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Dispersion of Kinetic energy for Traffic Safety

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Abstract

The paper presents an analysis of kinetic energy absorption during car collisions (hitting an obstacle). A task of calculation of the mechanism of energy absorption during road traffic accidents is solved. A technical solution for energy measurement has been found with the aim to reduce personal injuries in car collisions or when hitting an obstacle.

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Keywords: kinetic energy; motor vehicle; moving mass; system; design

1. Main text

In order to develop alternative movement of safety components in traffic, the analysis of kinetic energy dispersion has been conducted, based on the presentation of design solutions for energy dispersion equipment. The vehicle in motion has kinetic energy E_k associated with the movement of its entire weight at a certain speed, as well as with an additional energy resulting from the rotation of wheels E_{ko}. The vehicle may also have potential energy E_p where the stopping point of vehicle is below the point of brake application. Stopping the vehicle requires loosing of these three types of energy [Evtiukov et al. (2016), Rajczyk et al. (2015)]. The total energy of the system E consists of E_p potential energy, kinetic energy of motion, kinetic energy E_k and rotation E_{ko} as described by the formula:

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$$E = E_k + E_{ko} + E_p \tag{1}$$

where: E_k — the kinetic energy of forward progression , E_{ko} — the kinetic energy of rotation , E_p — potential energy.

The kinetic energy of forward progression E_k is determined by following equation:

$$\mathrm{E_k} = \frac{\mathrm{m_S V^2}}{2} \tag{2}$$

where: m_s — vehicle weight, v — vehicle speed.

The kinetic energy of rotation E_{ko} is determined by following equation:

$$\mathrm{E_{ko}} = \frac{1}{2}\mathrm{I}\omega^2 \tag{3}$$

where*: I* — the mass moment of inertia, ω — rotation speed.

The potential energy E_p is determined by following equation:

$$\mathrm{E_P} = \mathrm{m_s g h} \tag{4}$$

1.1. Braking process involving a spring element with a movable mass

Scheme of braking is shown in Fig 1. [Rajczyk et al. (2014), Rajczyk et al. (2015)]. The system consists of a vehicle with mass m_s moving at the start of braking with initial speed V_s, that strikes the spring item of flexibility R_s in which's other end a receiver mass is found m_o, that at the initial moment is at rest.

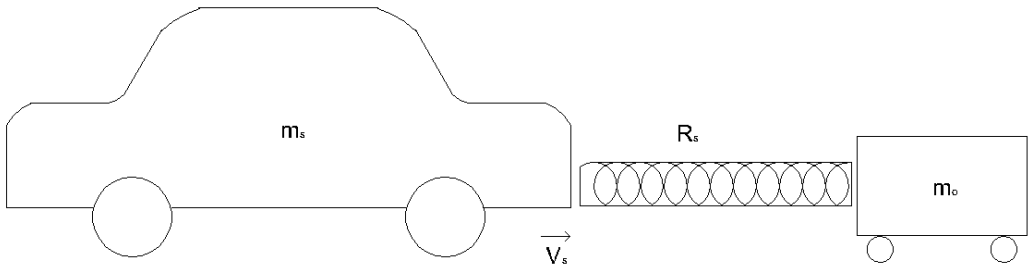

Fig.1. Scheme of braking system using the spring and the free mass.