



The Russian Federation
Nizhny Novgorod State Technical University named after R.Y. Alekseev
Transport Systems Institute

Estimation of Steerability and Cornering Stability of Light Commercial Vehicles by Results of Road Tests and Simulation

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NNSTU – the best traditions of Russian engineering

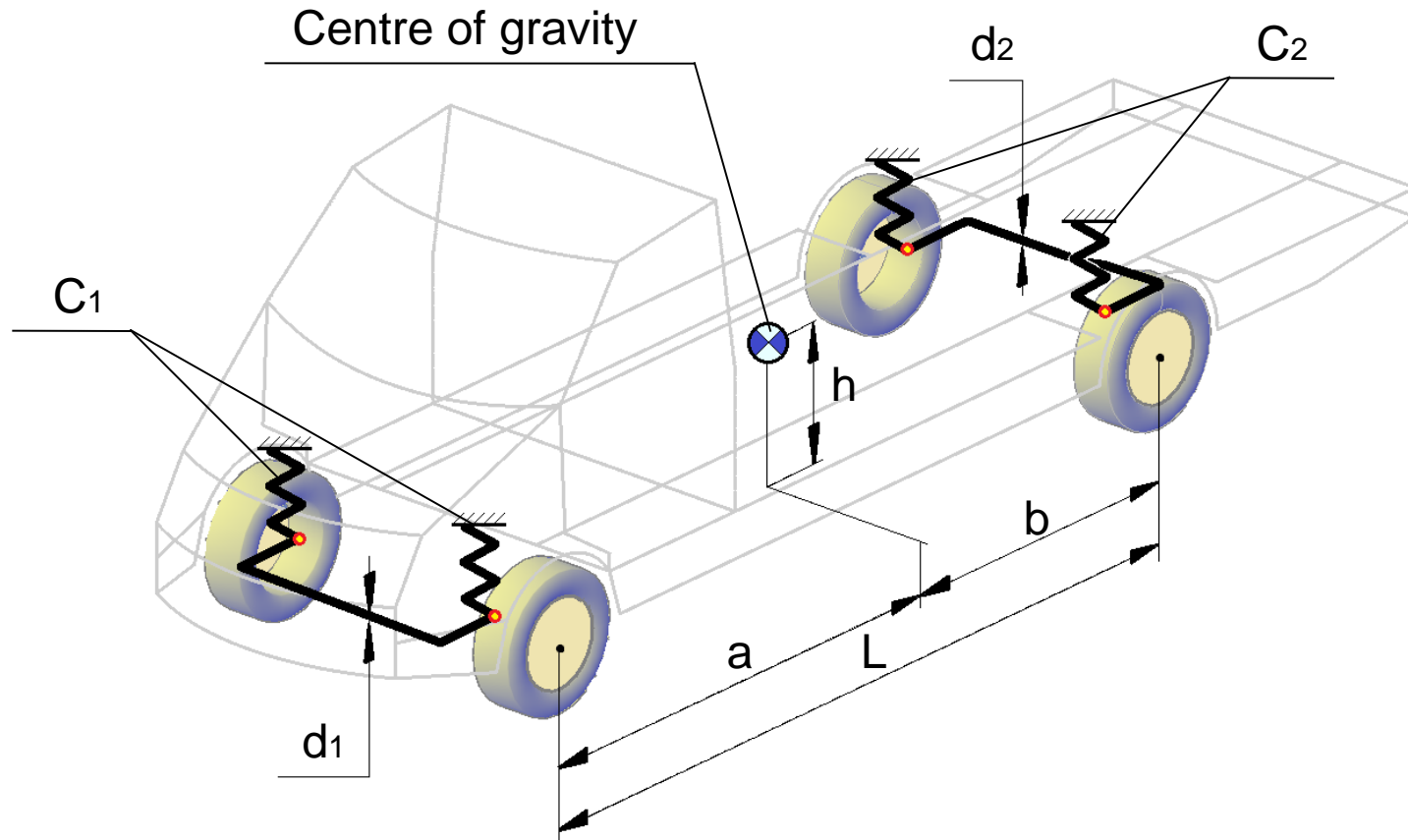


