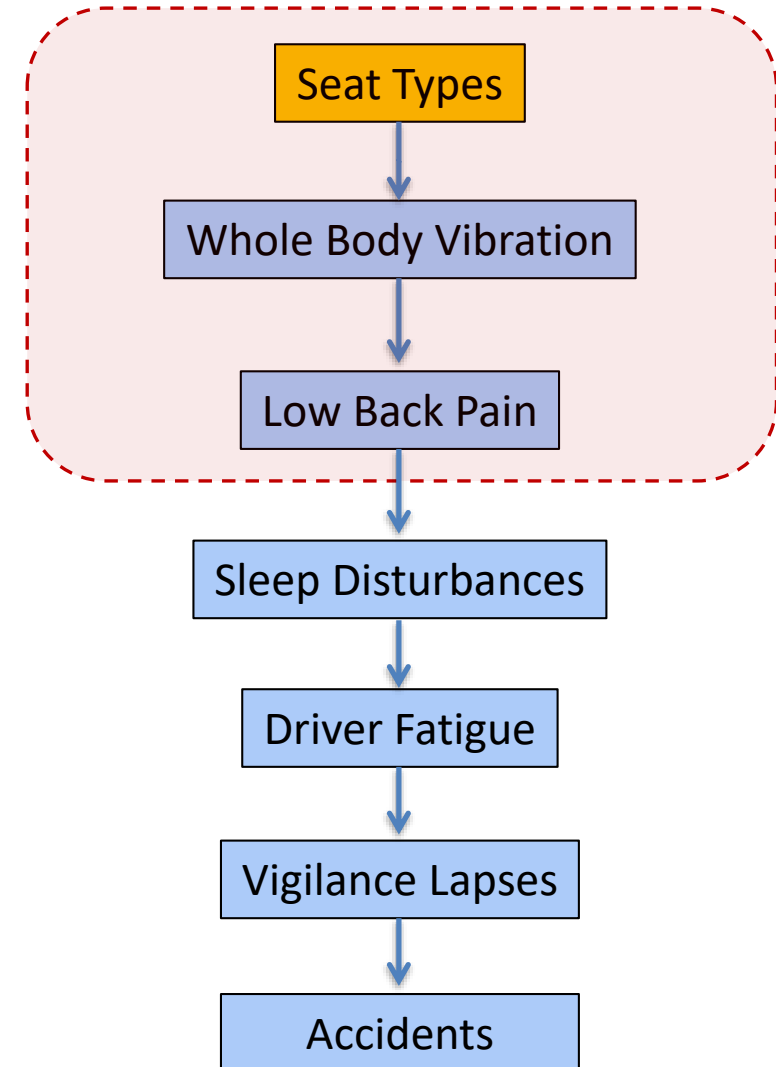
Seat selection may impact WBV, low back pain, claim costs, and productivity



