Estimation of influence of stiffness of chassis frame on LCV dynamics in conditions of curvilinear motion

Anton V. Tumasov, Sergey Y. Kostin, Danila A. Butin, Aleksey A. Vasiliev, Andrey A. Vashurin, Yuri P. Trusov

Transport Systems Institute
Nizhny Novgorod State Technical University n.a. R.E. Alekseev
Minin str., 24, 603950 Nizhny Novgorod, The Russian Federation
anton.tumasov@nntu.nnov.ru

Abstract

The paper deals with the problem of calculative and experimental studying of influence of torsional stiffness of chassis frame on LCV dynamics in conditions of curvilinear motion: start of the corner and line changing.

The object of research is LCVs with cargo bed (the vehicles capacity is up to 3,5…4,6 tonne) that have a wide range of wheel base dimensions: from 3145mm to 5045mm and, as a result, different torsional stiffness of chassis frame.

The influence of torsional stiffness of chassis frame on LCV dynamics is studied on the basis of results of experiments and simulation. The static experimental research was made in laboratory environment where the stiffness of the chassis frame were estimated (Figure 1a). Road tests were made in accordance with the Russian Standard GOST R 52302-2004 that presupposes different types of tests: static rollover, dynamic maneuvering on a road (line changing and running into the corner – Figure 1b). The multi-body simulation was made in MSC.ADAMS/CAR and MSC.NASTRAN software that allows imitating the LCV dynamics considering flexibility of chassis frame (Figure 2, 3).

a)   b)

Figure 1: Experimental research (a – estimation of torsional stiffness of chassis frame in laboratory environment; b - estimation of critical speed for running into the corner maneuver)
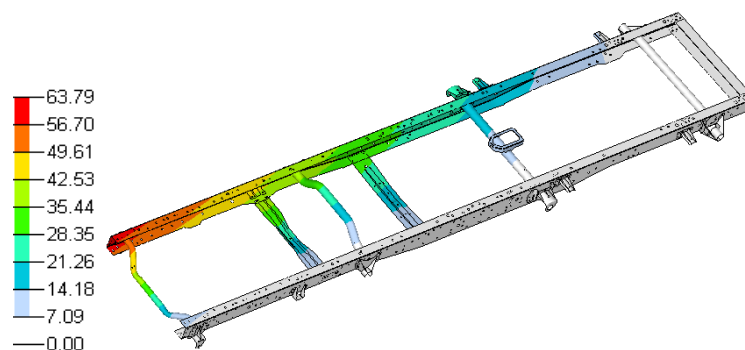

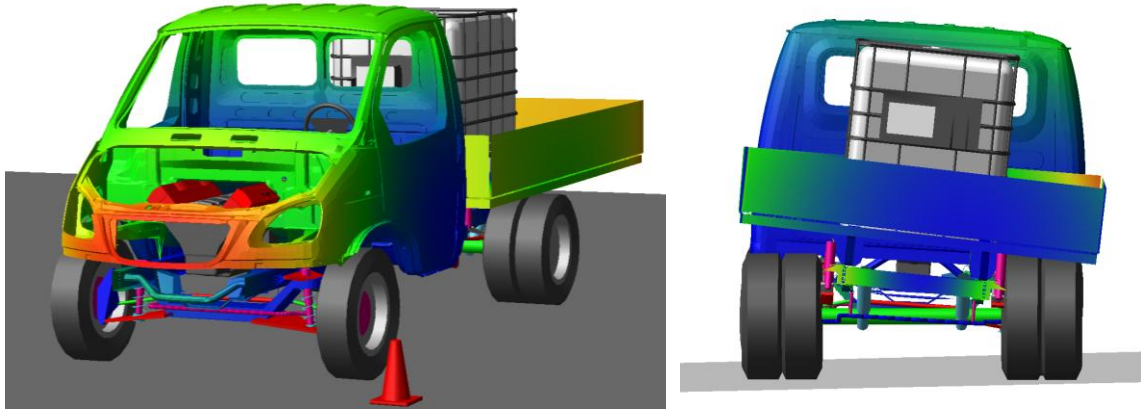Figure 2: Deformations (mm) of finite element model of a frame (MSC.NASTRAN simulation)

Figure 3: Multi-body simulation of LCV running into the corner maneuver with flexible frame, cab and cargo bed in MSC.ADAMS/CAR

The initial stages of a study were presented at different international conferences [1, 2]. This study is a continuation that pays a key attention to:
- Estimation of influence of wheel base on torsional stiffness of chassis frame;
- Analysis of mode of deformation of chassis frame in dependence on type of frame extender construction and fixation (for different wheel base magnitude);
- Estimation of influence of subframe construction on total torsional stiffness of chassis frame with extended wheel base;
- Estimation of influence of torsional stiffness of chassis frame on LCV dynamics (critical speed of curvilinear maneuver, wheels vertical reaction, roll of a vehicle).

References

[1] A. Tumasov, K. Shashkina, G. Konikova, A. Groshev, A. Bezrukov, Y. Trusov Estimation Of Steerability And Cornering Stability Of Light Commercial Vehicle By Results Of Road Tests And Simulation. FISITA 2014 World Automotive Congress, the Netherlands, Maastricht, 2-6 June - F2014-IVC-048. http://www.fisita2014.com/programme/sessions/F2014-IVC-048

[2] A. Tumasov, R. Musarsky, G. Konikova, A. Groshev, S. Kostin, Y. Trusov Estimation Of Light Commercial Vehicles Dynamics By Results Of Road Tests And Simulation . 16th International Conference on Advanced Vehicle Technologies (AVT), ASME 2014, USA, Buffalo NY, 17-20 August - DETC2014-34641.
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