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Experimental study of the tilt angle body of towing vehicle with different load

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Abstract

The body while the vehicle is moving is tilts the longitudinal and transverse directions. Transverse generated mainly by uneven road surface and longitudinal driving processes (acceleration and braking). Increasing the weight of the vehicle transported cargo enhances tilt. During cargo delivery vehicles are required to be adequately protected and the distribution of the load area in order to minimize dangerous tilt. Incorrectly secured load during heavy braking can move and change drive trajectory of the vehicle and extend the braking distances. The results of road tests change the inclination of car body of the vehicle a towing car transporting vehicles of different mass.

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1. Introduction

In road transport especially in urban area delivery trucks are applied for transport of cargo and people. Most of delivery trucks is characterised by permissible total mass up to 3,5t and such type of car can be driven by a person with B category of driving license. In comparison to goods vehicles the delivery truck is characterised by higher mobility in urban area and lower operation costs.

Transport of large loads can have an essential influence on steerability and vehicle movement trajectory. During loading one should remember about a proper distribution of load i.e. it should be placed between front and rear vehicle axis so as to get uniform distribution of mass for two axes [1]. Mounting of load in cargo space is also an

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essential problem. Relocation of huge mass during turning can change the distribution of unit pressure for particular wheels and in extreme cases it can lead to overturn of the vehicle. Delivery trucks for large loads are equipped with the systems of suspension stiffening (in most cases - pneumatic absorbing systems) which minimize the tilt of the vehicle body [2, 3]. It has a negative impact on driver's work comfort and especially it leads to higher wear of vehicle subassemblies – in particular suspension parts. In case of transport of fragile cargo it can lead to cargo damage. The change of load of vehicle wheels can lead to change of contact area between the tyre and road pavement – and this fact has an impact on acceleration and braking processes and road traffic safety [2, 4]. Overloading of vehicle is forbidden and it is punished by proper services with fine (in Poland: Road Transport Supervision). The article presents the influence of load changes on the value of the angle of the longitudinal vehicle.

2. Methodology and course of research

The aim of research was the measurement of angle of longitudinal tilts of a delivery truck with a special housing for transport of cars. The tests consisted of intensive acceleration of the towing vehicle from start to the expected velocity and next intensive braking until full stop. Road tests were conducted on an asphalt pavement in two stages. Additionally the measurements of environmental conditions were performed before each measuring series. In first stage the vehicle was not loaded with any cargo, and in second stage it was loaded with a car – Volkswagen Passat. During tests 5 drives without load and 5 drives with load were done.

The towing vehicle was equipped with the measuring apparatus ADIS 16385 from Analog Devices company which consisted of integrated three-axial piezogyroscope sensor and three-axial accelerometer. Measuring apparatus was mounted outside the cab i.e. on the vehicle roof. For registering and recording of data the mobile computer with dedicated software for sensors was applied. The measuring apparatus was characterized with measuring uncertainty on the level of 2% [5, 6].

3. Vehicles characteristic

Mercedes Sprinter was used as a delivery truck for transport of cars – it was produced in 1999 and it was equipped with the tyres MICHELIN AGILIS – size 225/70 (Fig. 2). The vehicle was equipped with manual 5-speed gearbox and it was adopted to transport 6 persons and cargo. This car is used to transport passenger cars with a total mass up to 1600 kg in Poland and Europe. This car travels about 20 000km per year.



Fig. 1. View testing Vehicle without load (left), with load (right).

4. Characteristics of environment and road surface conditions

Road tests were conducted in November 2013 on service roads of the airport of the Pila Flying Club. The results of environmental tests are presented in Tables 2, 3 and 4.

Table 1. The measurement results of environmental conditions runs towing car in asphalt pavement

	Before road test without load	Before road test with load
Ambient temperature	+5,0°C	+11,3°C
Humidity	---%	68,3%
Atmospheric pressure	1000,3hPa	1006,2 hPa
Temperature of saturation point	---°C	+5,8°C
Temperature of road surface	+4,4°C	+3,8°C

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