**Industry Standard
Seats**



**Enhanced
Seats**



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Original Article

BOHS
The Chartered Society for
Worker Health Protection



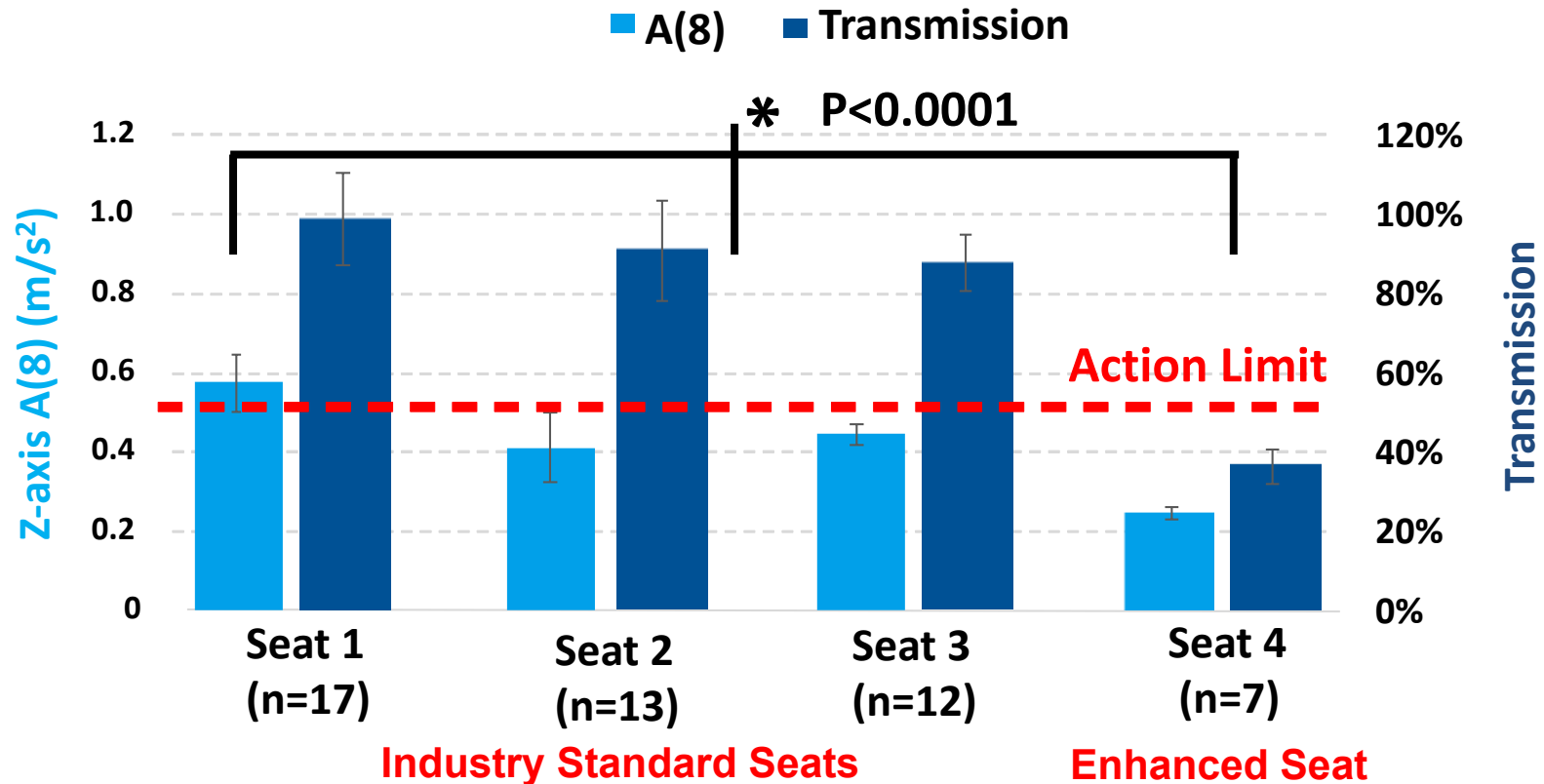
OXFORD

Original Article

Exposure to Whole-Body Vibration in Commercial Heavy-Truck Driving in On- and Off-Road Conditions: Effect of Seat Choice

Hugh W. Davies^{1,*}, Fangfang Wang², Bronson B. Du³, Rick Viventi⁴ and Peter W. Johnson²

