



Mercedes-Benz



GRSP working group child restraints: Load levels in anchorage system

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Initial situation



Discussion in ECE and US about extension (weight of child) of applicability of universal child restraint anchorage system (ISOFIX + TopTether)

Strength of child restraint anchorage system (ISOFIX + TopTether) defined in regulations:

- ECE R14: Static strength tests with load level of 8 kN
- FMVSS 225: Static strength tests with load level up to 15 kN

Points of investigation:

- Load levels of anchorage system in static and dynamic test
- Possibilities of increasing the permissible weight of child for current anchorage systems

Activities:

- Computer simulation: Comparison of load levels in static and dynamic test conditions
- Dynamic test: Test of current anchorage system with increased weight



Computer simulations: Basics



Comparison of load levels in anchorages system for static and dynamic test

Basis for simulation of static test:

- Static test with ISOFIX/TopTether according to FMVSS 225 (15 kN, forward direction)
- Including of 20% safety margin (tolerances in material and manufacturing process)
- Total load level of 18 kN, applied by D-FAD test device to ISOFIX and TopTether

Basis for simulation of dynamic test:

- Full vehicle crash test according to US-NCAP (56 km/h barrier test with 100% overlap)
- Uploaded 6 year old child (30 kg) in child restraint system (10 kg)
- Load application (total 40 kg) simulated by D-FAD test device

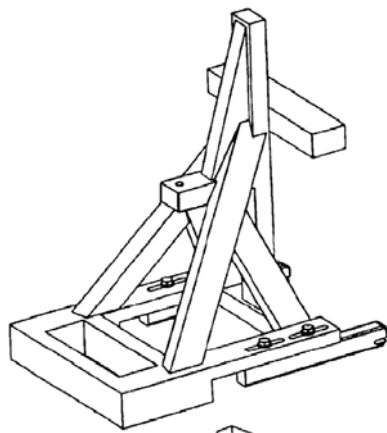


Computer simulations: D-FAD



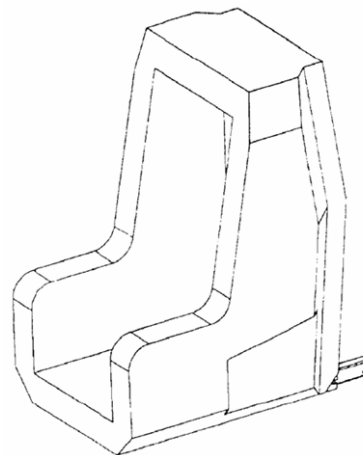
D-FAD (dynamic force application device)

- Geometry according to child restraint fixture (CRF = ISO/F2)
- Lower anchorages according to S-FAD (static force application device)
- Centre of gravity according to load application point of S-FAD
- Weight of D-FAD: 40 kg



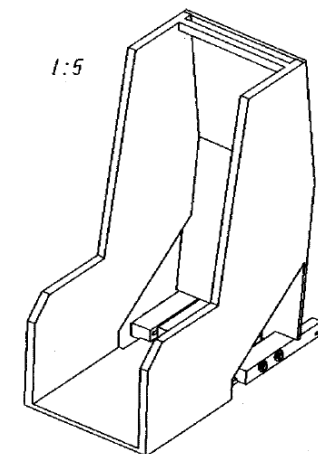
S-FAD
(ECE R14, FMVSS 225)

+



ISO/F2 (ECE R16)
CRF (FMVSS 225)

=



D-FAD
dynamic force application device



Computer simulations: Results



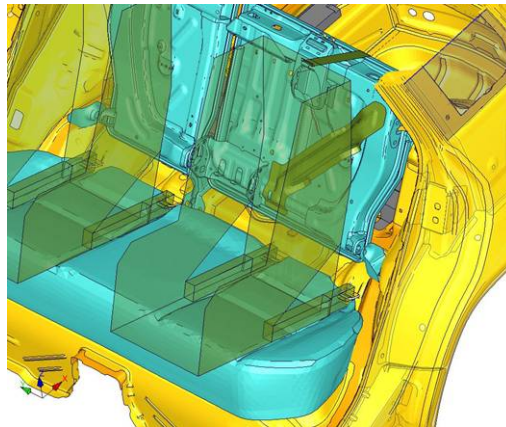
Load levels in (lower) ISOFIX anchorages:

red: static test (18 kN)

