Informal document No. **GRSP-35-9**
(35th GRSP, 3-5 May 2004,
agenda item A.6.)

JMLIT Compatibility Research

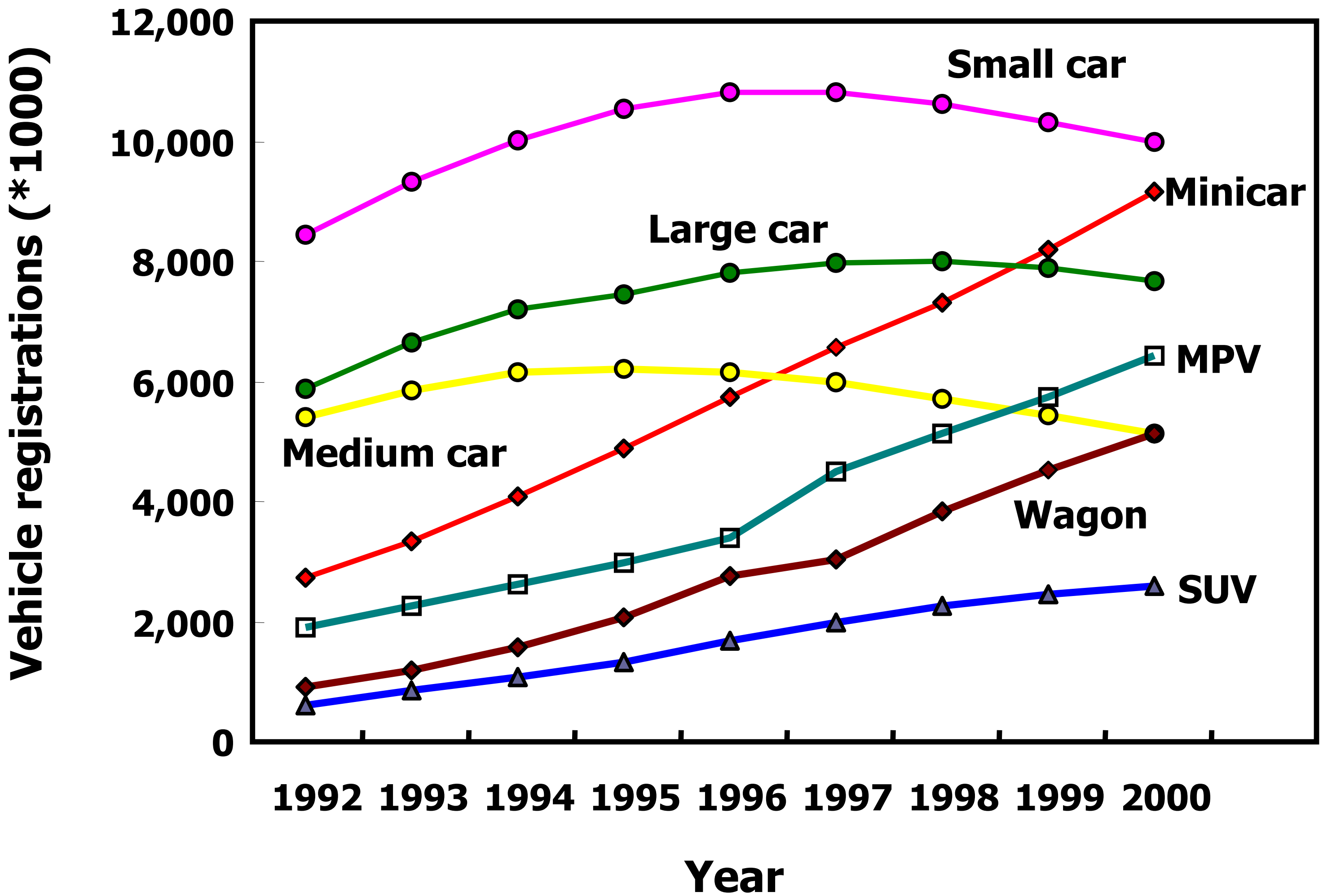
GRSP, May 2004

JMLIT

JMLIT Compatibility Research

- Development of test procedures
  - Accident analysis
  - Crash tests
- Cooperation with IHRA
- The research are conducted in JMLIT Compatibility WG

Vehicle Fleet in Japan



Key Factors of Compatibility

- **Structural interaction**
- **Force matching**
- **Compartment strength**

1. Full-Width Tests for Structural Interaction Evaluation

Full-Width Crash Tests

- Full-width rigid barrier crash tests have already been in the regulations of Japan, US and Australia as a high-acceleration test for restraint systems.
- Barrier force distributions are measured for structural interaction evaluation.
- Full-width tests are agreed as phase I in IHRA compatibility WG.

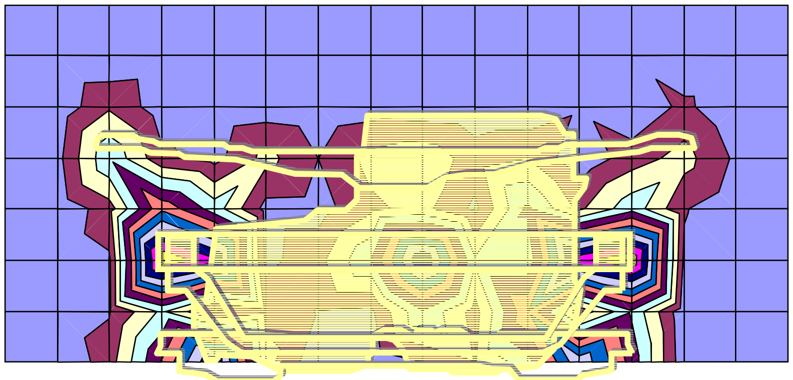
Full-Width Tests in Japan

- 125 x 125 mm load cells
- 44 rigid barrier tests (42 JNCAP + 2 additional tests)
- 6 (TRL) deformable barrier tests