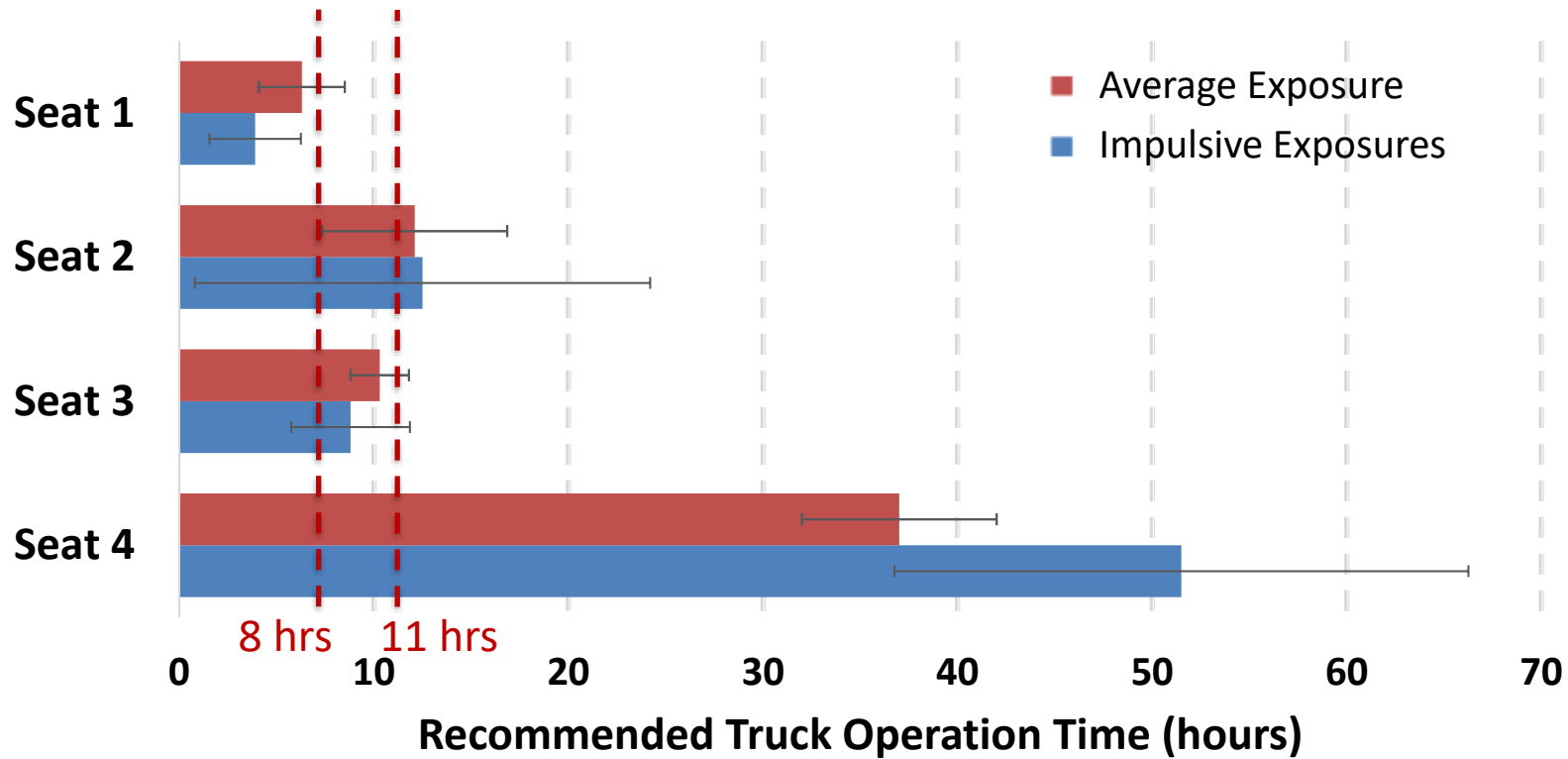
Results – Mean WBV Exposures over Whole Route



- Suspension **friction** (actually the lack thereof) is the holy grail to reduce vibration
- Adequate **damping** is essential to protect the seat operator from bottoming out
- The active seat (Seat 4) powers through **friction** and provides power for **damping**

Truck Operation Time

Time to Daily Vibration Action Limits (DVALs)



Median (\pm IQR) time in hours that the trucks could be operated until reaching the DVALs

Future Research to Reduce Vehicle Operator Whole Body Vibration Exposures

Evaluation of an Innovative Seat Technology to Reduce Workplace Whole Body Vibration Exposure 