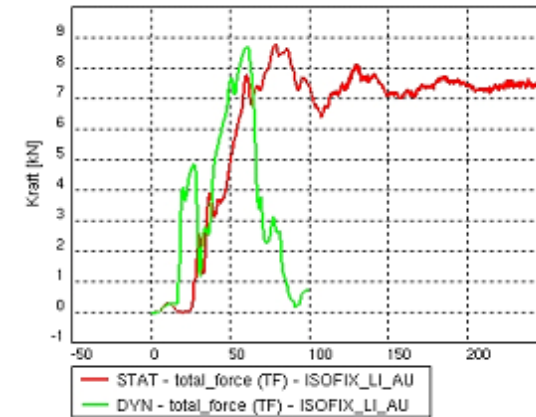
green: dynamic test (US-NCAP, 40 kg)

- Same load level for static and dynamic test
- Load level up to approx. 9 kN per anchorage
- Different load levels for in-/outboard anchorage (caused on vehicle geometry)

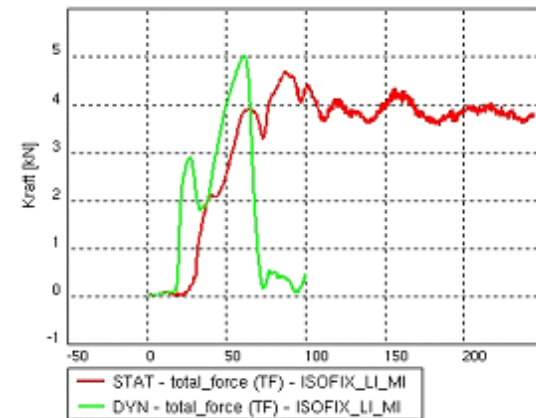
computer model
for simulation



outboard ISOFIX anchorage



inboard ISOFIX anchorage



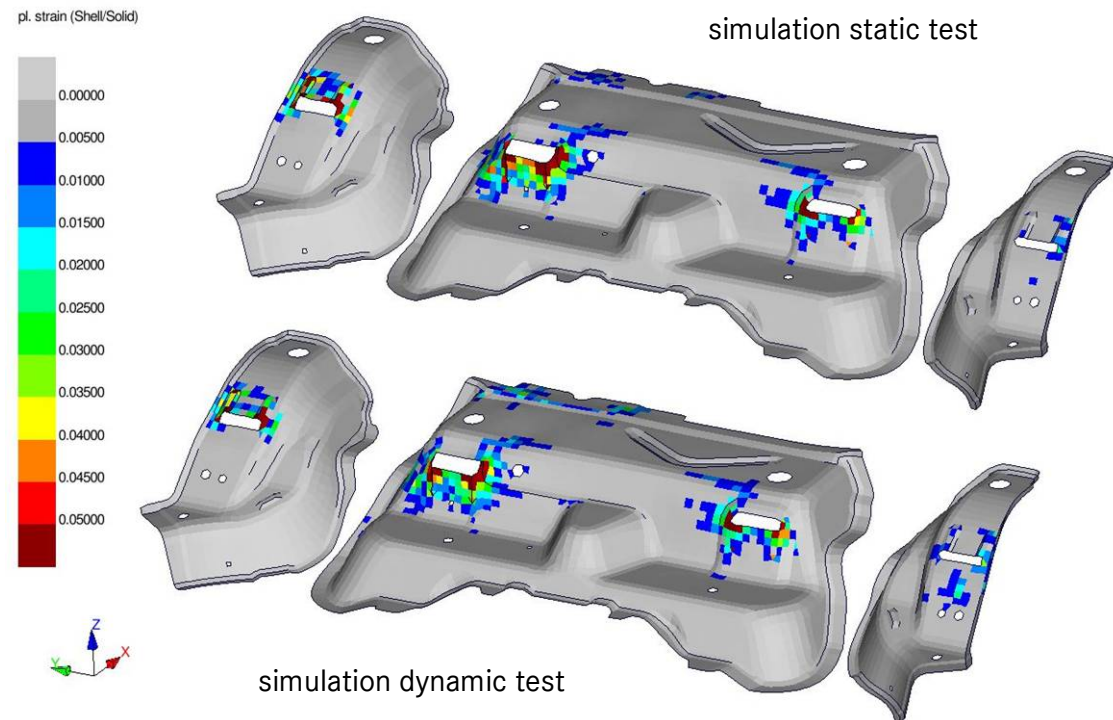


Computer simulations: Results



Plastic deformation of lower anchorages:

- Same level of plastic deformation for static and dynamic test
- Overload in some areas (red) (danger of cracking)





