Real-crash safety considerations for small, light vehicles

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WORKSHOP - THE SAFETY CHARACTERIZATION OF FUTURE PLASTICS AND COMPOSITE INTENSIVE VEHICLES (PCIVs)

DOT/RITA Volpe Center
Cambridge, MA

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INSURANCE INSTITUTE
FOR HIGHWAY SAFETY

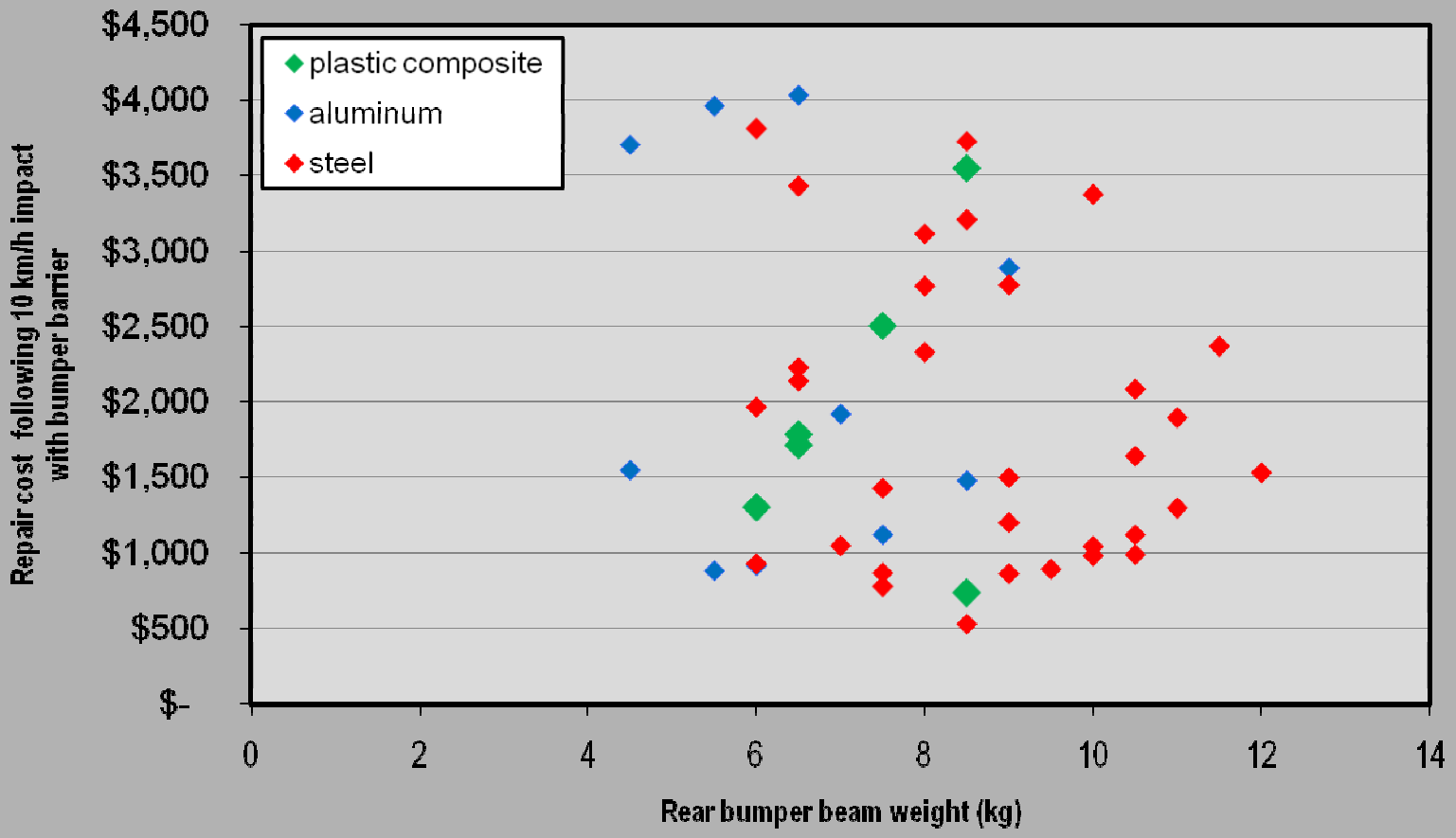
Plastic composite bumpers in IIHS test

10 km/h against bumper barrier

IIHS