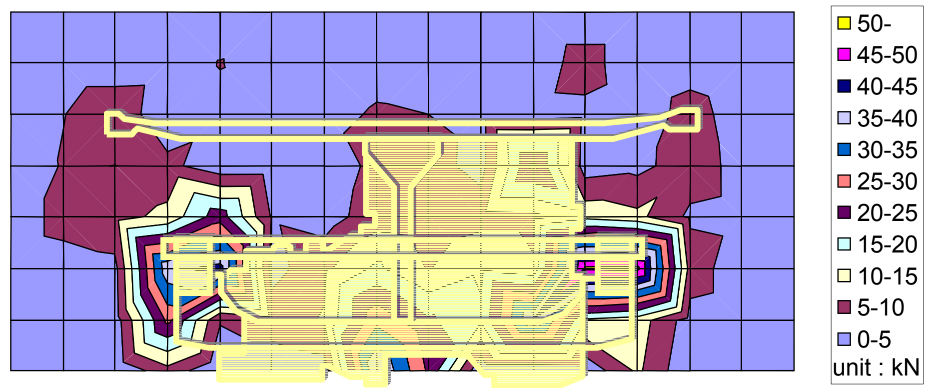
Rigid barrier

Deformable barrier

Force Distributions in Full-Width Rigid Barrier Tests

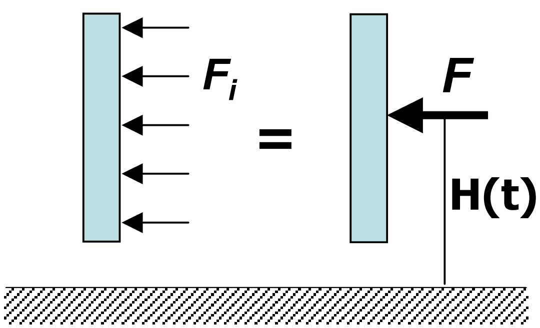


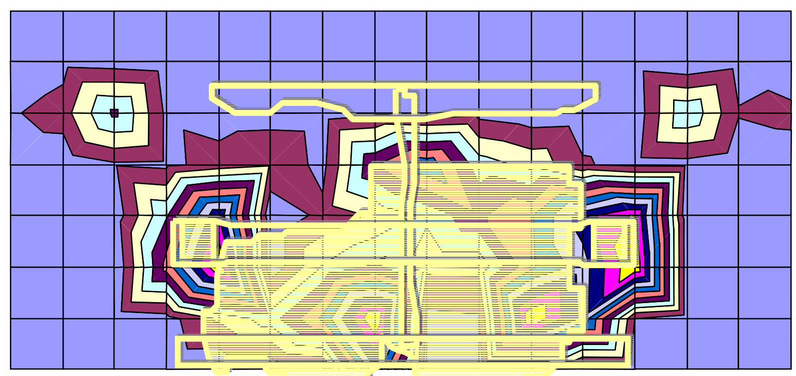
Honda Accord
AHOF: 410 mm



Nissan Liberty
AHOF: 434 mm

AHOF=average height of force

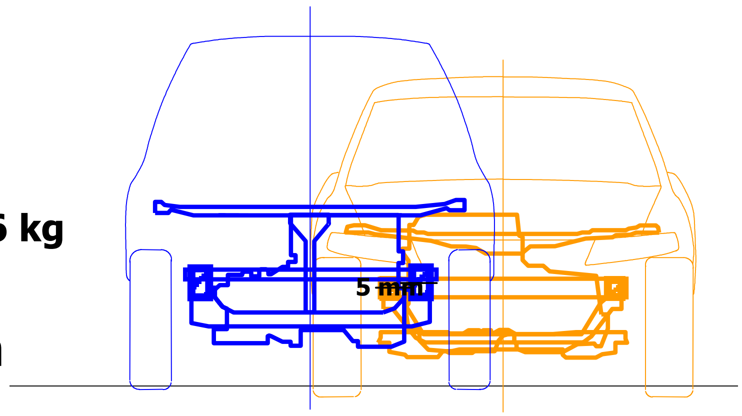




Honda Stepwgn
AHOF: 487 mm

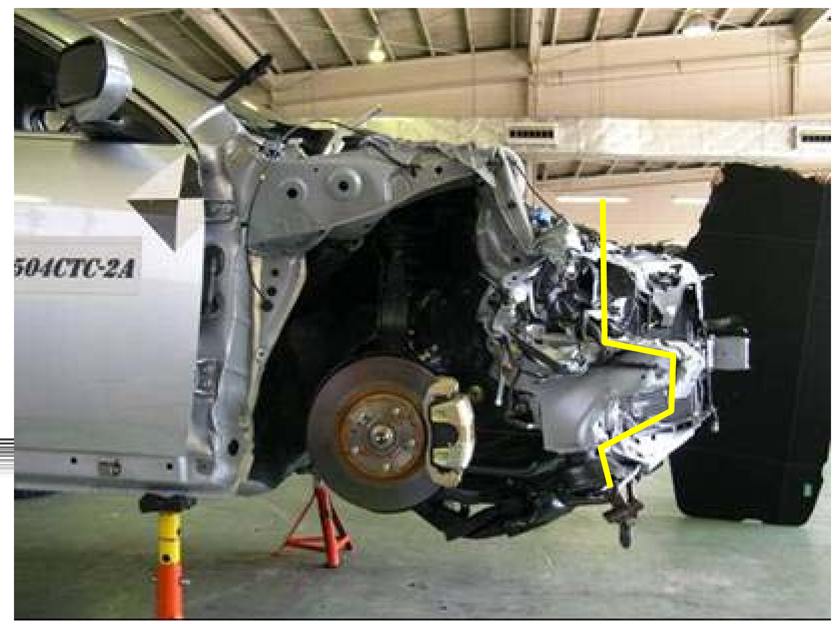
Car-to-MPV - Similar AHOF -

Nissan Liberty
AHOF: 434 mm
Kerb mass: 1516 kg



Honda Accord
AHOF: 410 mm
Kerb mass: 1441 kg

AHOF difference is 24 mm

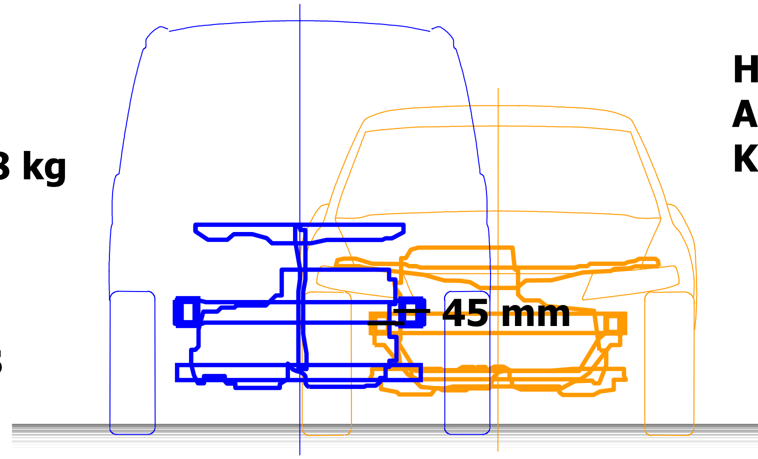


Car-to-MPV - Different AHOF -

Honda Stepwgn
AHOF: 487 mm
Kerb mass: 1528 kg

Honda Accord
AHOF: 410mm
