2ND WORKSHOP ON APPLIED AND SUSTAINABLE ENGINEERING

INFLUENCE OF ROAD PARAMETERS ON THE OVERLOAD DURING COLLISION OF A TRUCK WITH CONSTANT BARRIER

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SUMMARY

The hereby article discusses the process of collision of truck with a constant barrier. It also presents the influence of the car velocity on the braking distance with different loads. An analysis of overloads that might contribute to various body damage, created during the collision with different velocity and vehicle mass was carried out. The analyzed cases were accompanied by a presentation of the vehicle deformations created after collision with the obstacle.

INTRODUCTION

The software used in the process of car accident reconstruction was first used at the turn of 1960s and 1970s in the form of computer algorithms that enabled simulation of vehicle movement and collision (McHenry R. R., 1993). The appearance of microcomputers in 1980s caused a quick development of software designed for accident reconstruction software. It could be divided into the following groups: picture, calculation, photogrammetric, for time-spatial analysis, simulation (Prochowski L. and others, 2008).

Constant development of computer technology makes it possible to construct more and more complex simulation models. It is also connected with increasing the level of accuracy of engineering analyses. Road accident reconstructions are carried out for a variety of reasons. Depending on the purpose of the performed simulation, the results can be applicable respectively in the following areas: process of road accident reconstruction, designing and modification of vehicles and their subassemblies, road engineering [Wicher J., 2012].

It is therefore crucial to undertake works that shall contribute to improving both the active and passive safety. The conducted analysis of vehicle collision with a constant barrier is supposed to visualize how important in terms of safety are the vehicle mass and velocity.

Another way of obtaining the information necessary for conducting analysis of the course and consequences of a collision of mechanic vehicles with each other, with other traffic participants and with field obstacles is conducting a simulation using proper software.

The hereby article discusses the analysis of overloads that might contribute to various body damage, created during the collision with different velocity and vehicle mass was carried out.

RESULTS OF RESEARCH

The software used in the hereby work was V-Sim used for analysis of the influence of vehicle mass and velocity on safety during collision with a constant barrier. A simulation of collision with a constant barrier was conducted for truck. The simulations were carried out for active environment elements: surface type and parameters (road, roadside) - dry asphalt, μ: 0,80/0,75, resistance: 0,015; ground inclination - horizontally, height 0,00 m; speed and direction of wind - wind-free.

For each of the analyzed situations a situation model was designed in program Cyborg Idea V-Sim and a simulation of vehicle collision with a constant barrier in the form of a concrete pole was carried out. The simulation was conducted for varying vehicle velocity and different total mass. In case of the truck the trailer load mass was changed. In the first stage of the tests it was assumed that at the speed of 30 km/h the load-free vehicle will manage to brake directly before the barrier. The situation view of the place of the accident is presented in fig. 1.

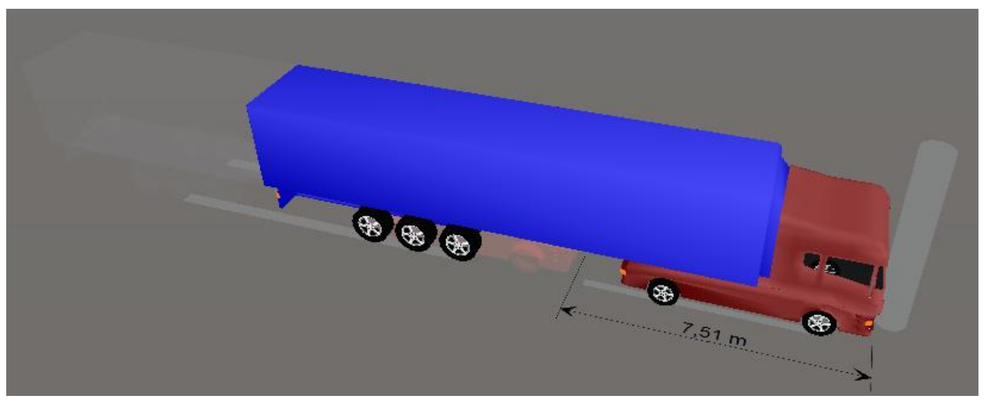

Fig. 1. Plan of the place of the accident made in V-Sim program

Table 2 presents the results of forces (maximum overloads) that affect the vehicles at the moment of collision with the barrier, with different initial velocity (at the moment of beginning the braking) and different loads

Table. 1. The overloads affecting the vehicle at the moment of collision

Initial velocity [km/h]	Max overload [g]		
	Min.- without the load	½ of the load 12000kg	Max. load 24000kg
30	0,5	25,5/25	21,1/27,1
50	45/130	43/148	40,1/246
70	58/130	59,6/480	55/556
90	78/125	72/415	74/430

Fig. 2 presents the influence of truck initial velocity onto the maximum overload during collision with a constant barrier.