Plastic/composite bumpers –

Perform similarly to steel & aluminum bumpers



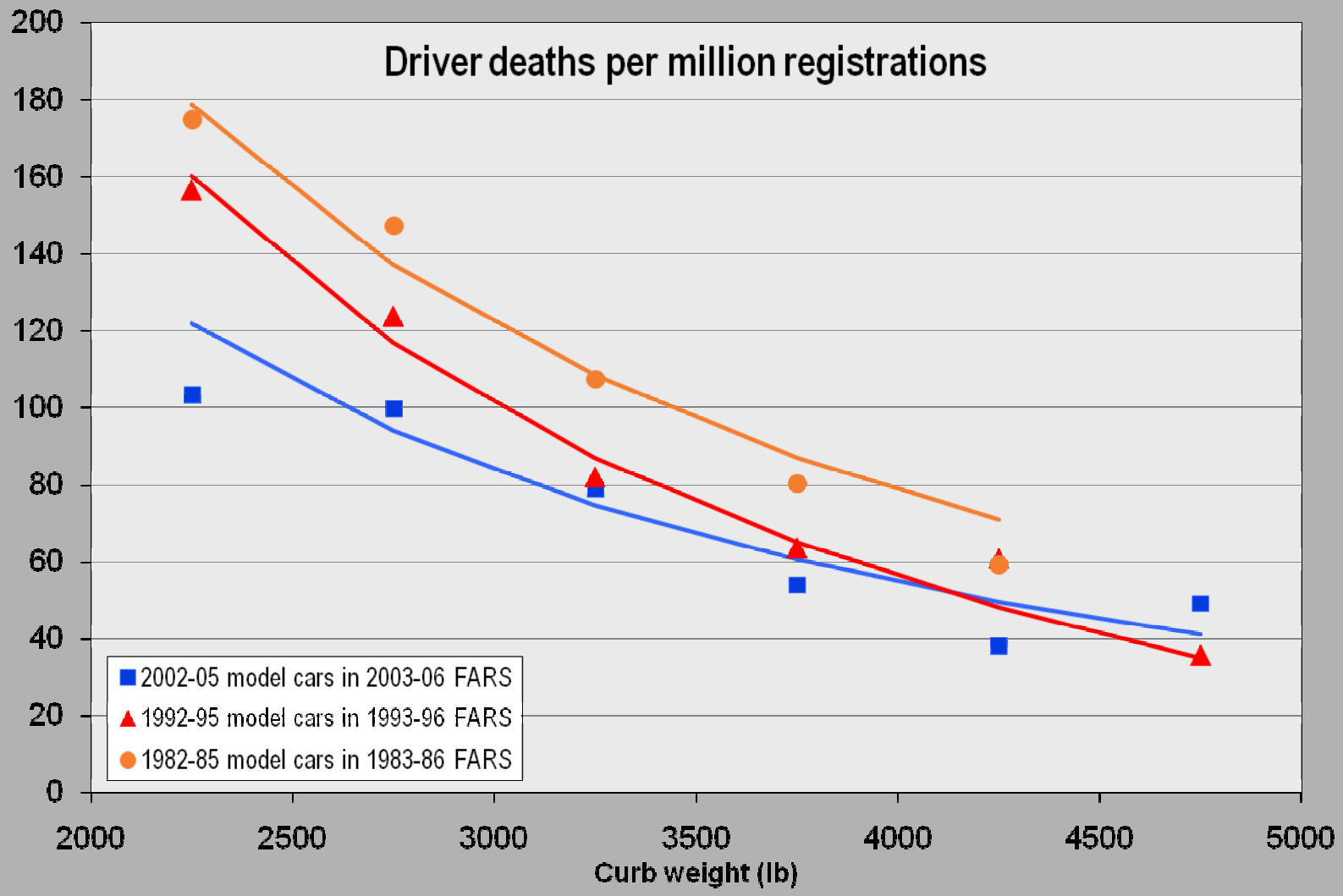
IIHS

Crashworthiness challenges for small light vehicles

- Mass is protective
  - Multiple vehicle crashes: Conservation of momentum → lighter car has larger velocity change
  - Single vehicle crashes: lighter vehicles tend to have higher acceleration
- Size is protective; large crush zones
  - Reduce risk of intrusion
  - Potentially allow slower deceleration