GAZ – Russian producer of LCVs



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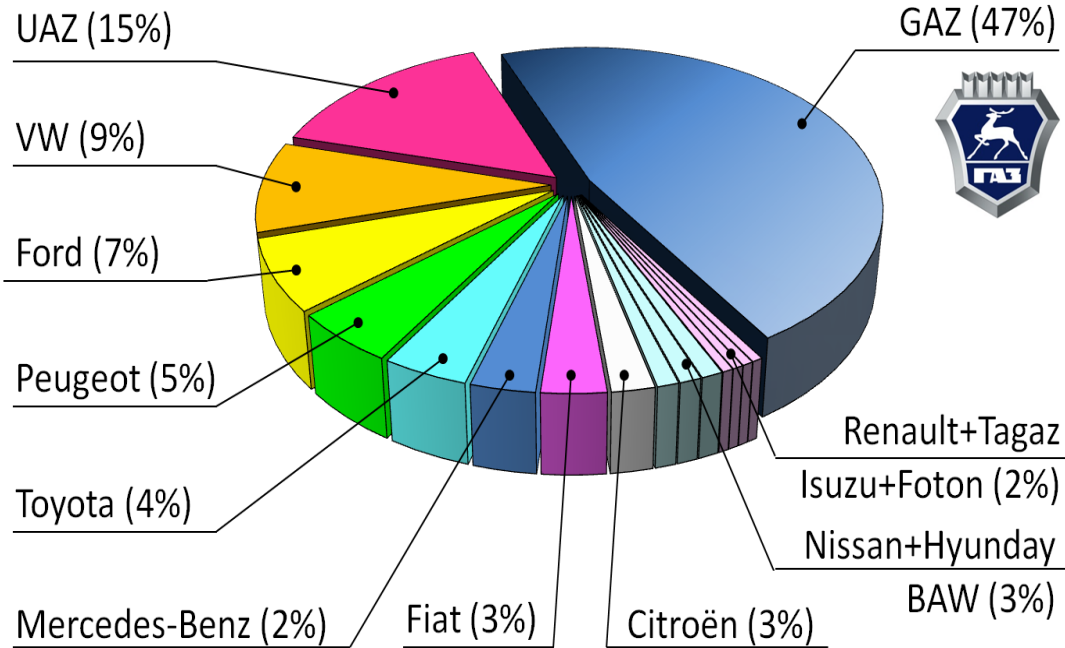
Parameters which affect steerability and stability



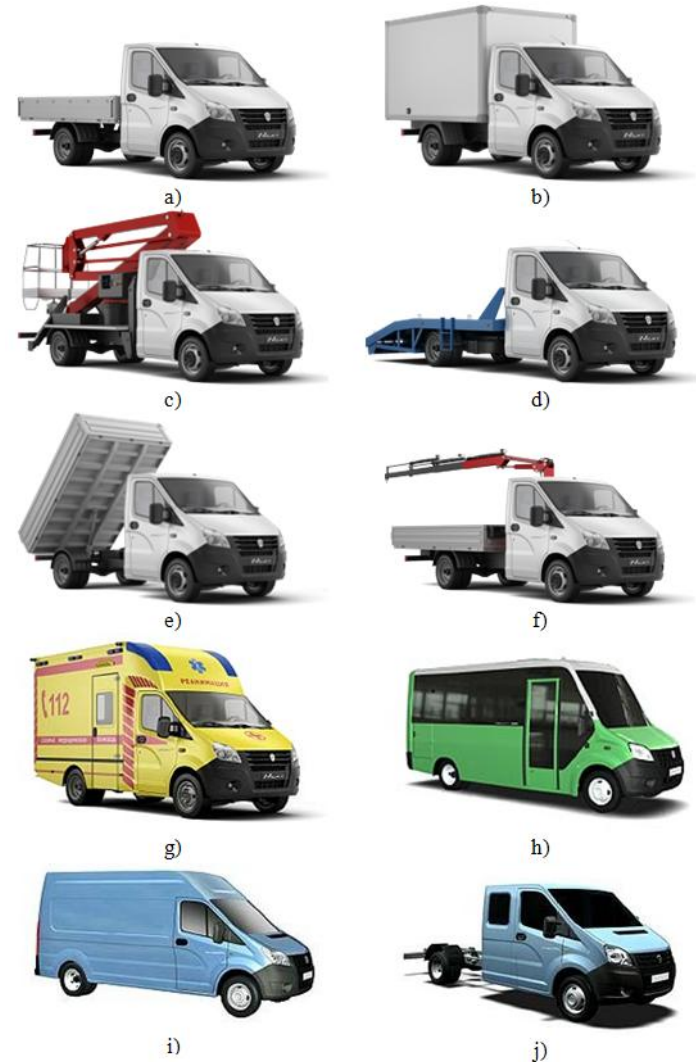
C₁ and C₂ – stiffness of spring elements of rear and front suspensions
d₁ and d₂ – diameters of antiroll bars of front and rear suspensions