Kerb mass: 1440 kg

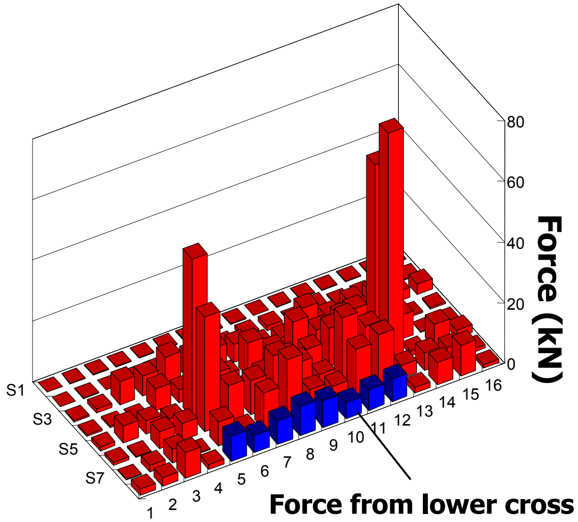
AHOF difference is 77 mm



AHOF can be an effective parameter to predict override/underride in car-to-car crashes.

Full-Width Deformable Barrier Tests

Excite shear deformation like car-to-car crashes

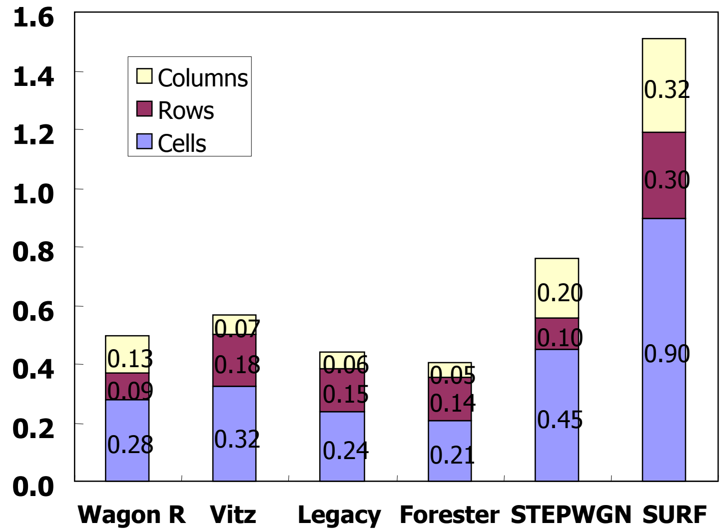


Force from lower cross member or force dispersion by honeycomb?

- Structural forces are seen clearly without engine footprint.
- Forces from lower cross member can be seen?
- Relative homogeneity assessment has been proposed in deformable barrier tests.

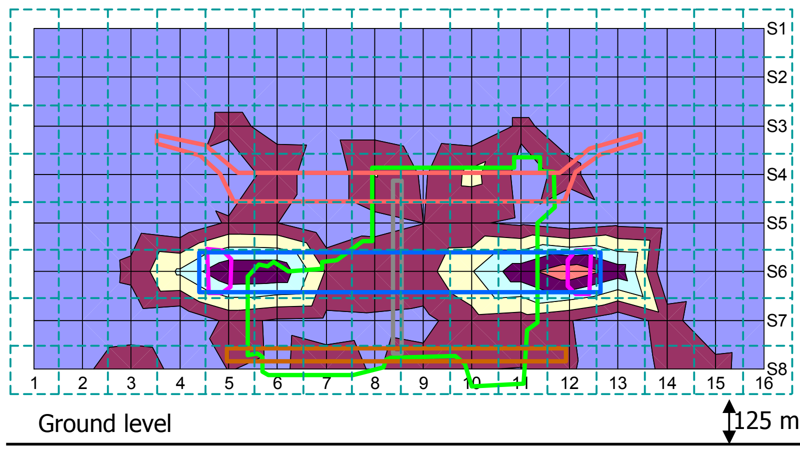
Relative Homogeneity Assessment

Variability of peak load (Individual cells, each row and each column)

