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THE MECHANICS AND MATHEMATICS MODELING OF ASSEMBLY TYRES-MATTER OF A TRUCK BODY

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Abstract: *In this paper I developed the oscillating mechanical equivalent simplified assembly tires - suspension, bodywork, with 7 degrees of freedom, own a truck and I illustrated some of the graphs resulting from calculations for each of the 7 masses.*
Keywords: *Truck, mechanical and mathematical modeling, suspension, acoustic, vibration*

1. INTRODUCTION

1.1 The description for trucks that carry mathematical modeling

Truck Actros 1844 LS Mercedes-Benz is characterized by excellent driving dynamics, ensuring optimal comfort and grip, maneuverability and excellent control. Several components of the transmission, the chassis and suspension have been redesigned and improved significantly. Hypoid rear axle has also improved and optimized. This allows more efficient transfer of engine power to the wheels and reflected in a better adaptation to the type of truck use, reduced fuel consumption and improved efficiency. "

Passive safety is further enhanced by the optional bi-xenon headlamps, cornering light function, daytime running lights and rear lights with LED technology. For the driver this means maximum comfort and a secure driving experience - from the start and to destination.

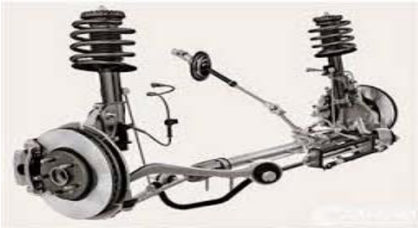
. In addition to standard Euro 5 and EEV, the new Actros is one of the first vehicles equipped with engines designed to meet already requirements for Euro 6, with a fuel consumption by up to 3% lower compared to the previous model equipped with engines Euro 5. With total costs extremely low, Actros is fitted with new innovative technologies and services designed specifically for your needs.

StreamSpace cabin with a width of 2300 mm, has a design for a driver suitable for use in the national transport over long distances. Optionally, it is available with a completely flat floor, which gives a height of 1.97 m *. With a higher volume of 100 liters and a storage space with 70 liters more than the previous model, the cab offers the best balance between aerodynamics and comfort during national transport operations over long distances. [Net2]

1.2. Mechanical Modeling

The contact between wheel and road safety movement is important for the trucks. Bumps, whether in the form of ruts or bumps, vibrations induce the vehicle structure have an unfavorable influence on both passenger comfort and cargo transported integrity and the reliability of the vehicle.

Also, these vibrations can lead to loss of contact wheel-way negatively impact the safety movement. To eliminate or reduce these undesirable phenomena damping systems use complex consisting of springs, dampers and tires (Fig.2.1.).



a)

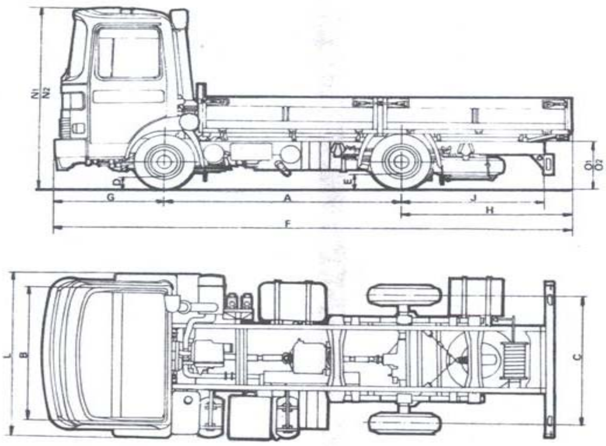
b)

c)

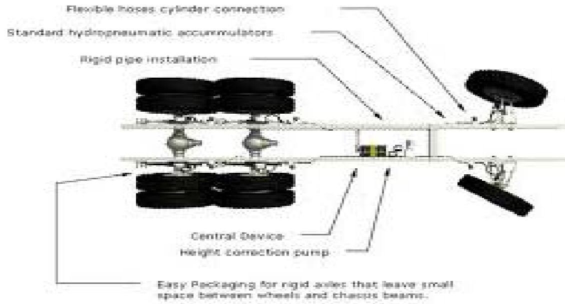
d)