January 9, 2024

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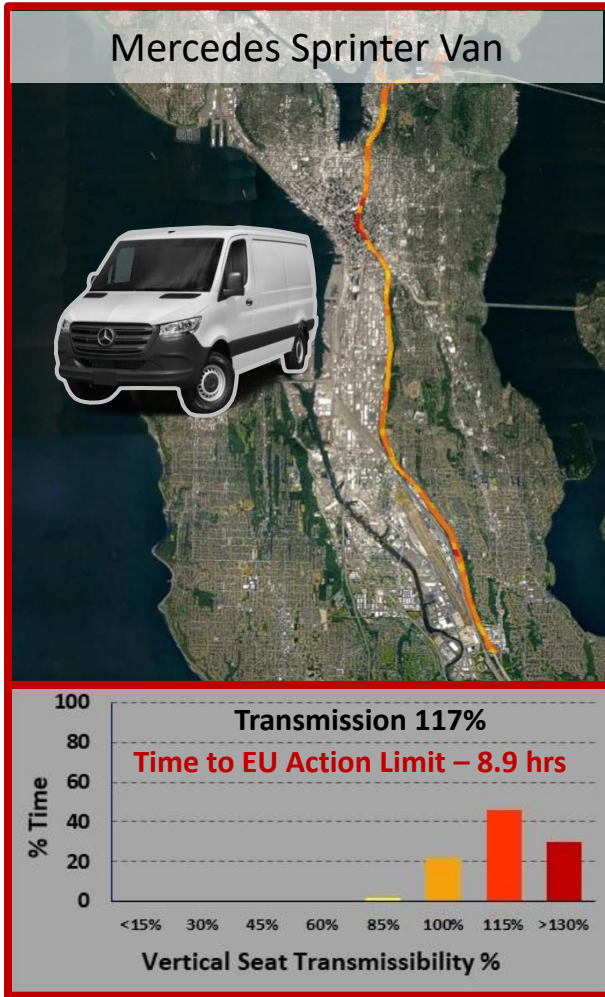
Grant Objectives



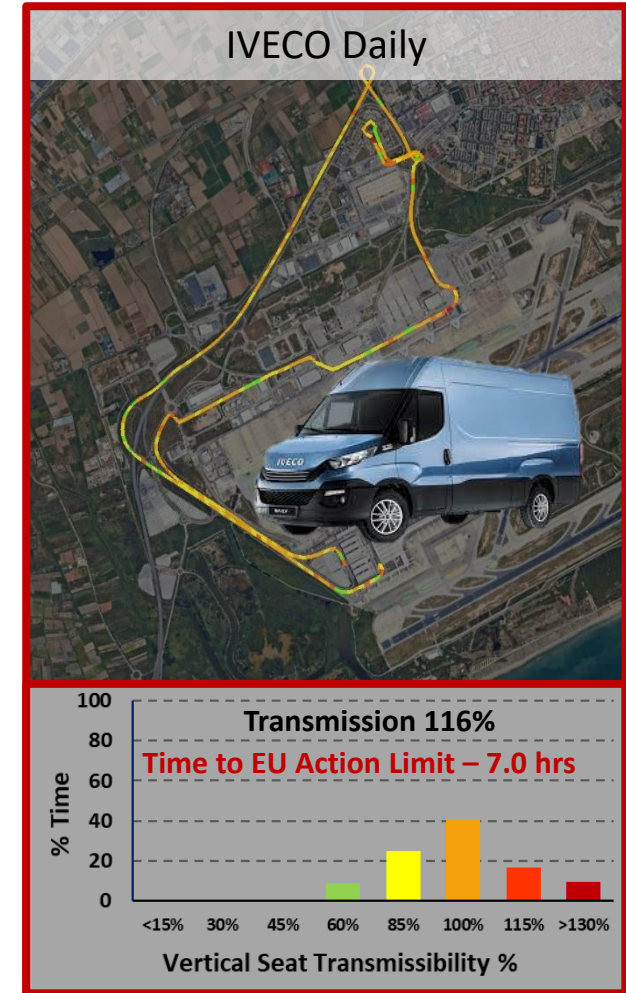
- WBV exposures to van, shuttle/mini-bus, and pickup operators are not well documented
- Static, suspension-less seats are predominantly used in these vehicles ... adequate WBV protection?
- Low-profile and newer-technology air-ride seats are available and untested ... is there a benefit?