LCV market in Russia

Variety of LCV basic modifications



The Russian LCV Market



Tested LCV Preparation for experimental research



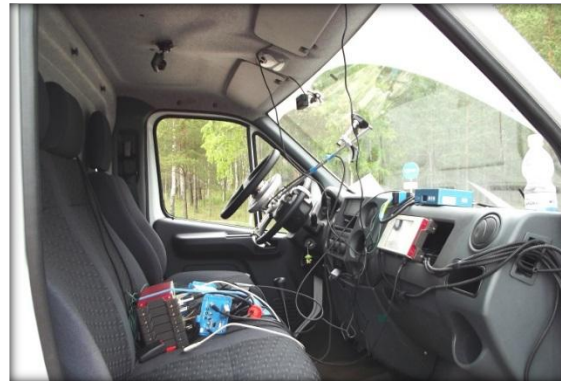
GAZ A21R22 NEXT



LCV ballasting

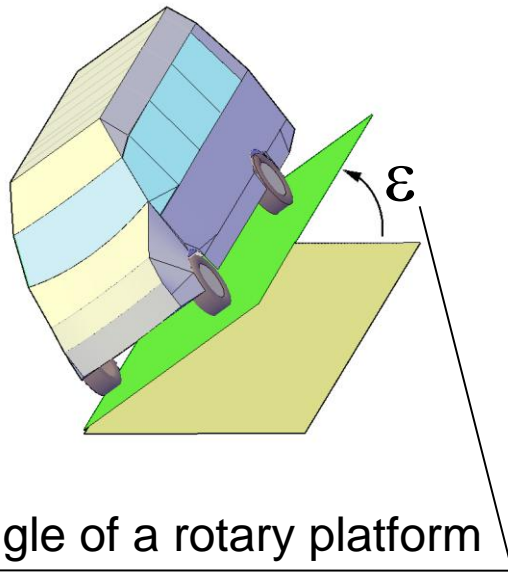


LCV weighing