Fig. 2.1. Damping elements for a truck
a) spring b) damper c) rim- tire.d) completely damping system [Net4]

For the theoretical study of vibration of a means of transport, to develop the oscillating mechanical equivalent simplified assembly tires - suspension, bodywork, with 7 degrees of freedom, own a truck. Figure 2.2. It presented such a truck suspension assembly.



a)



b)

Fig. 2.2. The size and a truck suspension assembly
a) The dimensions of a truck. b) a truck suspension [NEt3]

For an expression simpler to use abbreviated model, 7-SGP (7 - number of degrees of freedom - Tyres - Suspension - Body. The shaping mechanical structure assembly 7th PSC taking into account tires truck, suspension system and body (Fig. 2.3). Source of vertical vibration is considered to be irregularities tread.

Fig. 2. 3. The tires - suspension of a truck-body [Net1]

The 6 tires and related suspensions are mechanical model using Kelvin-Voigt model [2], which considers any mechanical element being a mass system - spring-damper. Masses each block in the tire-reel format - suspension concentrated masses are represented by a point. The bodyshell is treated as a rigid solid mass loaded wheels, M7. It is assumed that the center of gravity of the truck is located at its geometric center. The entire mechanical system so modeled, has 7 degrees of freedom (each table moves in the vertical direction) and free subject to vibration, shock absorbers, viscous damping Figure 2.4 contains mechanical model of this system

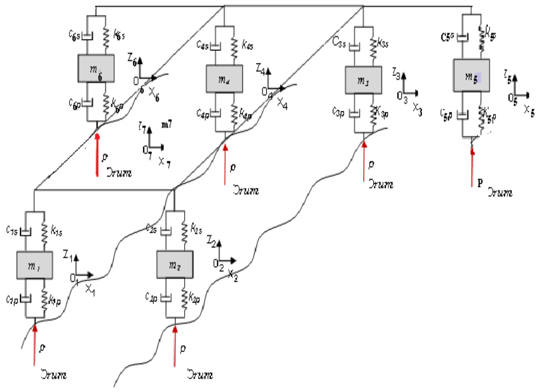


Fig. 2.4. The mechanical 7- TYRE - SUSPENSION-BODY of a truck

In Figure 2.4. I adopted the following notations:

- m1, m2, m3, m4, m5, m6- mass-suspension-reel blocks tire [kg];
- m7 - Body weight [kg];
- c1p, c2p, c3p, c4p, c5p, c6p - tire damping constants [Ns / m];
- c1s, c2s, c3s, c4s c5s c6s - the suspension damping constants [Ns / m];
- k1p, k2p, k3p, k4p k5p, k6p - elastic constants of tires [N / m];
- k1s, k2s, k3s, k4s, k5s, k6s - elastic constants of the suspension [N / m].

The disruption of the system is the elevation of the road, which can be approximated by a sinusoidal curve form of expression:

$$p = h_0 \sin \omega t, \qquad (1.1)$$

where:

- p - road layout function;
- h0 - amplitude shading the road layout [m];
- ω - frequency excitation due to road layout [Hz] [2]

$$\omega = \frac{2\pi \cdot v}{\lambda}, \qquad (1.2)$$

in which :

- v - running speed of the truck [km / h];
- λ - wavelength (length of shading) [m].
- p - road layout function;
- h0 - amplitude shading the road layout [m];
- ω - frequency excitation due to road layout [Hz] [2]

3. Mathematical modeling of tire-suspension body assembly

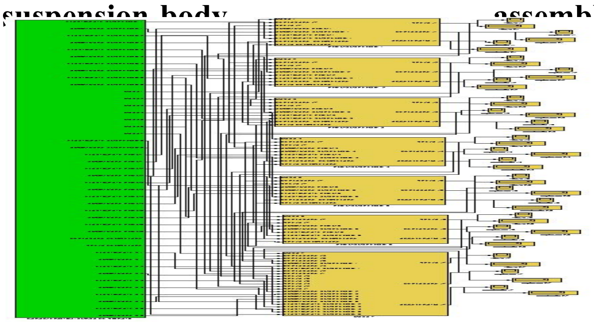


Fig. 3.1 Matlab Simulink program developed to solve mathematical model

The mathematical model for the mechanical model 7-PSC, a truck, in Figure 2.4. is the system of differential equations, homogeneous, dynamic equilibrium, obtained for each segment of the mechanical model by applying the principle of d'Alembert[2].