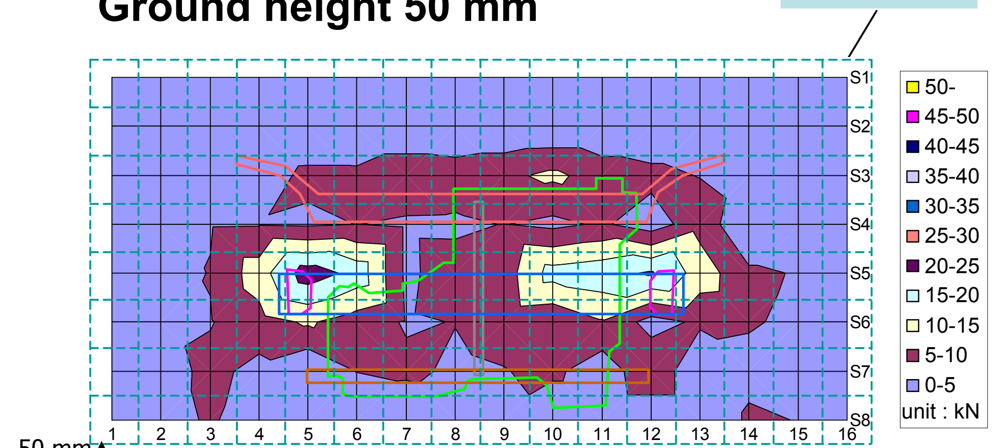


Force Distributions by Load Cell Alignment

Ground height 125 mm

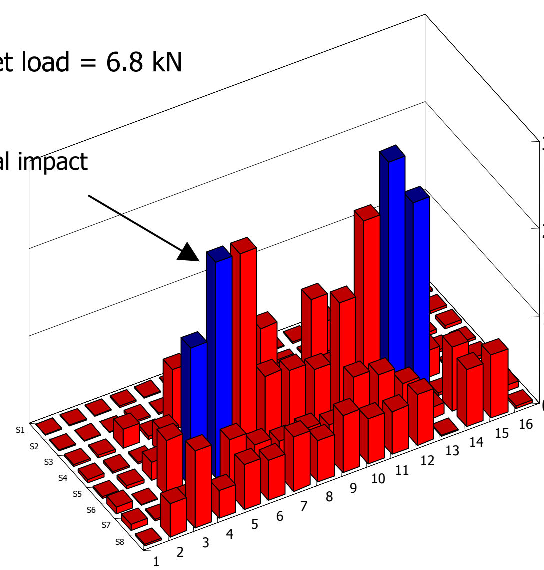


Ground height 50 mm

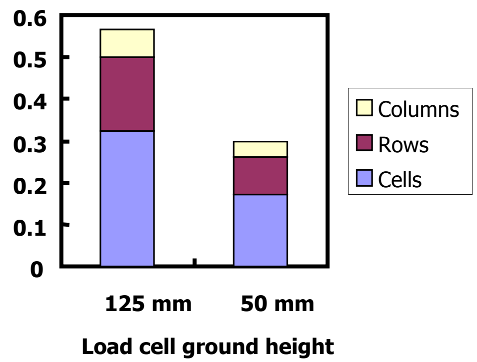


Target load = 6.8 kN

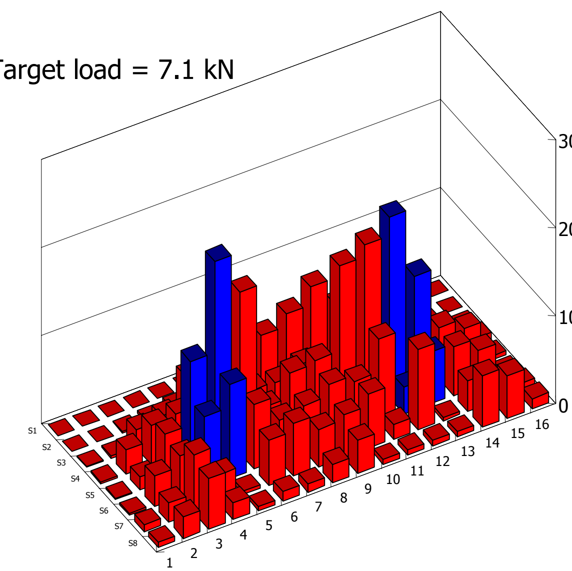
Londitudinal impact load cell



Relative homogeneity assessment

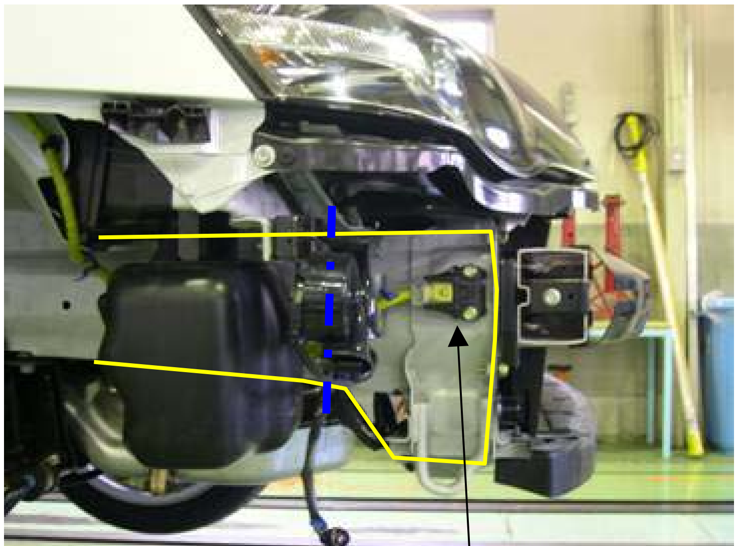