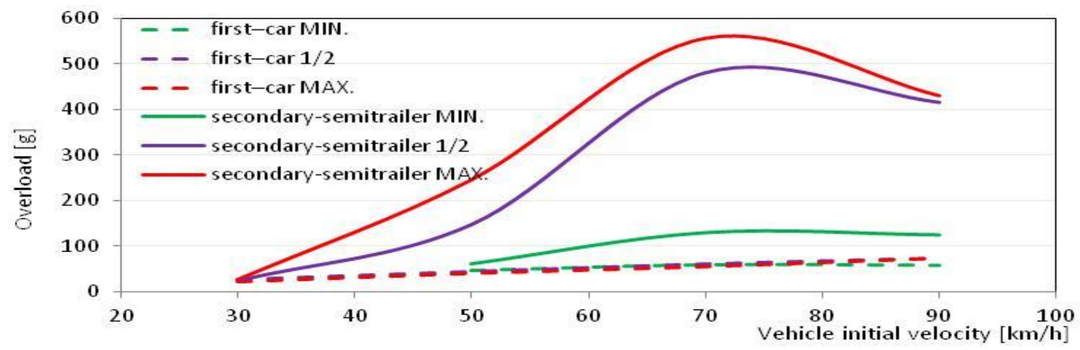

Fig. 2. Influence of initial vehicle velocity onto the maximum overload during the collision with a barrier

Exemplary course of the velocity, path and overload in force during collision with the initial velocity of 70km/h of a truck with maximum load (24000kg), is presented in fig. 3.

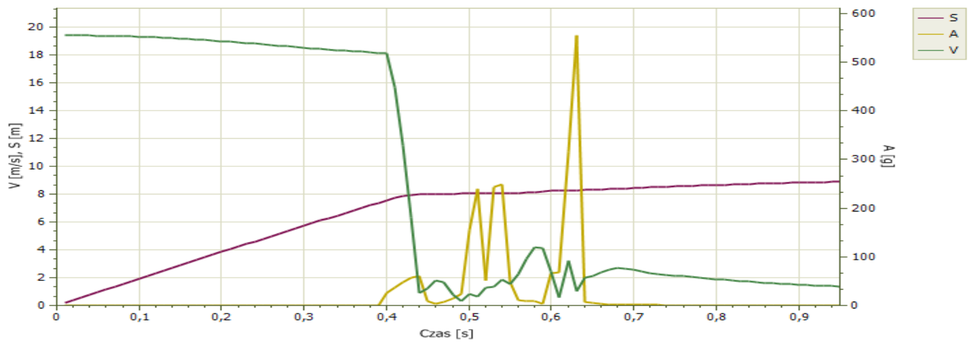

Fig. 3. Influence of initial truck velocity onto the maximum overload during the collision with a barrier

Fig. 4 presents exemplary values of deformations of a vehicle with maximum load (4 passengers) traveling with the initial velocity of 70km/h.

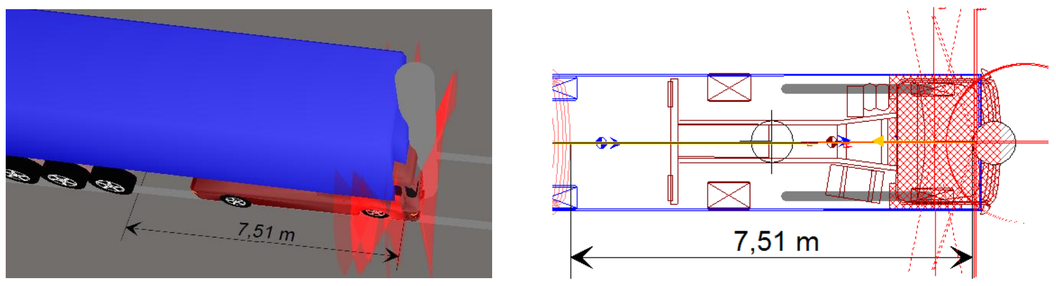

Fig. 4. Value of deformation of truck with maximum load (24000kg) during collision with a constant barrier - initial velocity:70km/h

CONCLUSION

During collision of the vehicle with constant barrier (concrete pole) first, the vehicle collides with the barrier, which causes damage of the front part of the truck tractor. In the next milliseconds the trailer coupler is broken and the coupler, with its whole mass, hits the vehicle, namely the back part of its cabin. In the next stage, the trailer bounces off the cabin. The vehicle is damaged both at the front and at the back and the chances of the driver's or the passenger's survival are minimal.

Depth of deformations, even with relatively low speed of 50km/h, causes deformations that reach as far as the whole vehicle engine chamber. What is particularly dangerous to the health of the travelers are the overloads occurring during collision with barriers. As the vehicle velocity increases, the value of the maximum overloads grows. This looks extremely disturbing during collision of a truck that transports a heavy load. When the trailer coupler snaps, the whole mass hits the tractor, often leaving the driver or passenger without any chances of survival.

LITERATURE

1. Prochowski L., Unarski J., Wach W., Wicher J.; Podstawy rekonstrukcji wypadków drogowych; WKiŁ, Warszawa 2008.
2. McHenry R. R.; Computer Program for Reconstruction of Higway Accidents; SAE Technical Paper 730980, 1993.
3. Wicher J.; Bezpieczeństwo samochodów i ruchu drogowego; WKiŁ, Warsaw 2012.