Preliminary Studies

- Not uncommon for static seats to amplify vibration (right)
- Mechanical seats with friction can amplify on-road vibration (left)
- Low-profile air-suspension seats predominantly untested
- A new, untested air-suspension technology is available for testing



Stock Suspension-less Seat



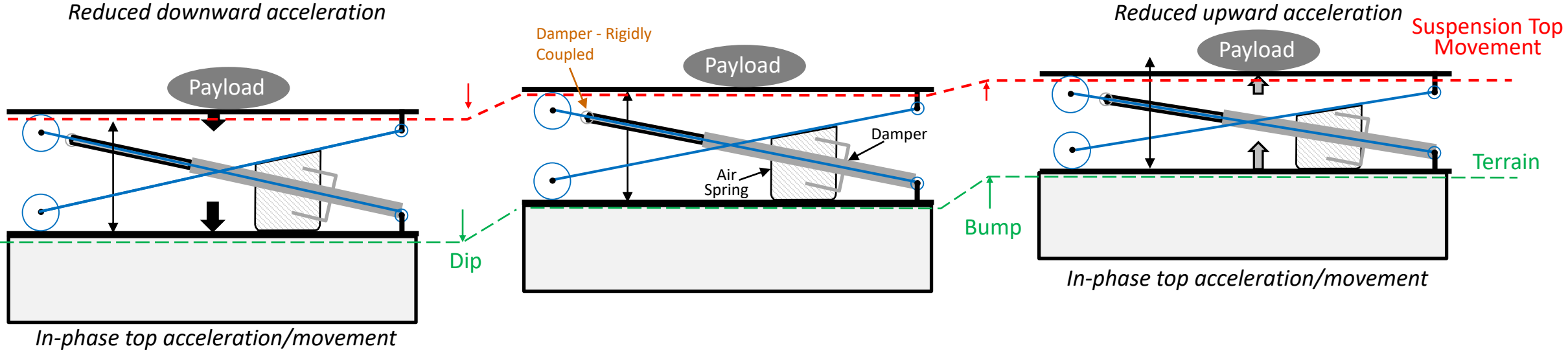
Mechanical Suspension Seat

Air Suspension made by Suspension Systems Technologies (SST)