Target load = 7.1 kN

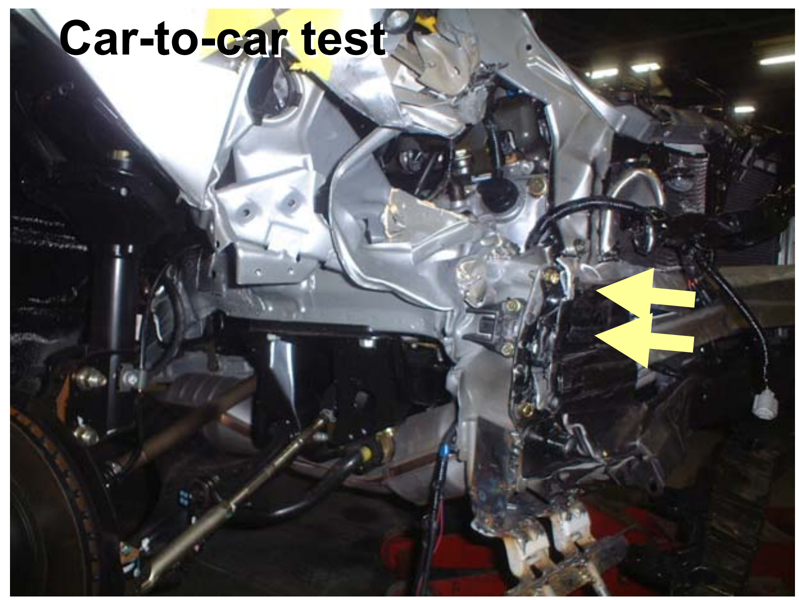


Unrealistic Deformation by Deformable Barrier

Car structures

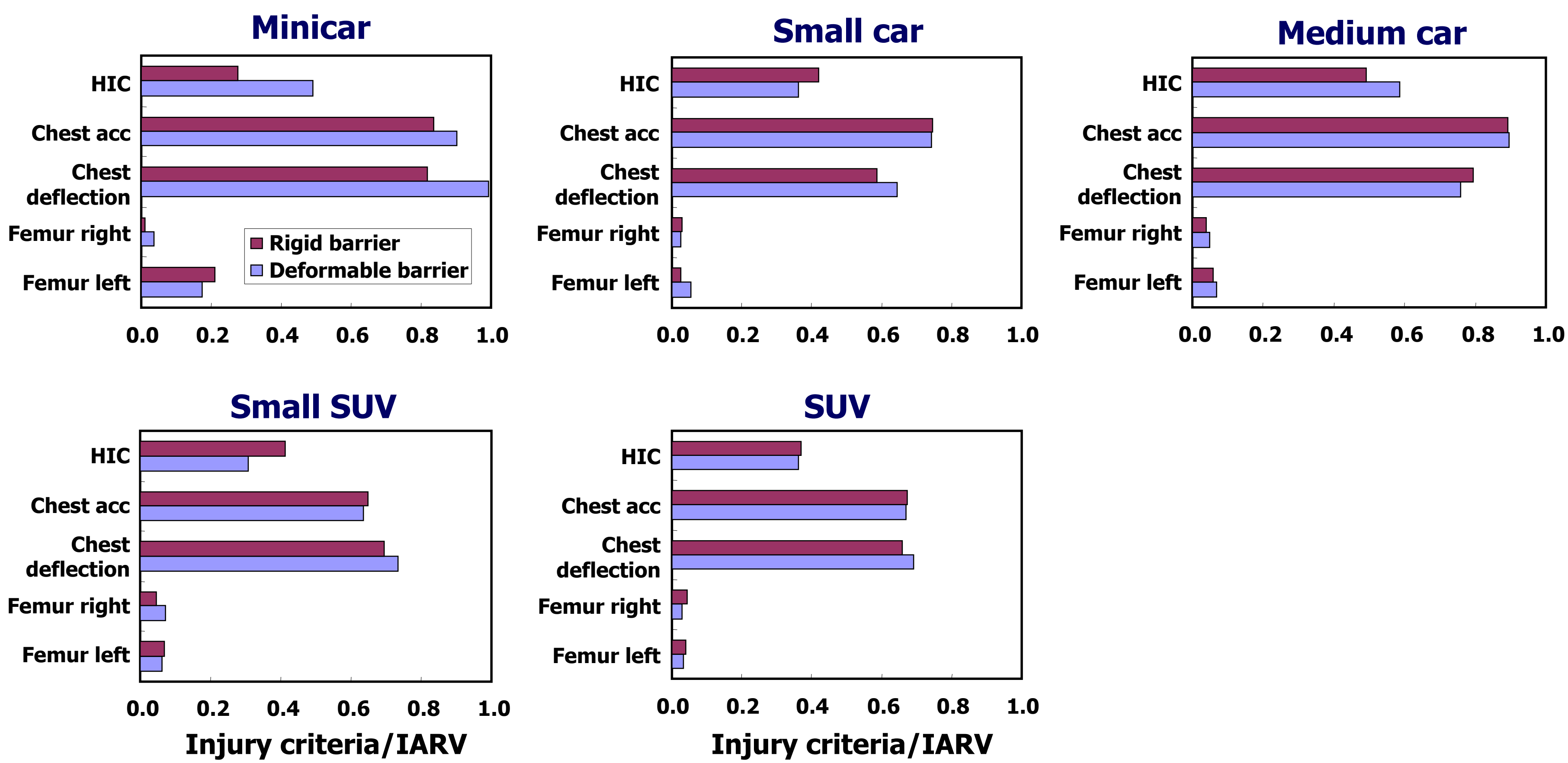


Satellite sensor



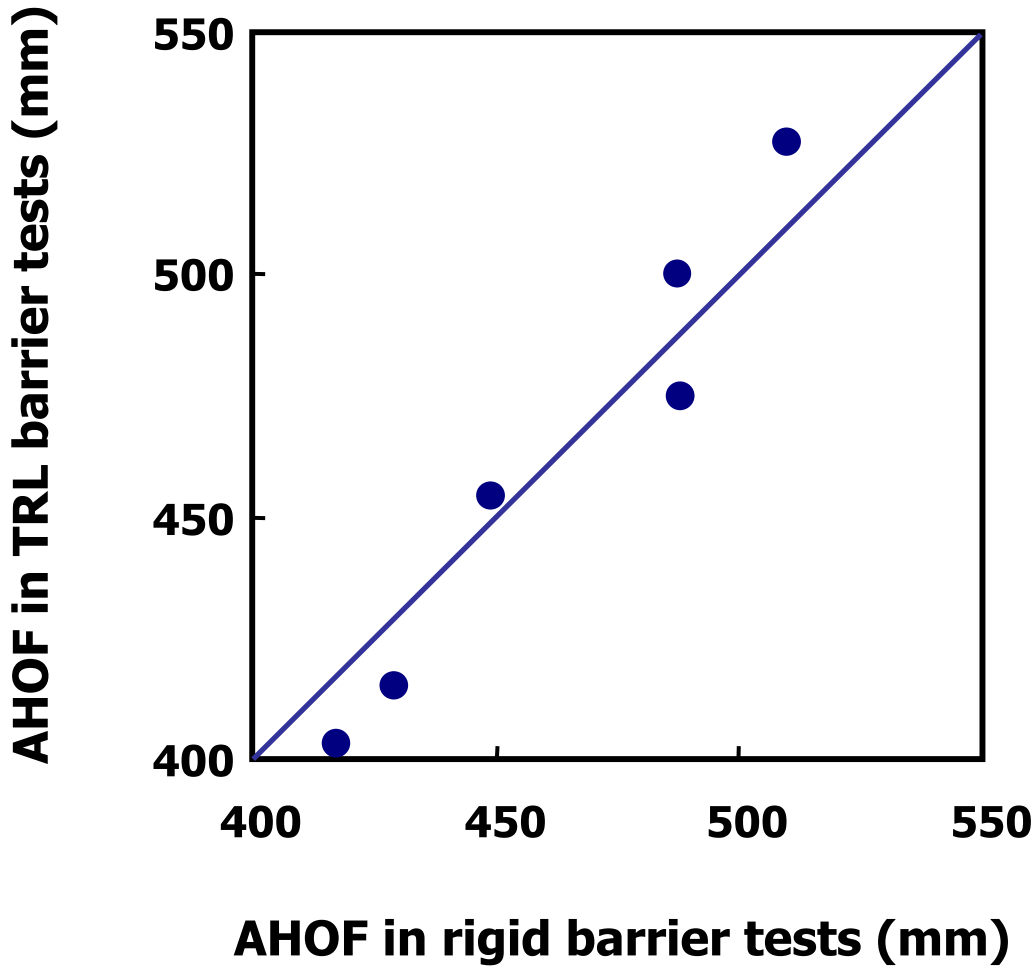
Large cross-section of front-end, which will be useful for structural interaction, can be disadvantageous in full-width deformable barrier tests.