$$\begin{cases}
m_1 \cdot \ddot{Z}_1 = C_{1P} \cdot \dot{p}(t) + K_{1P} \cdot p(t) - C_{1S} \cdot \dot{Z}_7 - K_{1S} \cdot Z_7 - C_{1P} \cdot \dot{Z}_1 - K_{1P} \cdot Z_1 \\
m_2 \cdot \ddot{Z}_2 = C_{2P} \cdot \dot{p}(t) + K_{2P} \cdot p(t) - C_{2S} \cdot \dot{Z}_7 - K_{2S} \cdot Z_7 - C_{2P} \cdot \dot{Z}_2 - K_{2P} \cdot Z_2 \\
m_3 \cdot \ddot{Z}_3 = C_{3P} \cdot \dot{p}(t) + K_{3P} \cdot p(t) - C_{3S} \cdot \dot{Z}_7 - K_{3S} \cdot Z_7 - C_{3P} \cdot \dot{Z}_3 - K_{3P} \cdot Z_3 \\
m_4 \cdot \ddot{Z}_4 = C_{4P} \cdot \dot{p}(t) + K_{4P} \cdot p(t) - C_{4S} \cdot \dot{Z}_7 - K_{4S} \cdot Z_7 - C_{4P} \cdot \dot{Z}_4 - K_{4P} \cdot Z_4 \\
m_5 \cdot \ddot{Z}_5 = C_{5P} \cdot \dot{p}(t) + K_{5P} \cdot p(t) - C_{5S} \cdot \dot{Z}_7 - K_{5S} \cdot Z_7 - C_{5P} \cdot \dot{Z}_5 - K_{5P} \cdot Z_5 \\
m_6 \cdot \ddot{Z}_6 = C_{6P} \cdot \dot{p}(t) + K_{6P} \cdot p(t) - C_{6S} \cdot \dot{Z}_7 - K_{6S} \cdot Z_7 - C_{6P} \cdot \dot{Z}_6 - K_{6P} \cdot Z_6 \\
m_7 \ddot{Z}_7 = K_{1S} \cdot Z_1 + C_{1S} \cdot \dot{Z}_1 + K_{2S} \cdot Z_2 + C_{2S} \cdot \dot{Z}_2 + K_{3S} \cdot Z_3 + C_{3S} \cdot \dot{Z}_3 + K_{4S} \cdot Z_4 + C_{4S} \cdot \dot{Z}_4 + \\
+ K_{5S} \cdot Z_5 + C_{5S} \cdot \dot{Z}_5 + K_{6S} \cdot Z_6 + C_{6S} \cdot \dot{Z}_6 - Z_7 (K_{1S} + K_{2S} + K_{3S} + K_{4S} + K_{5S} + K_{6S}) - \\
- \dot{Z}_7 (C_{1S} + C_{2S} + C_{3S} + C_{4S} + C_{5S} + C_{6S})
\end{cases}$$