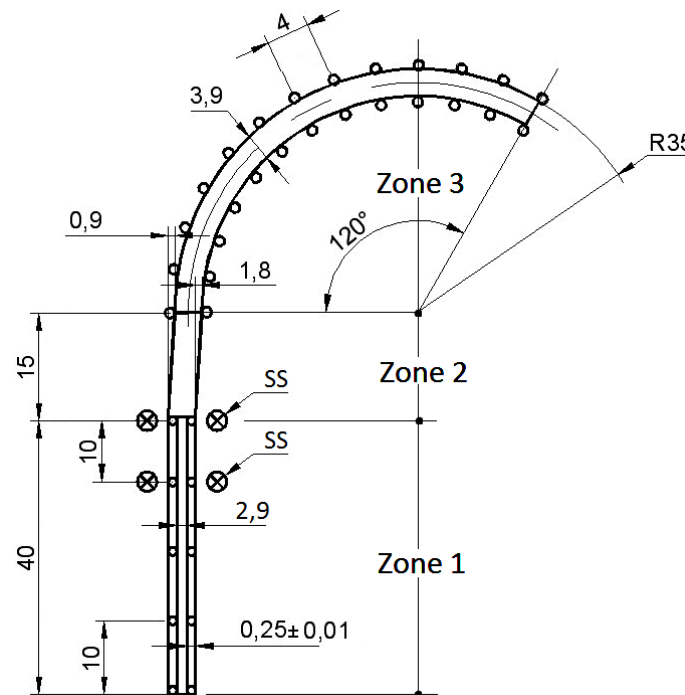
Test equipment installation

Static rollover test

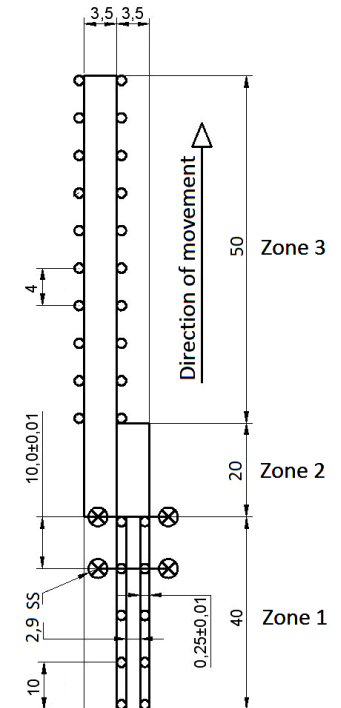


Dynamical road tests

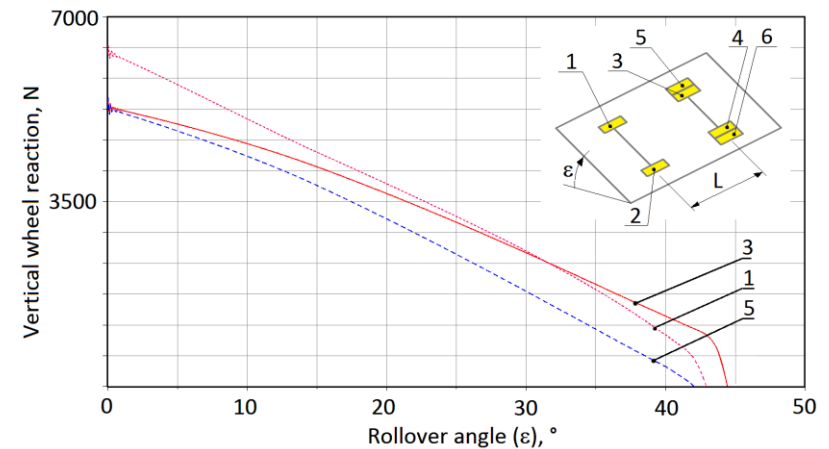
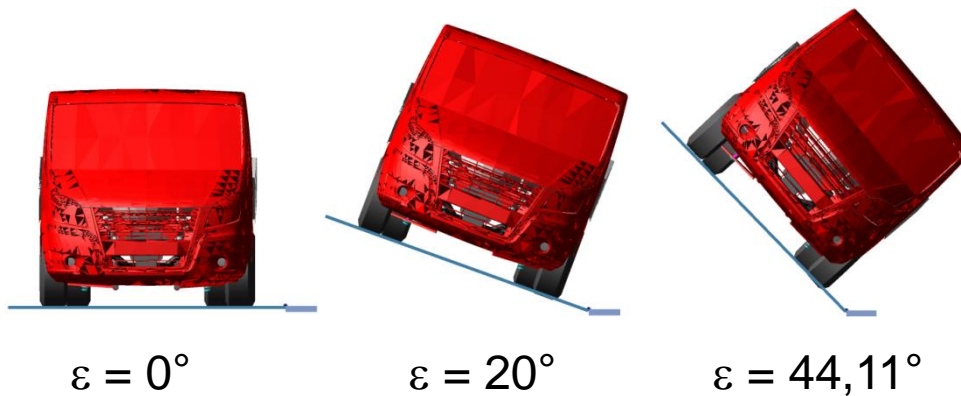
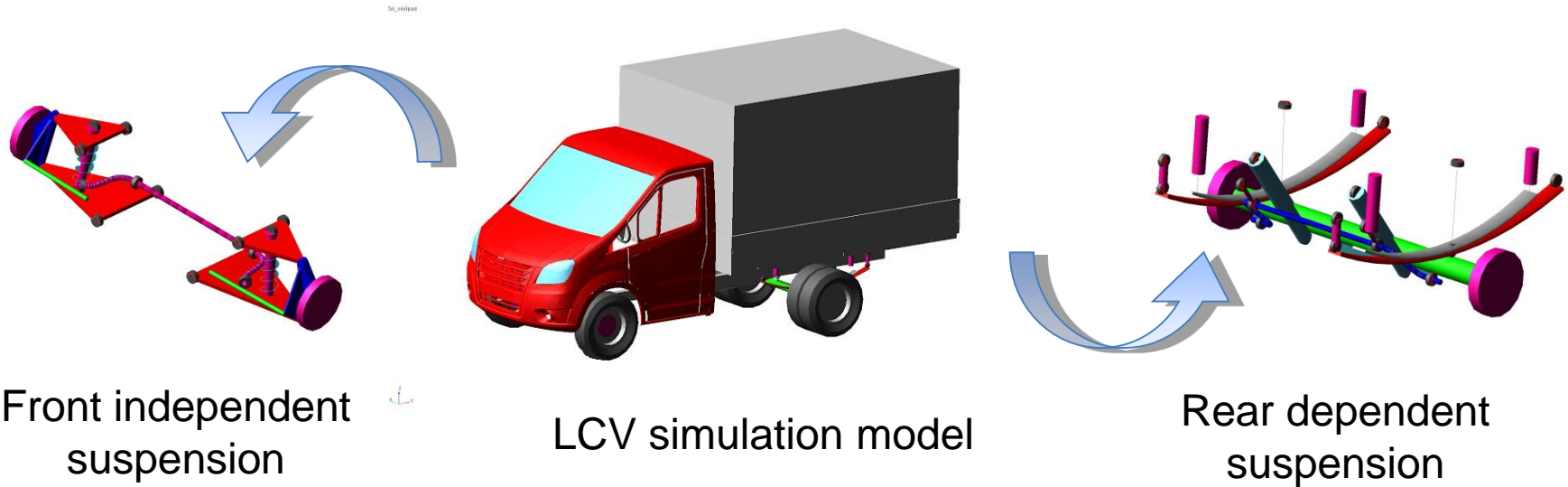
“Going into the corner” test