Injury Criteria of Driver Dummy in Full-Width Rigid and Deformable Barrier Tests



- **Injury criteria are comparable between rigid and deformable barrier tests.**
- **Due to crash sensing time differences, injury criteria in deformable barrier tests can be higher than rigid barrier tests, especially for high-acceleration cars.**

AHOF in Full-Width Rigid and Deformable Barrier Tests



Full-Width Deformable Barrier Tests

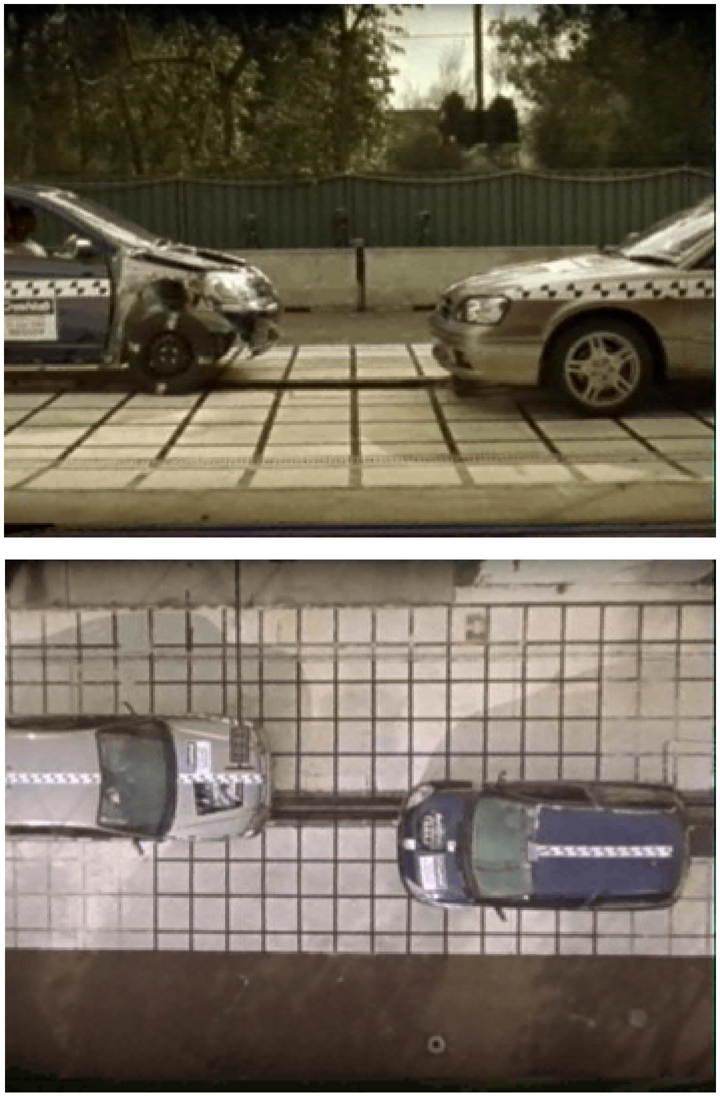
- **Forces from structures can be seen clearly.**
- **It is still not clear if the foot print of cross members can be seen in deformable barrier tests.**
- **AHOF is comparable between rigid and deformable barrier.**
- **Load cell alignments affect force distribution measurements and relative homogeneity assessments.**
- **Unrealistic deformation can occur.**
- **Deformable barrier tests can be used as high deceleration tests for restraint system evaluation.**

Full-Width Tests for Structural Interaction Evaluation

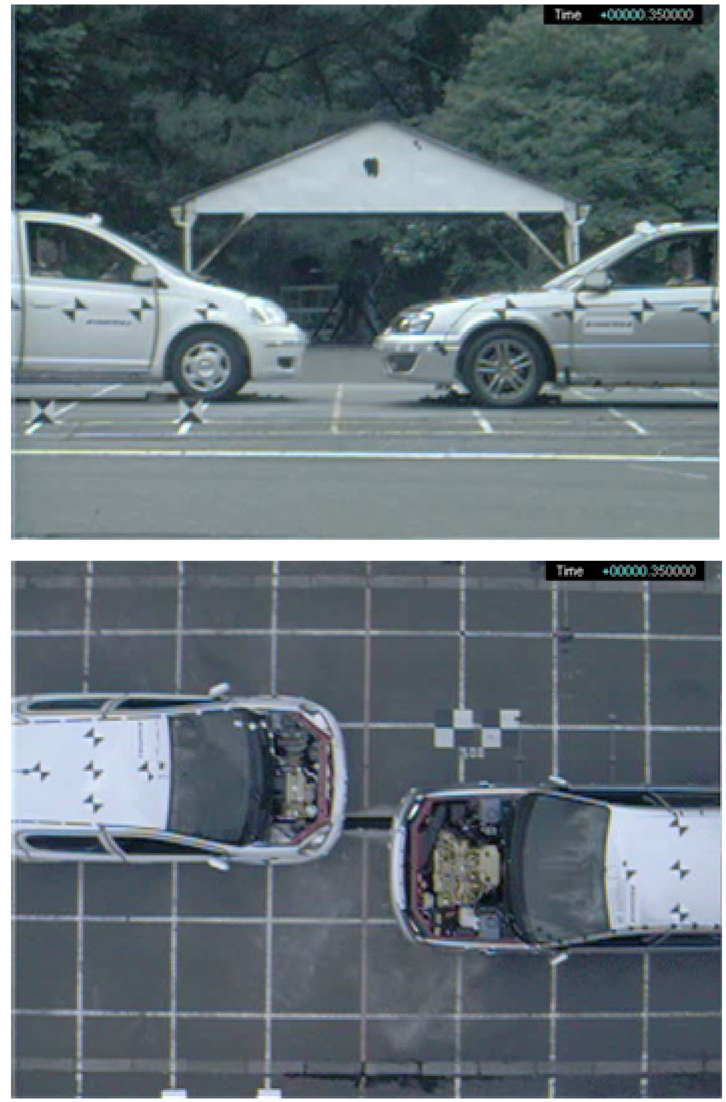
- AHOF is a useful criterion to evaluate underride/override.
- To determine the AHOF, the force distributions measured in either rigid or deformable barrier tests can be used.
- Further research is necessary for deformable barrier and homogeneity assessment criteria.

