Nya bältesgeometrier i baksätet – sett ur ett komfort, användning och säkerhetsperspektiv

New belt geometries in rear seat - from a comfort, handling and safety perspective

Dnr 2010 02846

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Project

- Partners
  - Volvo Cars
  - Chalmers
  - Autoliv Research

- 2011-2014
Sitting positions and shoulder belt position

- Normal driving – voluntarily position
  - Activity, comfort/discomfort, possibility to move
- Critical events / maneuvers – involuntarily positions
  - Vehicle movement

Background
– Pre-crash maneuvers are common

- 60% of drivers performed a pre-crash maneuver
  - (braking/steering) prior crash (Japanese data, IRTARDA)

- 49% of all frontal crashes had a pre-braking of 4 m/s²
  - (German data, GIDAS)

- 24% of all crashes were multiple crashes → increased risk of injury
  - (German data, GIDAS)

- 66% of the head injuries in frontal collision for belted children (4-12 years) is caused by impact to the interior due to slipping out of the seat belt (pre-crash maneuvers contributing factor) (US data)

Bohman, Katarina, Arbogast, Kristy B. and Boström, Ola(2011) 'Head Injury Causation Scenarios for Belted, Rear-Seated Children in Frontal Impacts', Traffic Injury Prevention, 12: 1, 62 — 70
Pre-crash maneuvers – future outlook

• Pre-braking more common
  • Increasing amount of autonomous braking will add to the current manual braking

• Steering maneuvers more common
  • Increasing amount of autonomous steering will add to the current manual steering maneuvers

• Autonomous maneuvers likely to occur earlier than manual maneuvers and to a greater extent (braking harder, more evasive steering maneuver)
Differences between front/ rear seat occupants

• Rear seat occupants are not as aware of what is happening on the road as compared to the driver

• Less lateral support in the rear seat compared to front seats

• Short children cannot support themselves with feet to the floor

• Younger children (<7 years) have less movement control and experience than older children => Less compensation for movement during maneuver

Aim

- Keeping the rear seat occupant in position for optimal protection in crash, including pre-crash maneuvers

- 4-point Seat Belt / Extra belt (2011-2012)

- Seat Belt with Electrical Pre-Pretensioner; ERR (2013-2014)
Extra belt in the rear seat

Criss cross & rucksack
Method

- Belt geometry cliniques
  - 48+32 participants
- Handling study
  - Observational study in the lab with 21 participants (5-60y)
- Attitude study
  - 5 focus groups - 29 participants (8-61y)
- Guessability/Handling study – focus rucksack
  - Observational study at the parking lot of a food store with 100 participants (4-85y)
- Comfort study
  - Driving study: 1h/concept with 32 participants (6-79y)
  - Driving study: 3h/concept with 11 participants (9-55y)
- Handling study – focus rucksack
  - Observational study at different occasions with 179 participants

- In total; 452 test persons participated
### 4-point seat belt/ Extra belt – Attitude, handling & Comfort

<table>
<thead>
<tr>
<th>Crisscross</th>
<th>Backpack</th>
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<tbody>
<tr>
<td>• Symmetry</td>
<td>• No symmetry</td>
</tr>
<tr>
<td>Percived Safety &amp; comfort</td>
<td>Not trapped &amp; comfort</td>
</tr>
<tr>
<td>Trapped &amp; discomfort</td>
<td>Strange &amp; discomfort</td>
</tr>
<tr>
<td>• No misuse</td>
<td>• 35% misuse for first time user</td>
</tr>
<tr>
<td>• Expensive</td>
<td>• Cheap</td>
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</tbody>
</table>

- The test subject chose the system resulting in less discomfort
- 56% prefer CrissCross before Backpack
Pre-pretensioner

- Pretensioner
  - Pyrotechnical
  - One-time (in crash)
  - Fast
  - High force

- Pre-pretensioner
  - Electrical motor
  - Reversible (prior crash)
  - Slow
  - Low force

ASSISTANCE
- Night Driving Assist
- Cross-traffic assist
- Adaptive cruise control
- Queue assist
- Traction Control

WARNING & EMERGENCY
- Pedestrian warning
- Lane departure warning
- Collision warning
- Blind spot warning
- Crash mitigation by braking
- Crash avoidance
- Stability control
- Active bumpers

PRE-CRASH
- Early sensing
- Active seatbelts
- Active structures
- Active knee bolster
- Pre-crash airbags

IN-CRASH
- Pedestrian Protection
- Seatbelts
- Airbags
- Anti-whiplash
- Battery cut-off switch

POST-CRASH
- Black-box Function (Event data recorder)
Method

- "run-off road" maneuvers in robot rig
- Steering maneuvers
- Static test with iPhone position
- 1g braking with optimal position, iPhone position, leaning sideways
- 1g braking => crash tests
- "run-off road" position (result from robot test) => crash tests
- "Run-off road" tests with complete vehicle
Method "Run-off road" method

Vehicle dynamics and robot indata "run off-road into ditch"

Source: Method described in Jakobsson et al. ESV 2015.

Robot simulation with "run-off road" pulse
"run-off road" pulse in a robocoaster
- 6 year old (Q6) and 50th male (THOR)

- No pre-pretensioner
- Pre-pretensioner 100 N
Steering maneuver:
6 year old (Q6) and small female (HIII5th)

Before  No PP  PP 170N  PP 300N
"Iphone" positions

Source: Osvalder et al. 2011
Results – static iphone position with Q6, HIII5th & HIII50th

<table>
<thead>
<tr>
<th></th>
<th>Q6</th>
<th>HIII5th</th>
<th>HIII50th</th>
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</thead>
<tbody>
<tr>
<td>Before</td>
<td></td>
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<tr>
<td>After PP activation</td>
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Conclusions – pre pretensioner

- Maintain the occupant in a "good" position by early shoulder belt engagement with occupant shoulder

- Reposition/ partly reposition (winch) the occupant from a forward leaning position
Overall Conclusions

➢ Valuable knowledge of new countermeasures to address pre-crash scenarios

➢ Method development
  ➢ Attitude, comfort and handling
  ➢ Pre-crash maneuvers