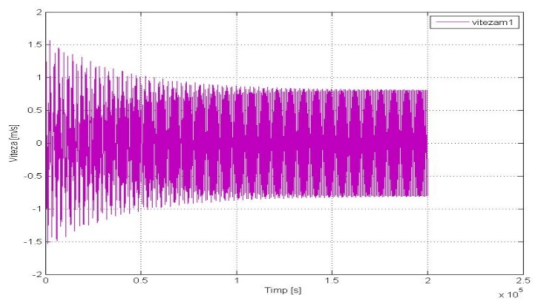


Fig. 3.2 The speed for the mass m1

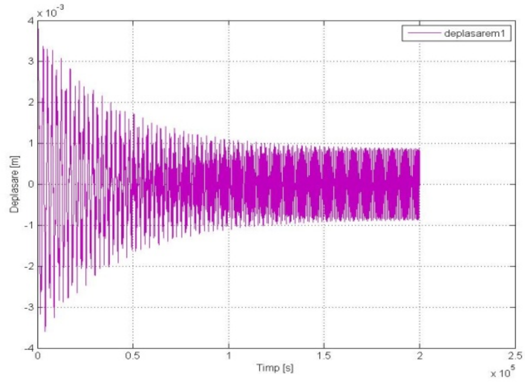


Fig. 3.3 The movement for the mass m1

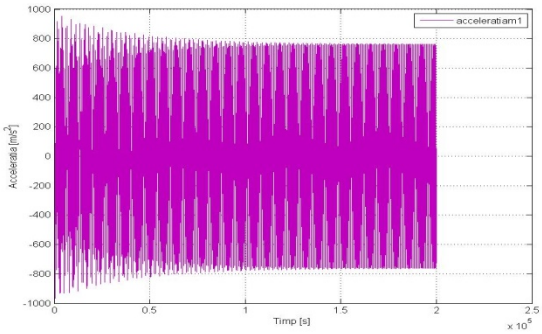


Fig. 3.4 The acceleration for the mass m1

Interpretation of results for the mass m1

The resulting chart study program run Simulink 7PSC results:

The movement of the table recorded with a maximum value 3.8 10-3for the mass m1 is smaller than the displacement introduced by the disturbance of the road with the value 1 x 10-2m;

The movement of the mass m1 is attenuated over time and after 1.5 seconds have stabilized at a value slightly below 1 x 10-3m.