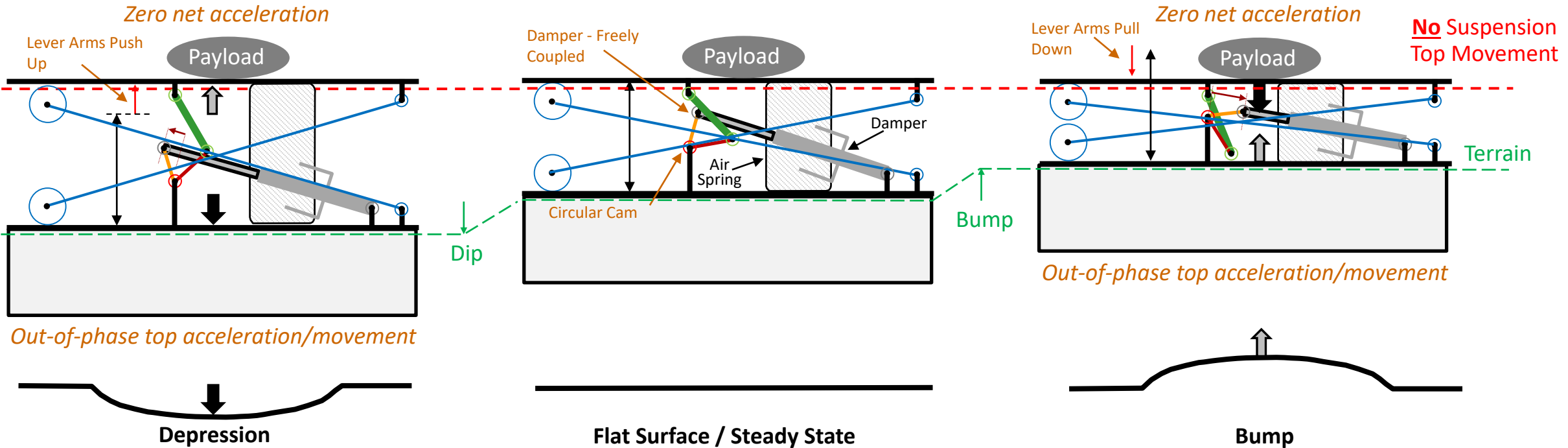


SST Suspension Moves in the Opposite Direction of the Terrain

Conventional Suspension

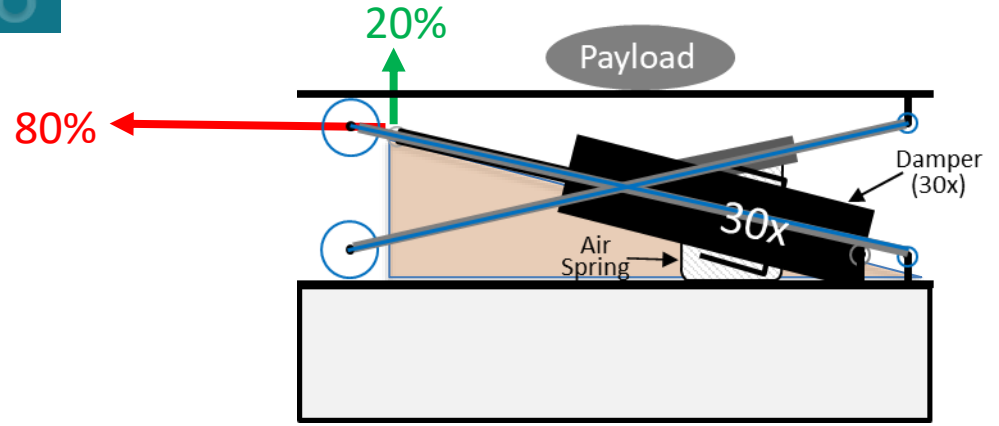


SST Suspension



SST Suspension simultaneously minimizes friction and enhances damping

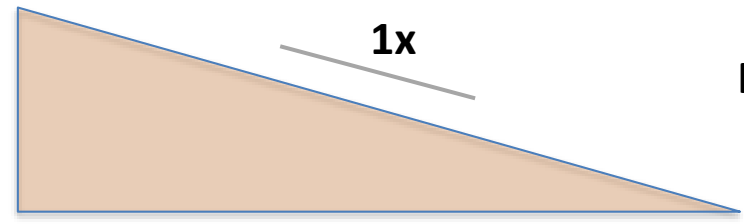
Conventional Suspension



High

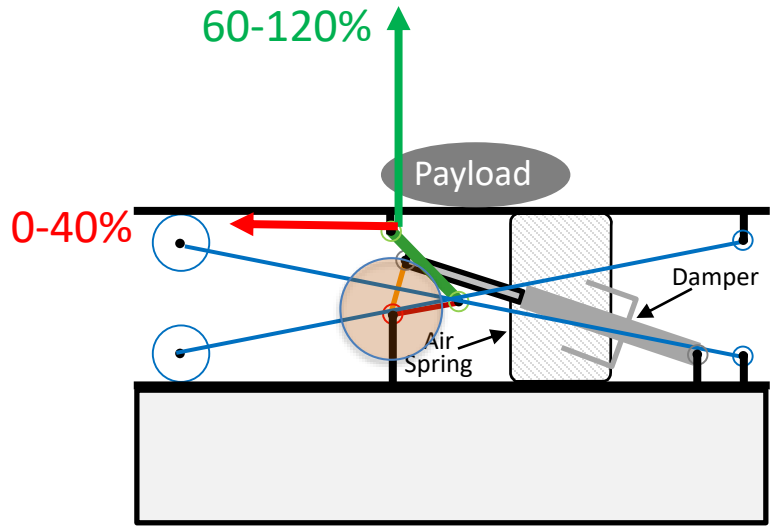
Suspension Height

Low