Safety has improved in all size/weight groups

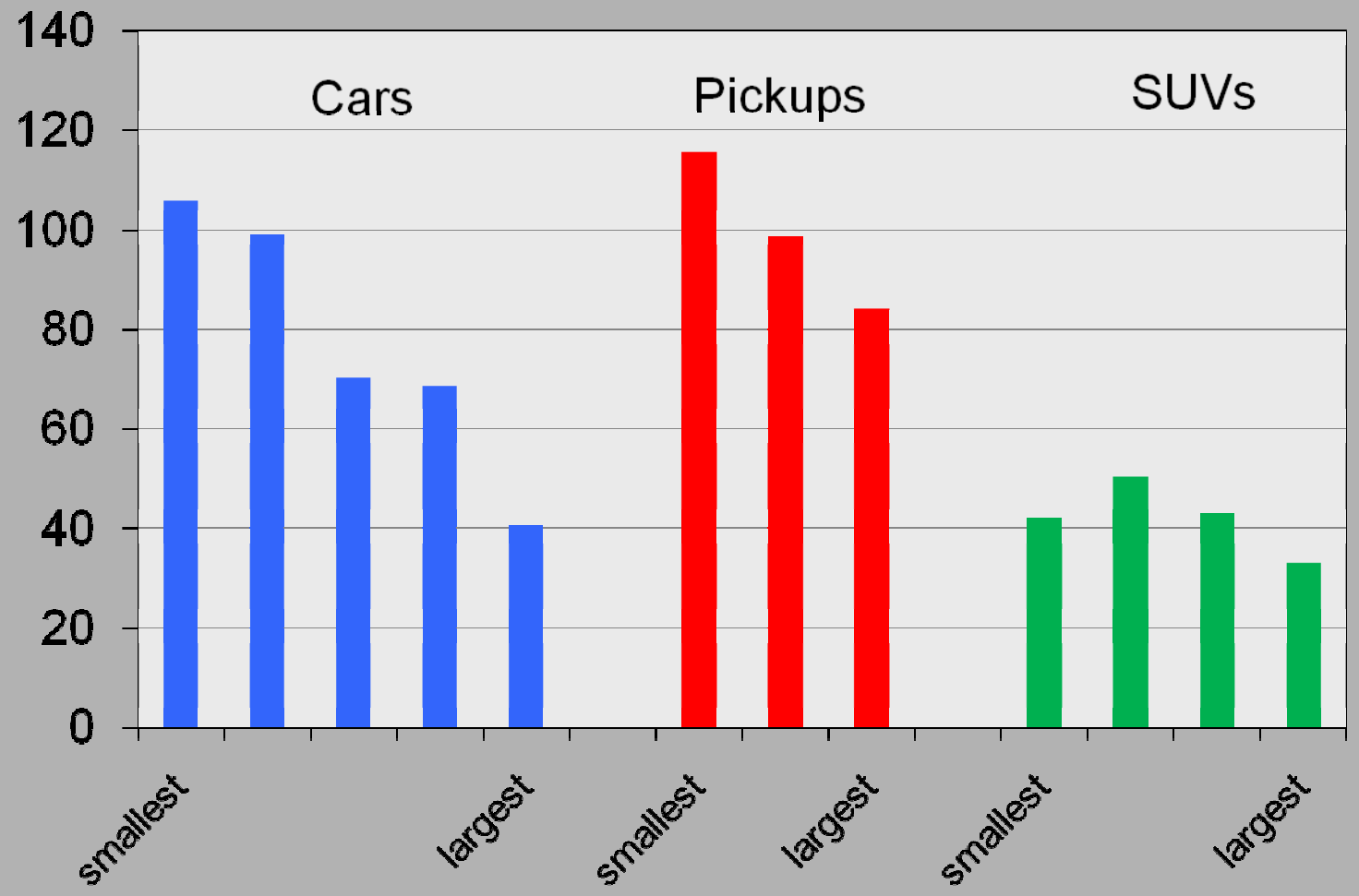
Improved vehicle and restraint design, greater belt use, etc.