“Lane-changing” test



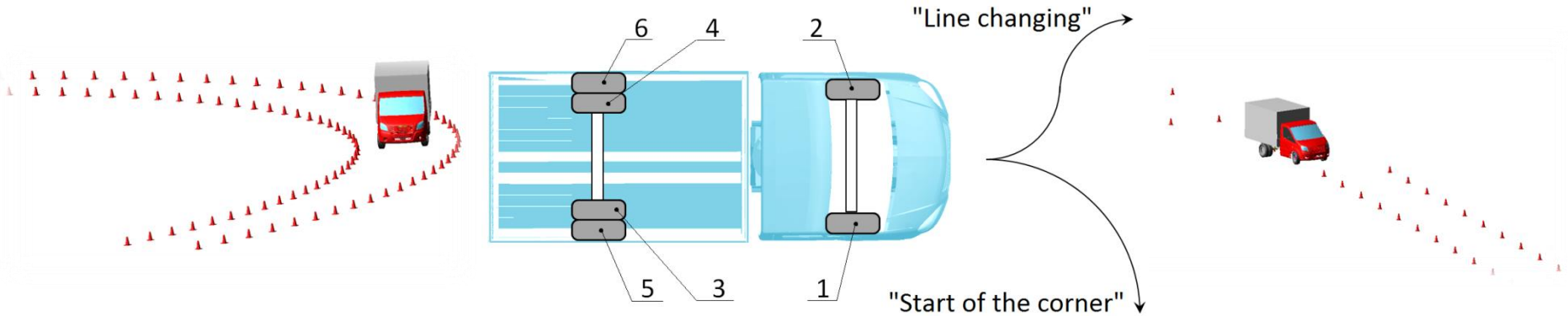
All dimensions in meters. SS – speed sensors



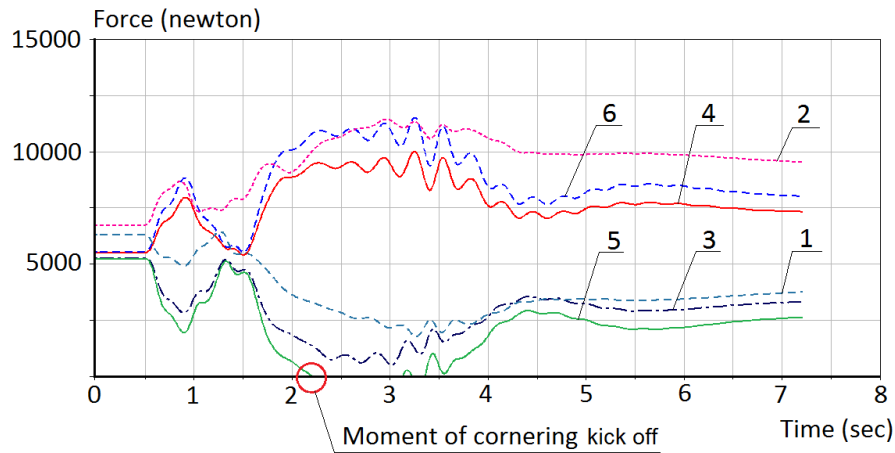
- Total permissible mass, front and rear antiroll bars
- Total permissible mass, front antiroll bar
- Total permissible mass, without antiroll bars

Total permissible mass			
ε – the angle of a rotary platform at the moment of kick off of both outer wheels			
Configuration	Rollover test, degrees	Simulation, degrees	Discrepancy, %
2 antiroll bars	38,83	40,042	3,07
Front antiroll bar	39,483	40,4	2,30
Without antiroll bars	40,85	42,11	3,04
λ = the roll angle of a vehicle spring mass - the angle of a rotary platform			
2 antiroll bars	6,23	5,89	5,61
Front antiroll bar	6,85	6,56	4,33
Without antiroll bars	6,75	6,4	5,32

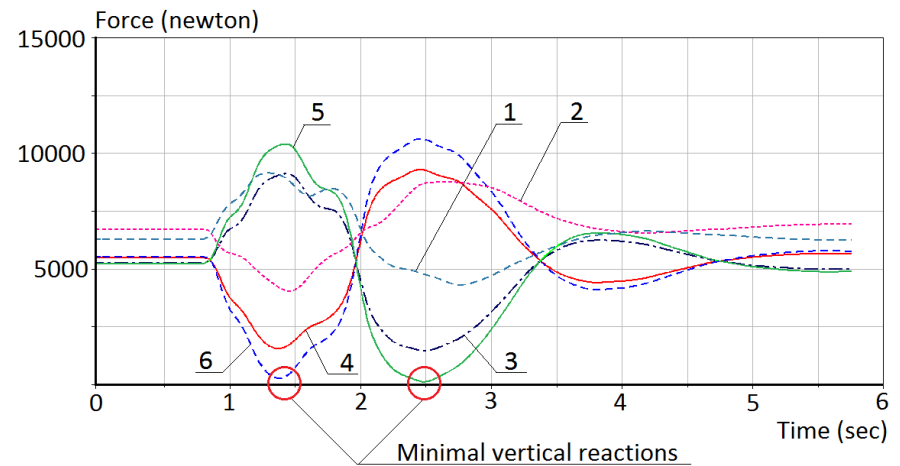
Simulation Analysis of dynamic stability