Fixed Damping

SST Suspension

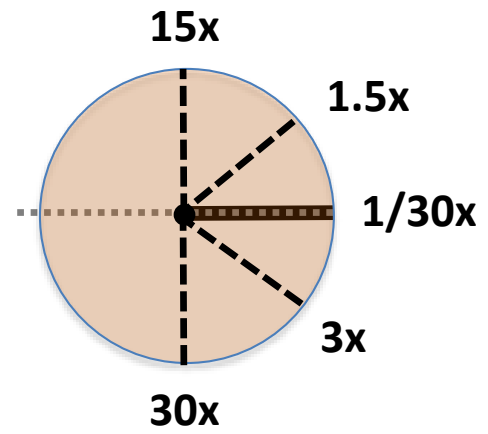


High

Suspension Height

Mid

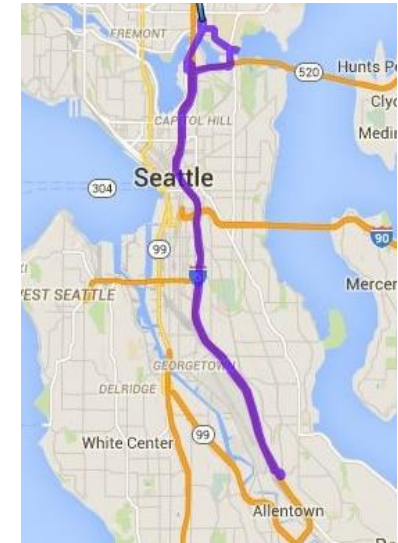
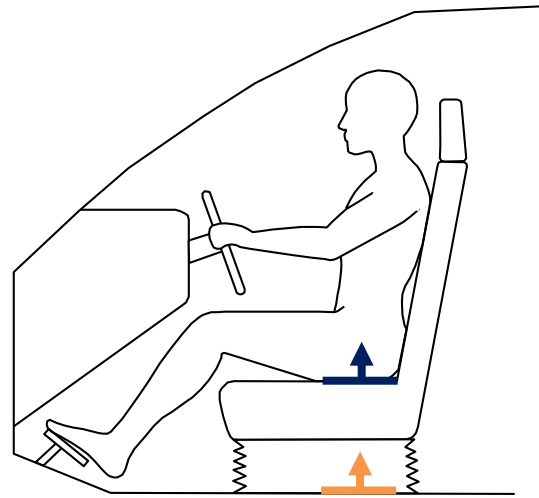
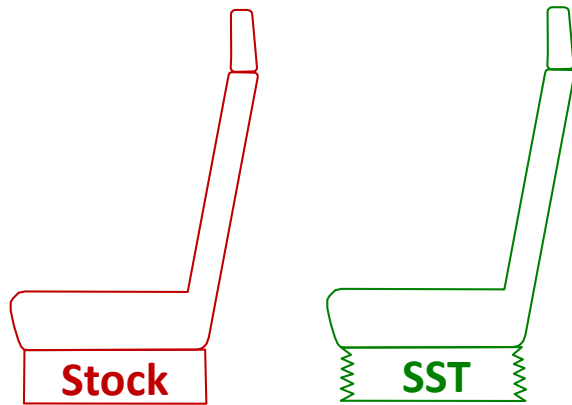
Low



Variable Damping

Reanimates a low-cost, conventional one-dimensional damper to behave like a high-cost, active damper

Field Case - Mercedes Sprinter Van (Proof of Concept)