IIHS

Driver deaths per million vehicle registrations

1-3 year old cars; 2006 FARS



IIHS

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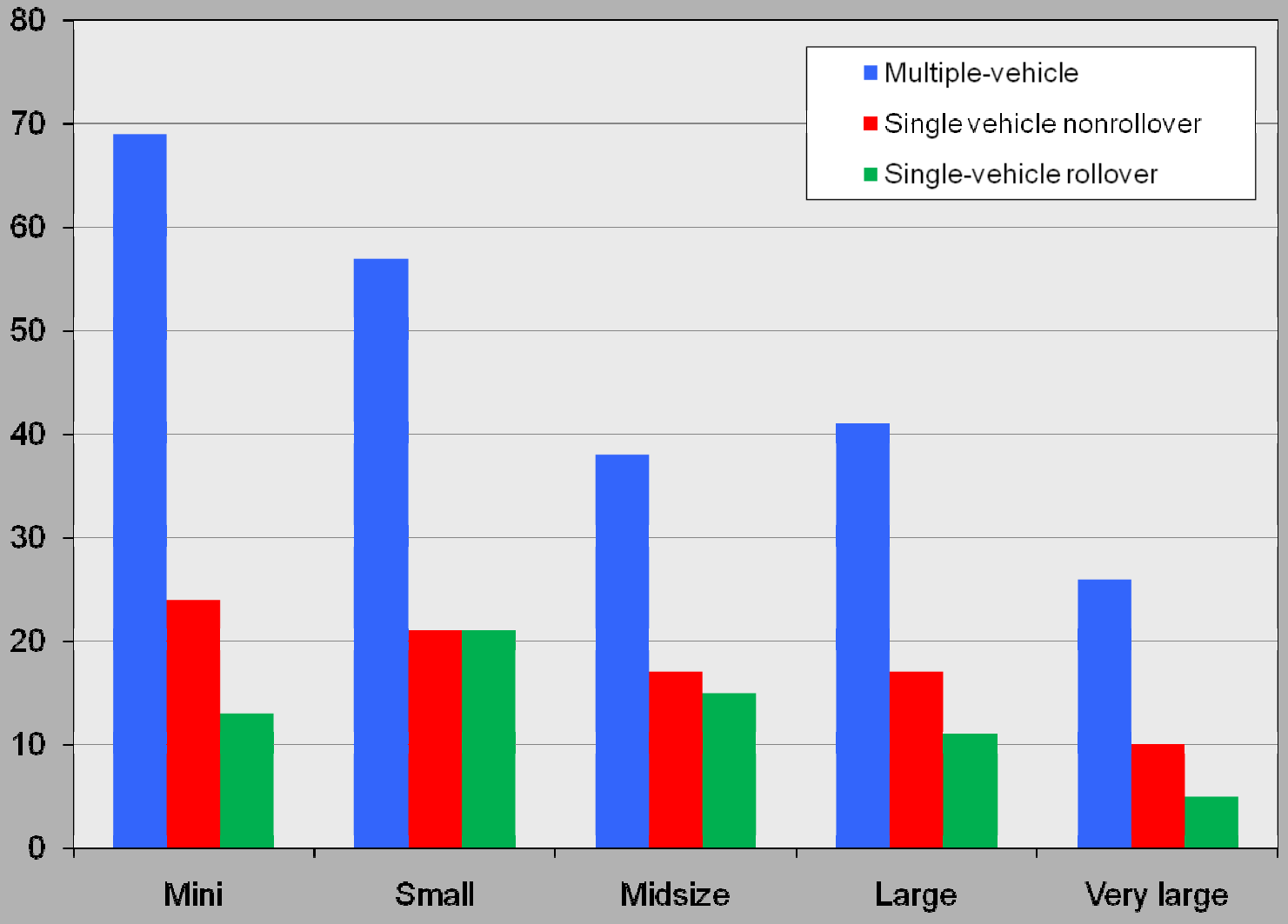
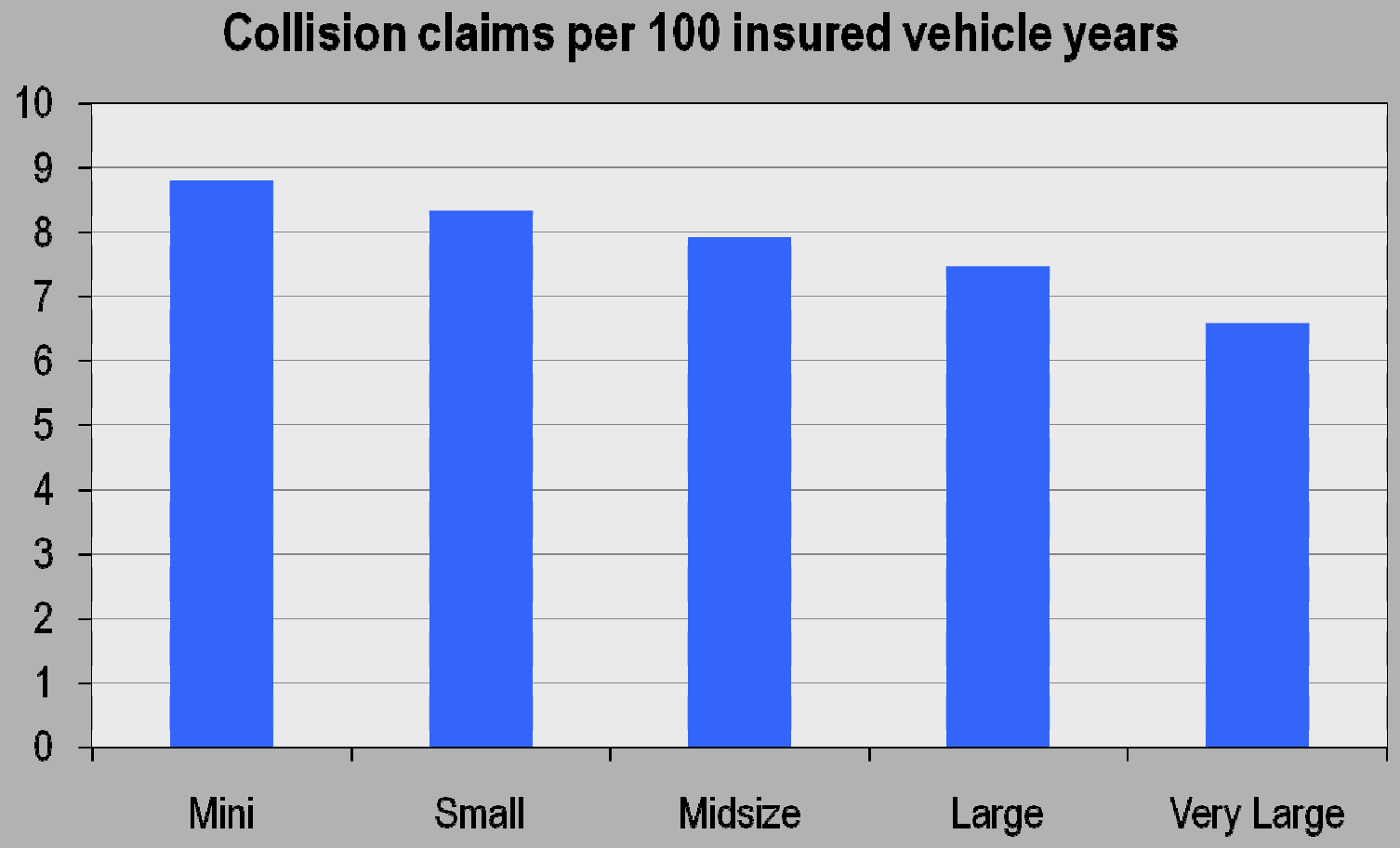