2. Compartment Strength Effectiveness and its Evaluation

Car-to-Car Tests (50 km/h)



Vitz(Echo) 2001 Australia test



Vitz 2003

Overload Tests (80 km/h)

2002 Vitz

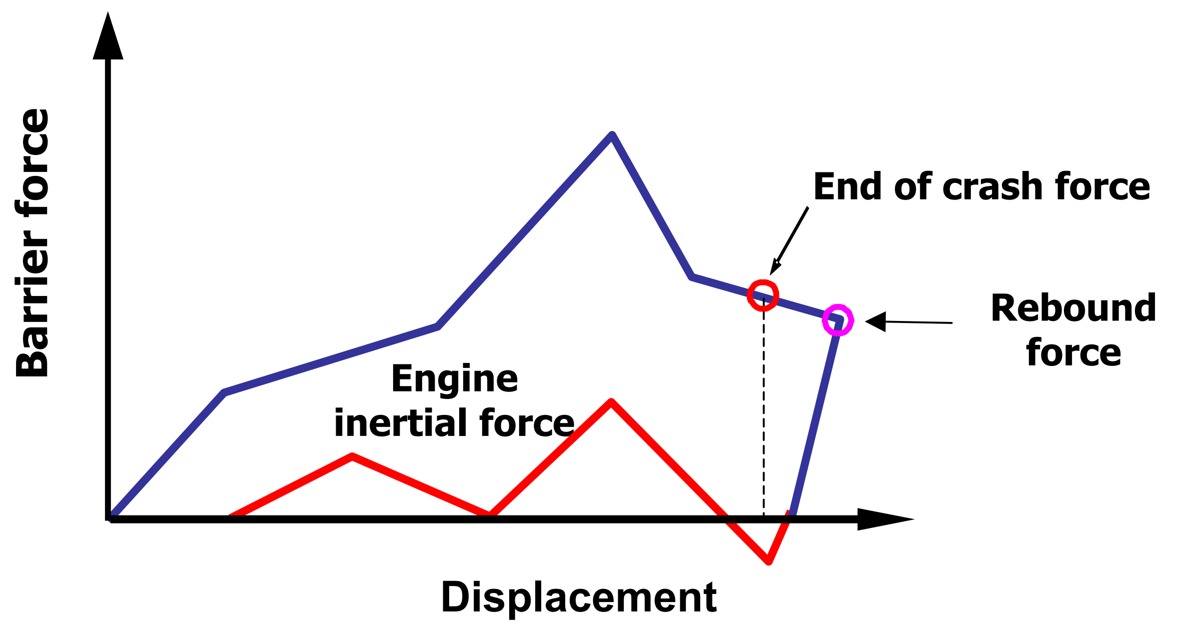
2003 Vitz

Compartment Strength Criteria

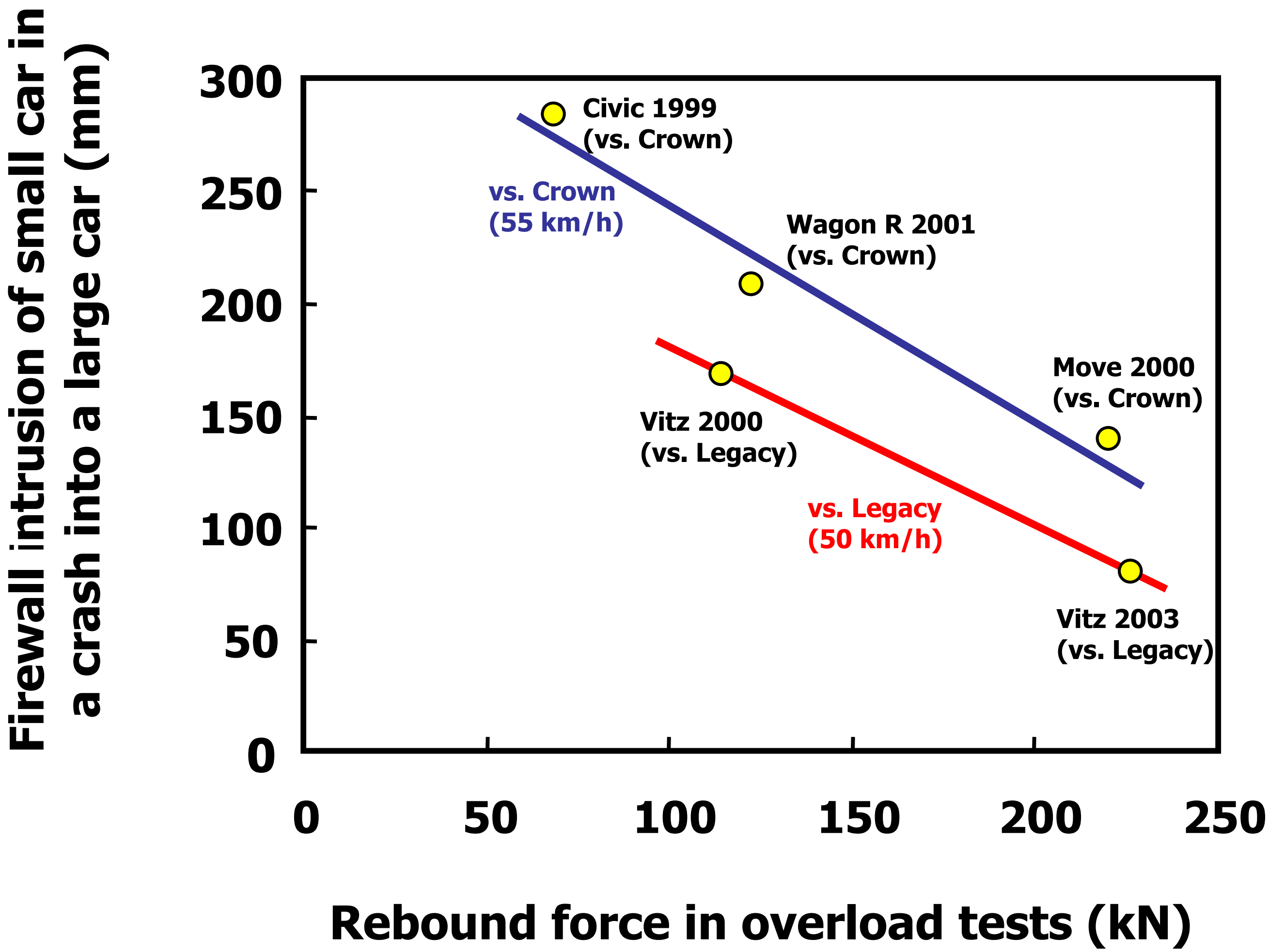
- **Maximum structural force**
- **End of crash force**