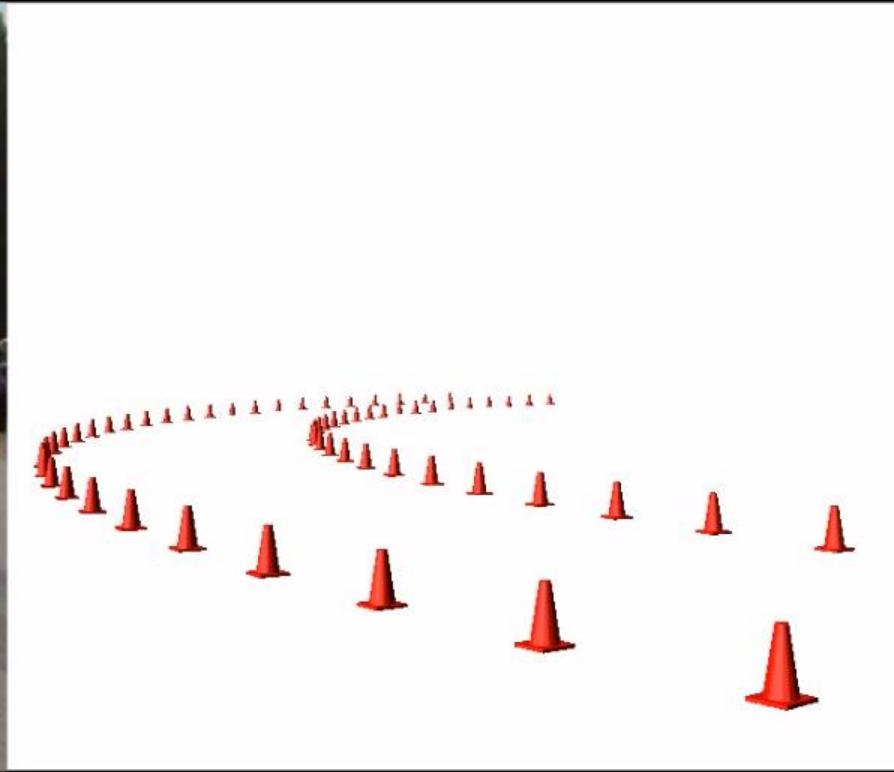


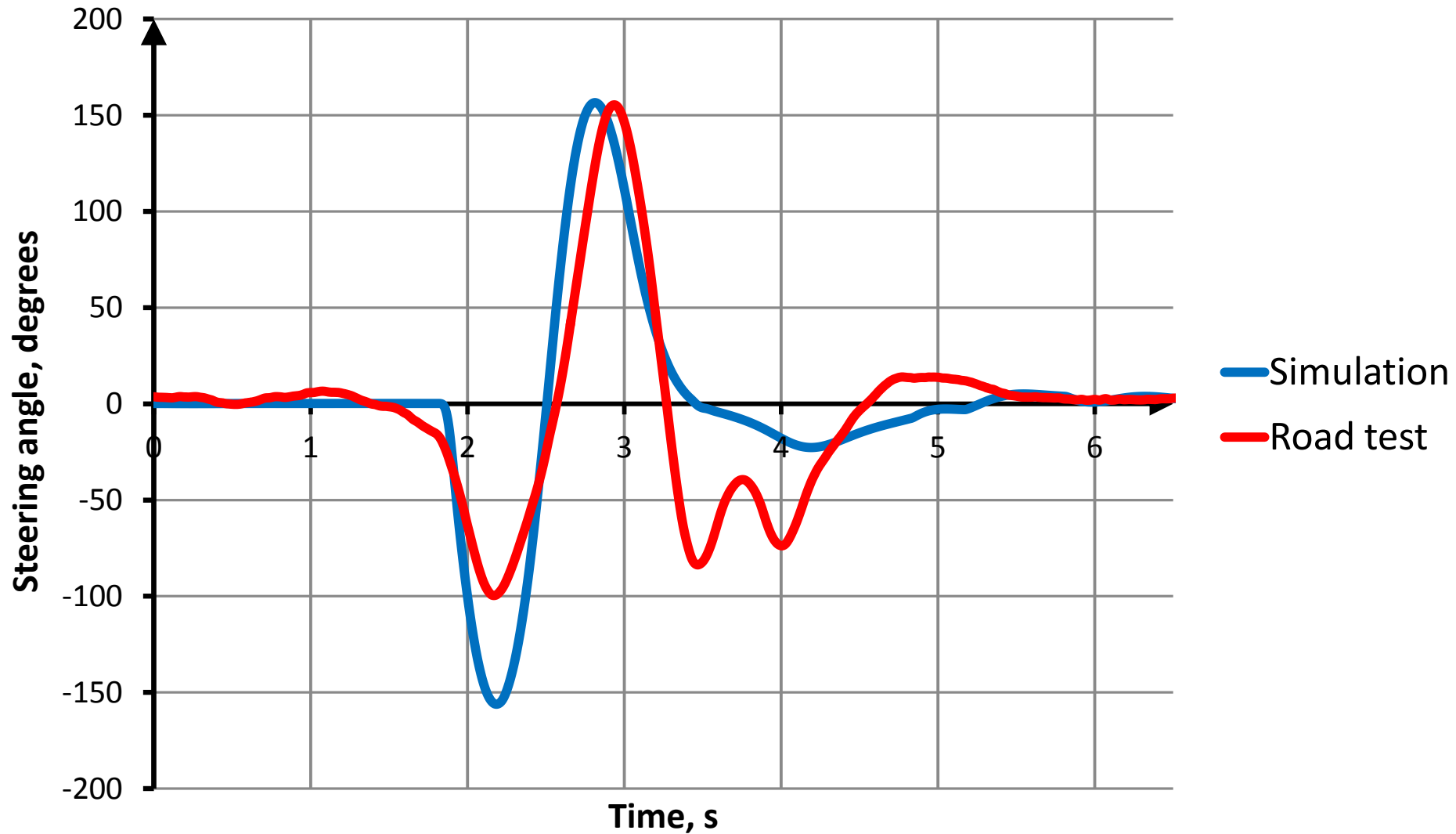
“Going into the corner” test



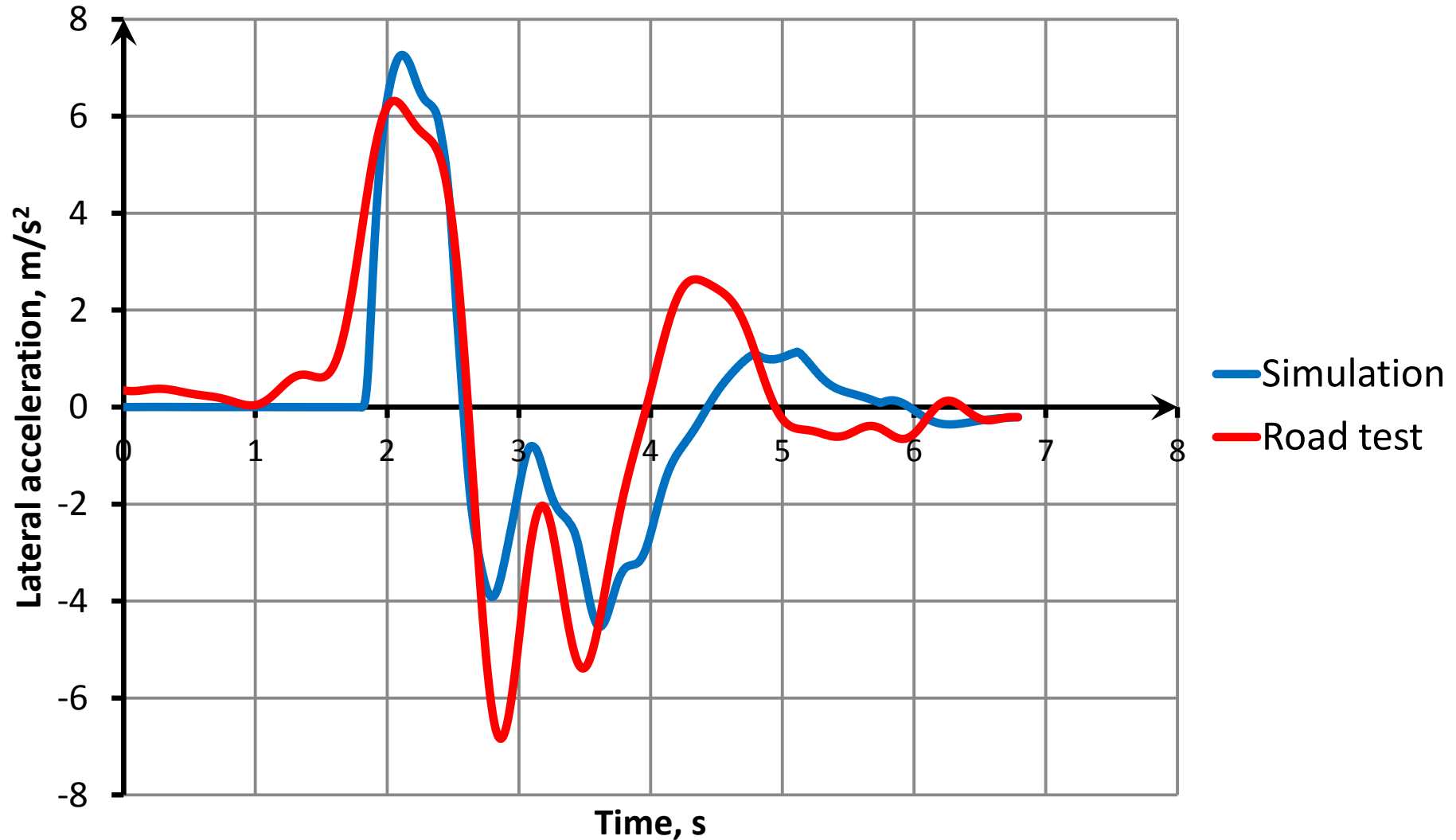
“Lane-changing” test







Comparative analysis of lateral accelerations

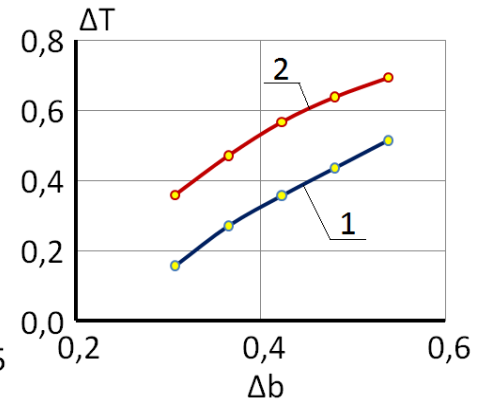
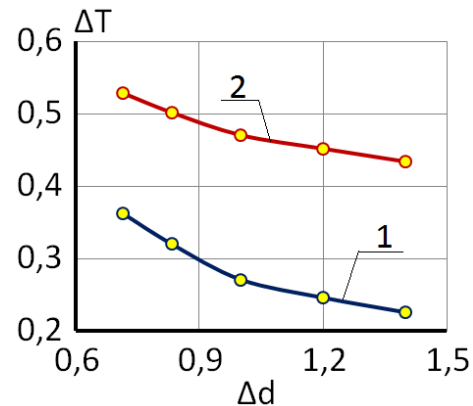
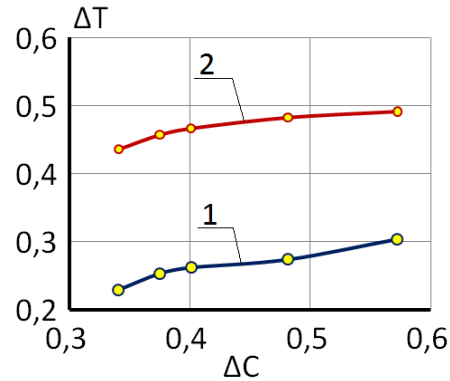
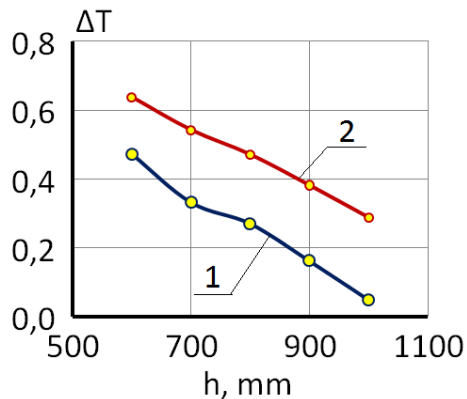


Total permissible mass			
Going into the corner R=35m (regulated 60 km/h)			
Configuration	Critical speed (road tests), km/h	Critical speed (simulation), km/h	Discrepancy, %
2 antiroll bars	62,0	60,2	2,9
Front antiroll bar	61,8	60,0	2,9
Without antiroll bars	60,4	59,0	2,3
Lane-changing S=20m (regulated 70 km/h)			
2 antiroll bars	73,5	70,8	3,7
Front antiroll bar	73,5	70,2	4,5
Without antiroll bars	71	70,2	2,8



Influence of LCV parameters on ΔT value
 1 – “going into the corner”; 2 – “lane-changing”

ΔT – relative vertical wheel reaction



h - height of the center of gravity

ΔC - ratio between vertical stiffness of spring elements of front and rear suspensions

Δd - ratio between diameters of antiroll bars of front and rear suspensions

Δb – ration between horizontal distance, between LCV’s center of gravity and rear axle and wheelbase

- Specific Russian standards in the field of estimation stability and cornering stability include three certification tests.
- After any design modification or for entering the Russian market the manufacturer should confirm the compliance to the Standards.
- Adequate simulation model can help to make express estimation of the influence of some parameters on stability and steerability.

The results of the study could be used by engineers at the preliminary stage of design of a new range of LCVs.



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Thank you for attention!

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