IIHS

Smaller cars are not involved in fewer crashes

Adjusted for driver age, gender & marital status, state, zip code and deductible



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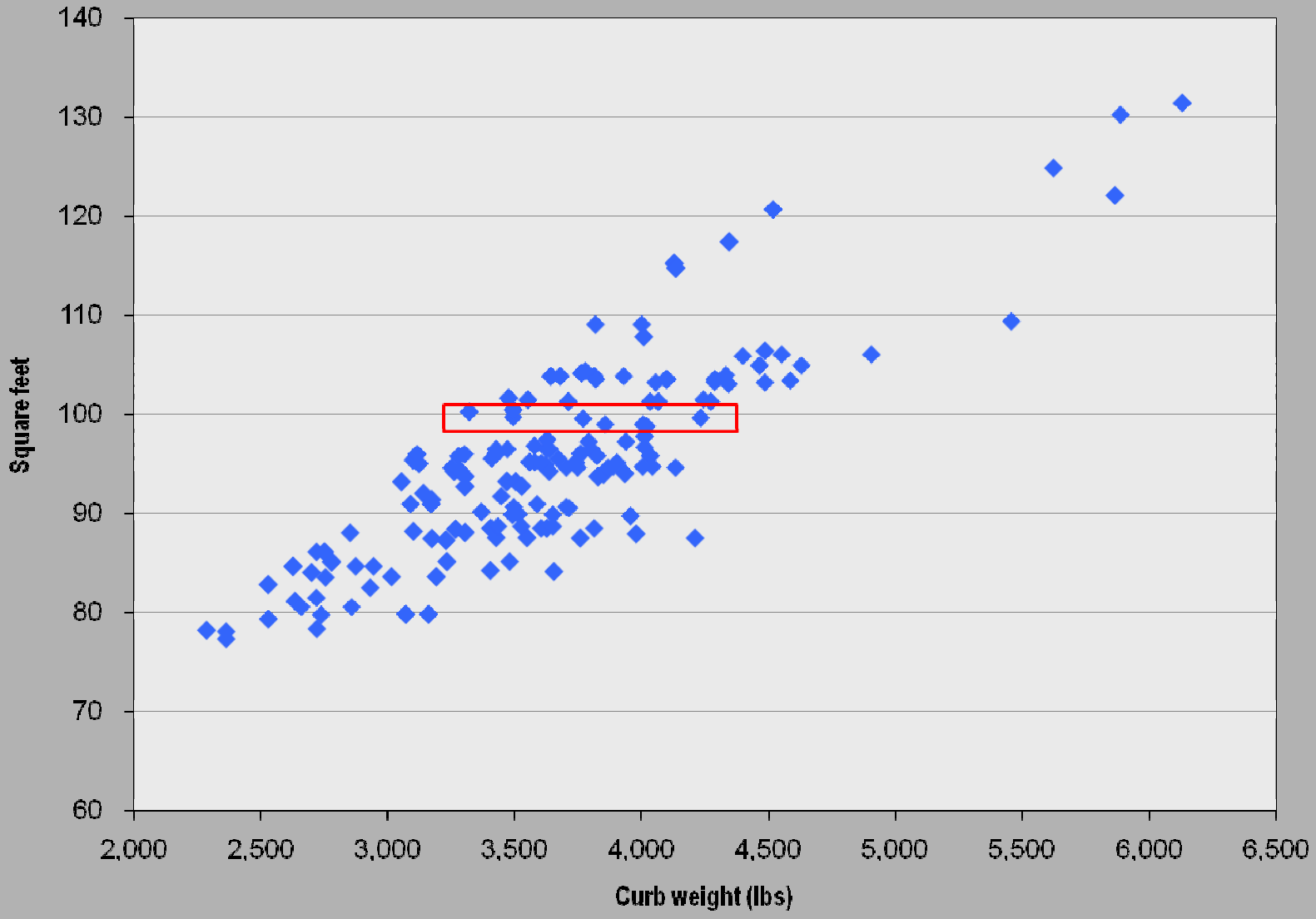
Vehicle size (shadow – length x width)

Strongly correlated with weight



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Cars with a shadow of about 99 square feet

Weight correlated with engine size and luxury

	Curb Weight	Engine Type	Horsepower
Toyota Avalon	3,495	3.5L 6 cyl	268
Kia Amanti	3,770	3.8L 6 cyl	264
Cadillac STS	3,857	3.6L 6 cyl	255
Cadillac STS	4,006	4.6L 8 cyl	320
Mercedes-Benz CLS	4,020	5.5L 8 cyl	382
Cadillac STS-V	4,233	4.4L 8 cyl	469

Safety for small light vehicles

- Larger crush zones
  - Mean less of vehicle package for occupant comfort and cargo
- Better occupant restraints
  - Control of occupant motion and distribution of restraint system forces mean less comfort for everyday driving

Are racing restraints and vehicle design practical for everyday driving?

Courtesy of IMS Photo
By Jim Haines

Courtesy of NASCAR

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Future vehicles

- Crash avoidance systems may prevent some crashes
- Systems using pre-crash sensors
  - Do prepare occupants and restraints for impact (e.g. Mercedes-Benz Pre-Safe)
  - Could deploy inflatable/expanding crush zones

Maximum crashes potentially preventable

By type of system

	annual	fatal
forward collision warning	2,268,000	7,166
brake assist	417,000	3,079
lane departure warning	483,000	10,345
blind spot detection	457,000	428
adaptive headlights	143,000	2,553
total unique crashes	3,435,000	20,777

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Example benefit: Lane departure warning

If as effective as rumble strips…

- Rumble strips reduce crashes 25-30 percent
  - Head-on
  - Oncoming sideswipe
  - Run-off road
- LDW could prevent
  - More than 100,000 crashes
  - More than 2,500 deaths

Deployable crush zones could increase crash protection for small lightweight vehicles

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