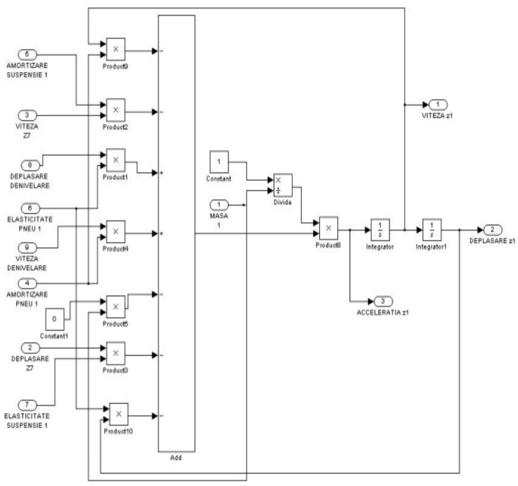


Fig. 3.5 The tire-suspension system for mass m1

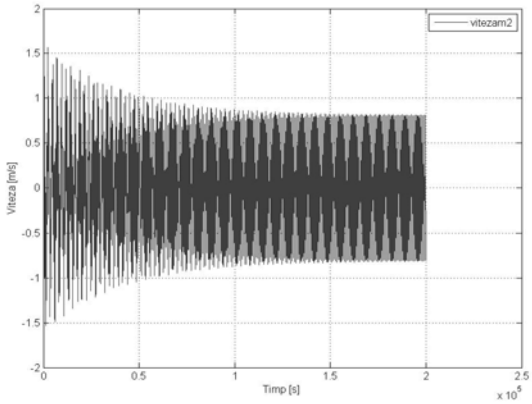


Fig. 3.6 The speed for the mass m2

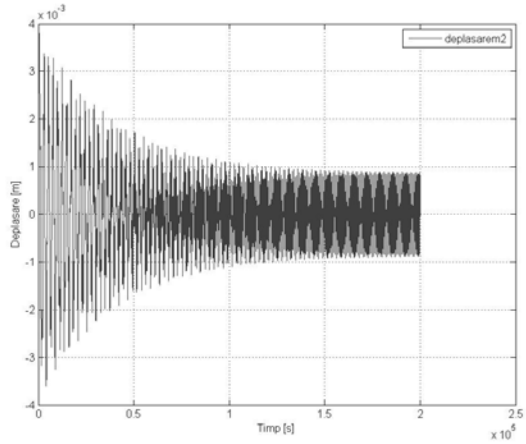


Fig. 3.7 The movement for the mass m2

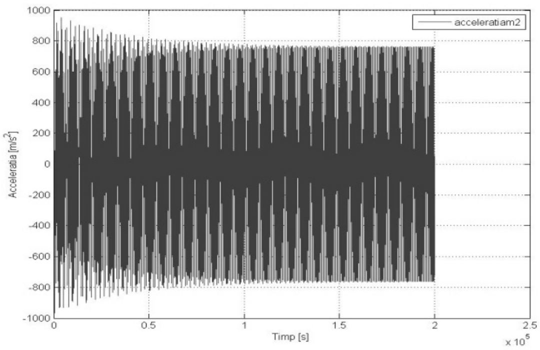


Fig. 3.8 The acceleration for the mass m2

Interpretation of results for mass m2:

The resulting chart study program run Simulink 7PSC results:

The movement of the table recorded with a maximum amount of 3.8 m2 · 10-3 m is smaller than the displacement introduced by the disturbance of the road ie 1 x 10-2m;

The movement of the mass m1 is attenuated over time and after 1.5 seconds have stabilized at a value slightly below 1 x 10-3m