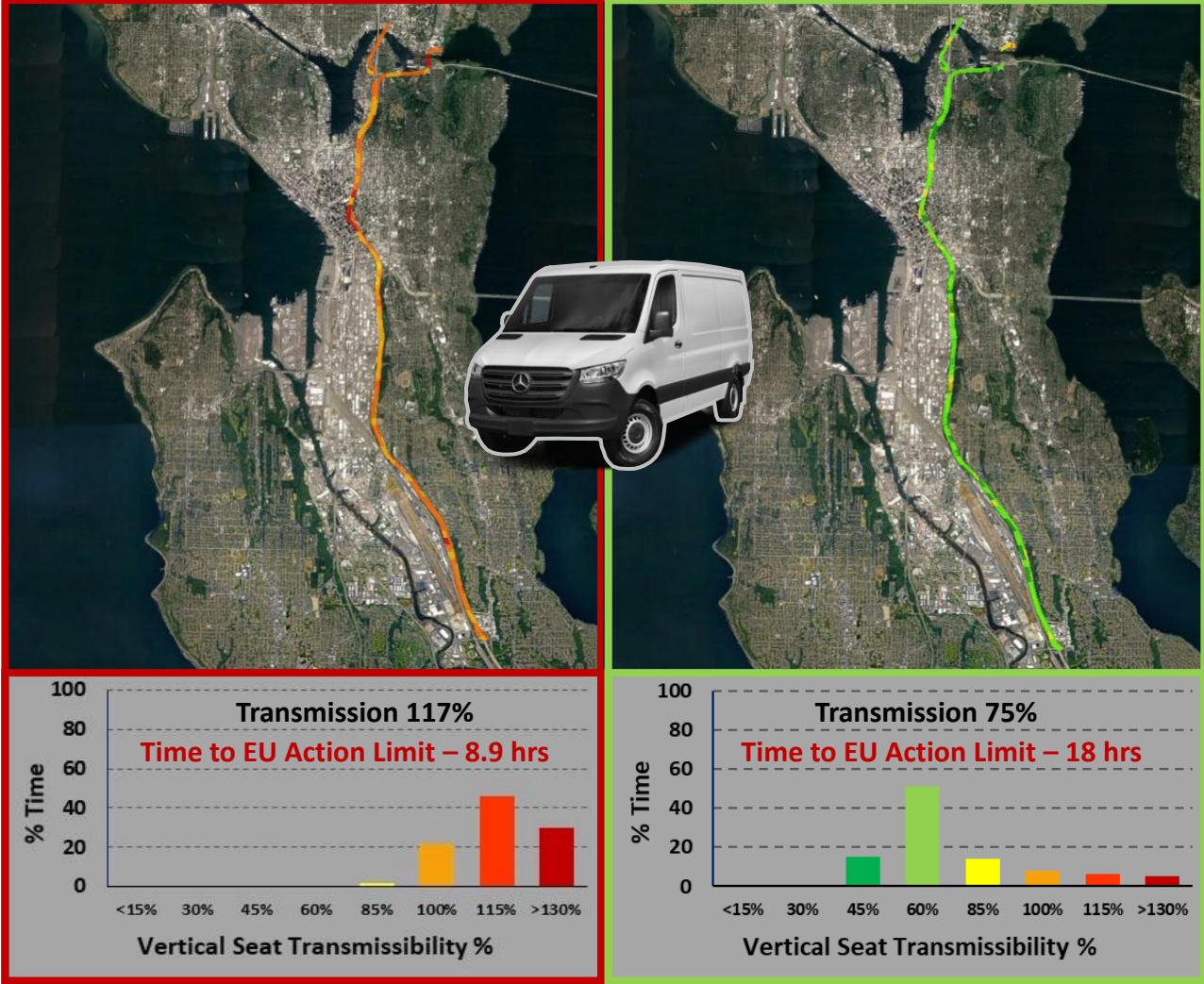
- Two Seats were evaluated

- Vibration collected from the **floor** and **seat** of the van

- Traveled on 40 km of roads in Seattle

Field Case Example - Mercedes Sprinter Van

- SST seat reduced driver vibration by 42% compared to the stock seat
- SST seat doubled the time to reach EU daily vibration action limits



Stock Seat

SST Seat