Computer simulations: Results

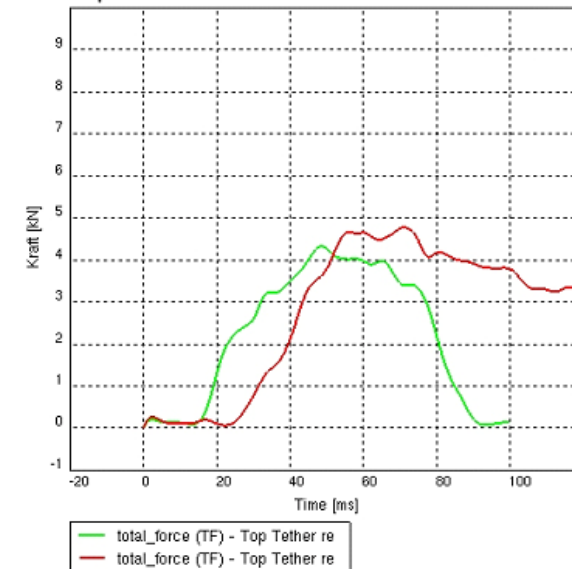
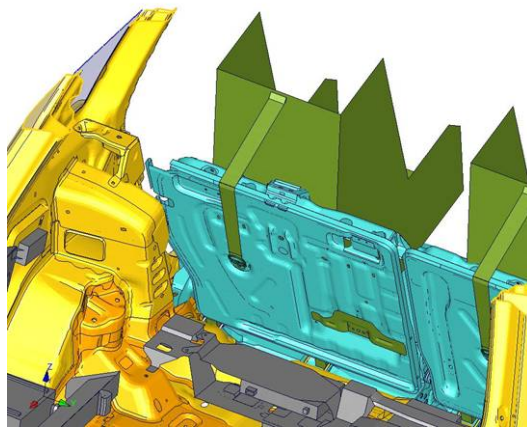


Load levels in (upper) TopTether anchorage:

red: static test (18 kN)

green: dynamic test (US-NCAP, 40 kg)

- Same load level for static and dynamic test
- Load level up to approx. 5 kN per anchorage



load levels TopTether anchorage



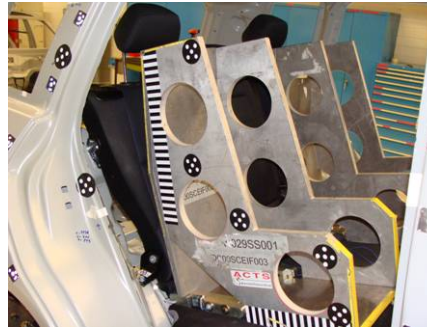
Dynamic sled test: Results

Dynamic sled test:

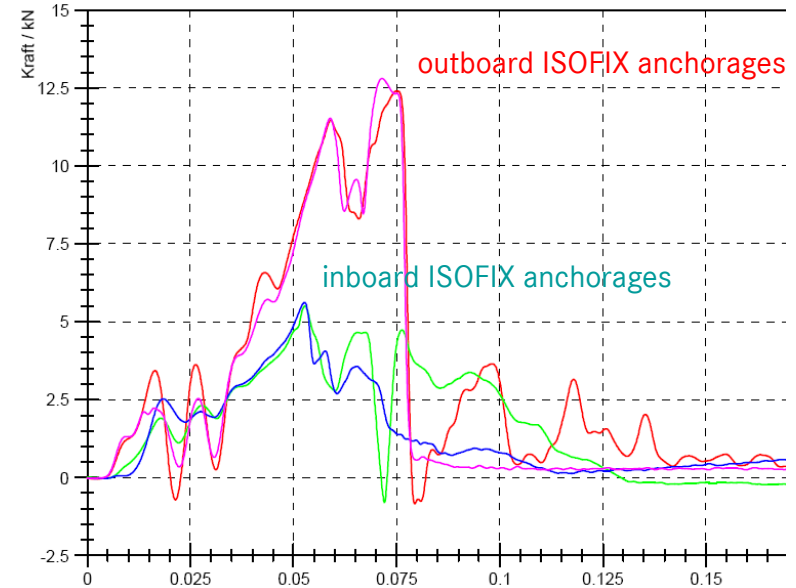
- Deceleration curve from US-NCAP crash test
- Vehicle body with two D-FADs, each 40 kg, attached with ISOFIX / TopTether

Results:

- Load levels in anchorages are corresponding with results from computer simulation
- Partly tearing of some anchorages



sled test configuration
with two D-FADs
(40 kg) in vehicle body





Conclusions:



With the current static strength requirements of FMVSS225 it is not possible to extend the applicability of the universal child restraint anchorage system (ISOFIX + TopTether) up to an age limit of 6 years (30 kg child and 10 kg child restraint weight)

With consideration of the lower static strength requirements of the ECE R14 in comparison to the FMVSS 225, it is not possible to extend the applicability of the ISOFIX system in Europe.

Proposal to reach more flexibility in the application of ISOFIX child restraints:

- Definition of a „total system weight“ (child + child restraint)
- Permissible weight of the child is then depending on child restraint weight (light child restraint could be occupied with heavy child and heavy child restraint only could be occupied with smaller child) (concept similar to payload of vehicle)