

Submitted by the expert from Finland

Informal document GRSP-71-07  
71th GRSP, 9-13 May 2022  
Agenda item 5



# Three-point safety- belts in buses and coaches

# Background

- ▶ Finland has raised a concern about the safety of passengers in buses and coaches due to requirements of the seat back and lack of three-point safety-belts. (GRSP-66-07 and GRSP-66-08)
- ▶ Concerns were based on investigations and safety recommendations of the Finnish Safety Investigation Authority
- ▶ On 68<sup>th</sup> meeting, GRSP agreed to resume consideration (on the basis of accident data) of a proposal from the expert from Finland on the possibility to require three-point safety-belts in M2 and M3 categories of vehicles
- ▶ On 70<sup>th</sup> meeting, Finland presented accident data from publications and a cost and impact analysis of three-point belts. The concerns about negative aspects of three point safety-belts caused during impact and evacuation were raised in the last session of GRSP

# Gueler & al. (2009) Effectiveness of seat belt usage on the rollover crashworthiness of an intercity coach

Proceedings of the 21st (ESV) International Technical Conference on the Enhanced Safety of Vehicles, Stuttgart, Germany.

- ▶ This study was discussed in last session of GRSP. A finding shown in the conclusions of the study was that three-point belt usage increased the neck forces during a rollover.
- ▶ Looking the study more closely, the neck forces increased with three dummies and decreased with three dummies. See table below:

Dummy	Head Injury Criteria, HIC			Neck force		
	Lap belt	3p-belt	Difference	Lap belt	3p-belt	Difference
M1	308 @ 0.230 s	290 @ 0.220 s		-18 1400 @ 0.280 s	1400 @ 0.270 s	0
M2	160 @ 0.210 s	160 @ 0.210 s		0 1600 @ 0.270 s	1600 @ 0.280 s	0
M3	175 @ 0.120 s	175 @ 0.120 s		0 1950 @ 0.215 s	2300 @ 0.210 s	350
M4	255 @ 0.110 s	750 @ 0.125 s		495 2840 @ 0.100 s	3400 @ 0.100 s	560
M5	295 @ 0.230 s	205 @ 0.225 s		-90 1450 @ 0.280 s	1050 @ 0.192 s	-400
M6	155 @ 0.210 s	155 @ 0.216 s		0 1570 @ 0.270 s	970 @ 0.200 s	-600
M7	640 @ 0.185 s	225 @ 0.200 s		-415 2700 @ 0.245 s	1750 @ 0.185 s	-950
M8	1130 @ 0.105 s	345 @ 0.112 s		-785 1210 @ 0.135 s	2450 @ 0.112 s	1240

- ▶ In that context, "wearing the three-point belt generally increases the neck forces during a rollover accident" seems quite strong impression.

# Sayed et al. (2019) Experimental assessment of vehicle performance and injury risk for cutaway buses using tilt table and modified dolly rollover tests.

Accident Analysis & Prevention, Volume 132, November 2019.

- ▶ Tilt table test and rollover test for minibus; passenger dummies using lap belt and three-point belt
- ▶ Study purpose: compare these two test methods
  - ▶ Tilt table test is good for the assessment of vehicle structural strength. Modified dolly rollover (MDR) test is more realistic for studying passenger injuries. Risk of injuries much higher in MDR test.
- ▶ Interesting results on seat belts:
  - ▶ Passenger dummy with lap belt had higher risk of injuries for its head, neck, and chest in both tests.
  - ▶ MDR test indicated that the 3-point seatbelt can reduce the risk of the head injuries by 80% compared to lap belt. Dummy with lap belt was partially ejected through broken window in MDR test.

# The Norwegian Safety Investigation Authority (NSIA) observations

- ▶ Finnish Transport and Communications Agency Traficom contacted The Norwegian Safety Investigation Authority (NSIA) about impacts of three-point belts.
- ▶ Based on studies of 22 bus accidents in 2005-2019, discoveries are related to lack of seat-belts, low seat belt wearing rate and insufficient safety of lap belts.
- ▶ In one accident which investigated by NSIA, a passenger was killed due to head injuries and the passenger would probably have been saved with three-point safety belts.
- ▶ NSIA have not observed neck injuries nor negative effects of evacuation which are related to the three-point belts.

# Proposal for the way forward

- ▶ Based on the discussions, Finland will consider drafting a working document for the 72<sup>st</sup> session of GRSP to remove the lap belt derogations from the UN Regulations 16 and 14 by adding new series of amendments with transitional provisions.

Thank you