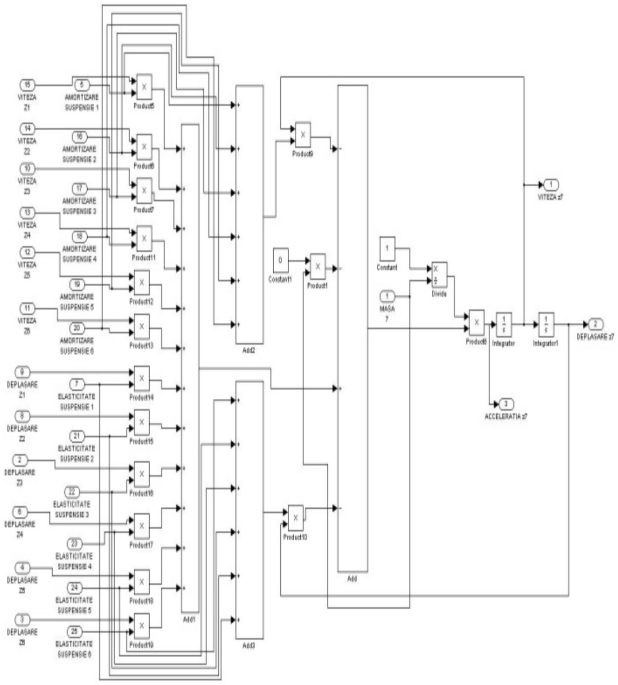


Fig. 3.9 The tire-suspension system for the mass M7

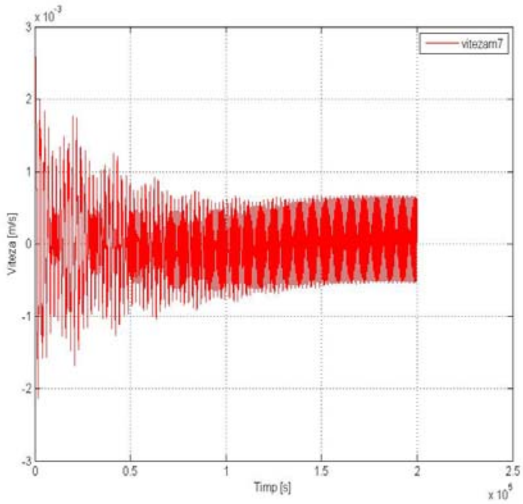


Fig. 3.10 The speed for the mass m7

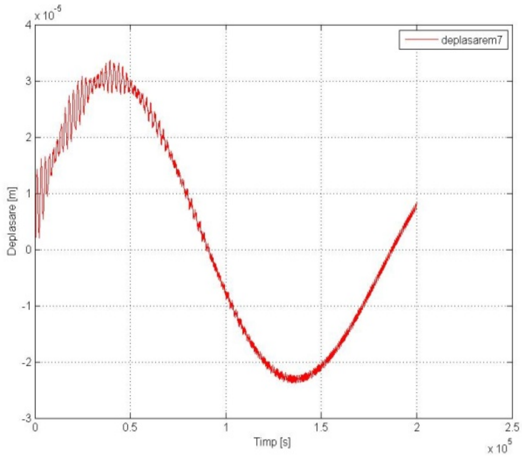


Fig. 3.11 The movement for the mass M7

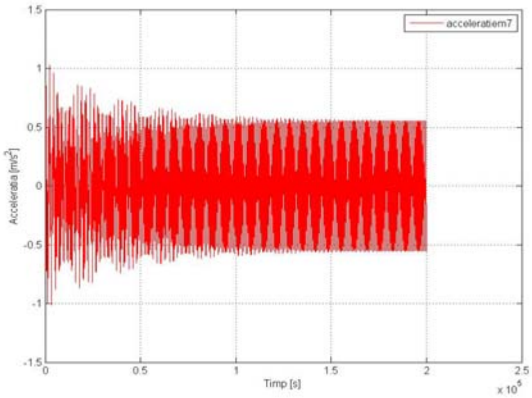


Fig. 3.12 The acceleration for the mass m7

Interpretation of results for M7 table:

The resulting chart study program run Simulink 7PSC results: -The movement recorded with a maximum mass m7is 3.3 x 10-5 m.This maximum value is smaller than the displacement introduced by the disturbance of the road and the value is 1 x 10-2m; -The movement of the M7 mass ranges swearing a sinusoid and fades in time and after 1.5 seconds stabilizes at a value of 2.4 x 10-5.

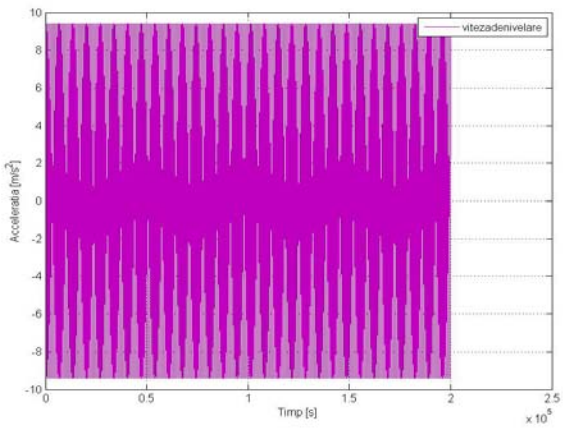


Fig. 3.13 The speed considering the unevenness of the road

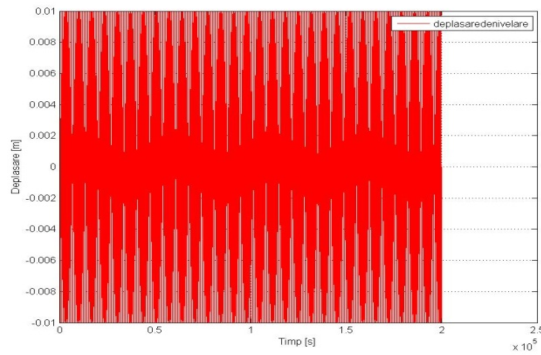


Fig. 3.14 The movement considering the unevenness of the road

5. CONCLUSIONS

The analysis of data obtained by running the program 7PSC can conclude:

1.The movement,speed and accelerate of the M1 and M2 masses are identical;

2.Se found that the variation in displacement, velocity and acceleration masses M3, M4, M5, M6 is the same;

3.This similarities are justified as the parameters that characterize the front or rear axle are identical while the disturbance seen on the right is the same as seen on the left

4. The difference recorded between the two decks is because they have different characteristic parameters;

5.The movement recorded of the mass M7 is much smaller than other masses, due to attenuation occurred throughout the entire system.

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[Net4]***https://www.google.ro/searchElemente+de+amortizare+pentru+un+autocamion

MODELAREA MECANICA ŞI MATEMATICĂ A ANSAMBLULUI ANVELOPE-CAROSERIE A UNUI CAMION

Abstract: In aceasta lucrare se realizeaza studiul oscilatiilor mecanice a sistemului amvelope-caroserie pentru un camion. Se considera un sistem mecanic cu 7 grade de libertate, un grad de libertate al caroseriei si 6 grade de libertate date de sistemul de asezare pe 6 roti anvelopate

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