  Barrier force at the time when the difference between engine inertia force and barrier force is maximal
- **Rebound force**

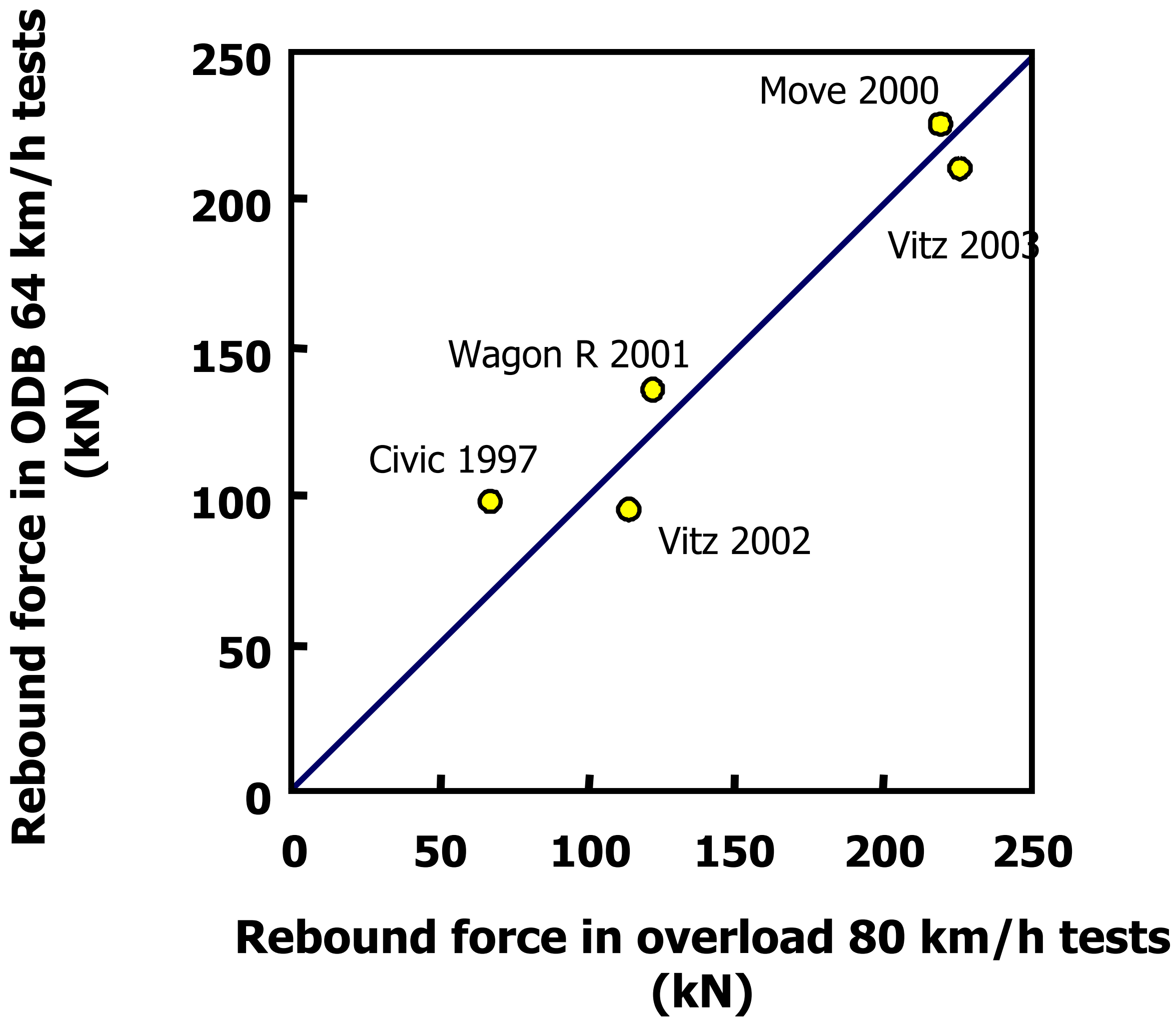
  Barrier force at the time when car starts to rebound



Overload and Car-to-Car Tests



Rebound Force in 80 and 64 km/h Tests



Summary – Compartment Strength

1. It was demonstrated that a strong compartment is effective in improving the self-protection.
2. Overload tests are useful for predicting the compartment strength.
3. Some criteria have been examined to evaluate the compartment strength.
4. Compartment strength may be evaluated in ODB 64 km/h tests.

JMLIT Compatibility Research Report for IHRA Compatibility WG

Test procedures	Key factors	Criteria
Full-width test **(Rigid barrier or deformable barrier)**	• Structural interaction	• AHOF • Initial stiffness • Relative homogeneity assessment
ODB 64 km/h **(Overload 80 km/h?)**	• Compartment strength	• Rebound force?
ODB 64 km/h	• Force matching	• Barrier force?