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COMPUTER SIMULATION OF THE M1 CATEGORY VEHICLE MOTION USING THE SUSPENSION BASED ON FOUR-LINK LEVER MECHANISM

Computer simulation has one of the most important parts to play in the design of cushioning systems at the early stages of design. Therefore, the use of powerful computers to improve or create new, more progressive vehicle systems is an inevitable step.

Of course, simulation can not completely replace physical experiments, its purpose is to ensure the proper definition of the results of experiments with nonlinear systems, interpolate and extrapolate their results. However, the development and breadth of numerical methods application in recent decades has meant that virtual design systems are now the instrument fully integrated in the design process of vehicle and road elements that provide safety.

To achieve the ultimate aim it was decided to develop a full-size model of the car IZH-2715, which would meet all road vehicle operating parameters. As a basic program SolidWorks software with MOTION application that is intended for modeling dynamic systems in the Solid Works environment was selected. Motion is also designed to simulate the mechanism motion taking into account kinematics and power factors. The program is fully integrated into SolidWorks, it operates the SolidWorks geometric model. The record of calculated parameters and results is also carried out in the SolidWorks model.

The program analyzes SolidWorks assembly transforming it into the conventional model of the mechanism taking into account the mass-inertial characteristics of details. These inertial parameters are borrowed from the geometry of the SolidWorks parts and the density (mass) can be designed independently of the geometric shell. Next the system of differential motion equations which is then solved using retail schemes was constructed for the mathematical model. After that, the program converts numerical results in type available for displaying. At this stage the system interacts with the real geometry again. Displays the estimated kinematic model (as icons) and results are directly displayed in a graphical SolidWorks window at the background of SolidWorks model assembly.

But it is necessary to assign the parameters of the suspension rather accurately to build the quality model (Fig. 1), and they will determine the accuracy and qualityof the displayed results.

Therefore, a lot of laboratory and road tests of the standard suspension of the tested vehicle were carried out. The elastic property was obtained by discrete loading and unloading of the car and the frequency of free oscillations was estimated by the “dumping” method.

According to experimental results the main characteristics of the standard (factory) suspension of the car were obtained that were used to build the base virtual model of IZH-2715 car in the SolidWorks MOTION shell with the basic suspension and the suspension based on four-link lever mechanism (FLLM).

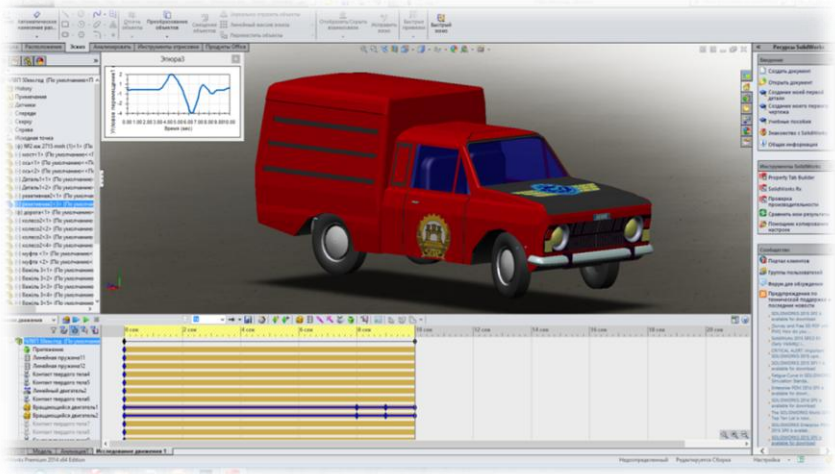

Fig. 1 The purpose of car suspension parameters

These models take into account all the geometrical parameters of the mass of the car and its elements, and the inertia forces, friction in the arms, damping elements, tires friction with the supporting surface, the gravity forces, etc.

The method based on DSTU 52302-2004 was worked out to practice the computer tests of “the evasive maneuver”. According to this method the car accelerates to the fixed desired speed and executes “the evasive maneuver” (Fig. 2) without braking and acceleration on the road interval of 20 m and the width of 7 m.

This method allows testing at various speeds with different loading of the vehicle. Testing “the evasive maneuver” at the model of IZH-2715 car with the standar suspension and the FLLM suspension on the road interval of 20m was done at the speed of 50km/h.

Fig. 2 The comparison of “the evasive maneuver” results in computer and road tests

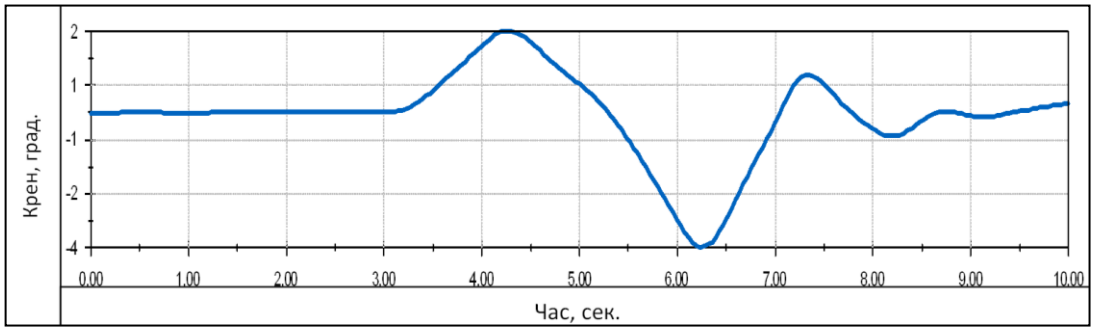

Fig. 3 The roll of car body with the standard suspension executing “the evasive maneuver”

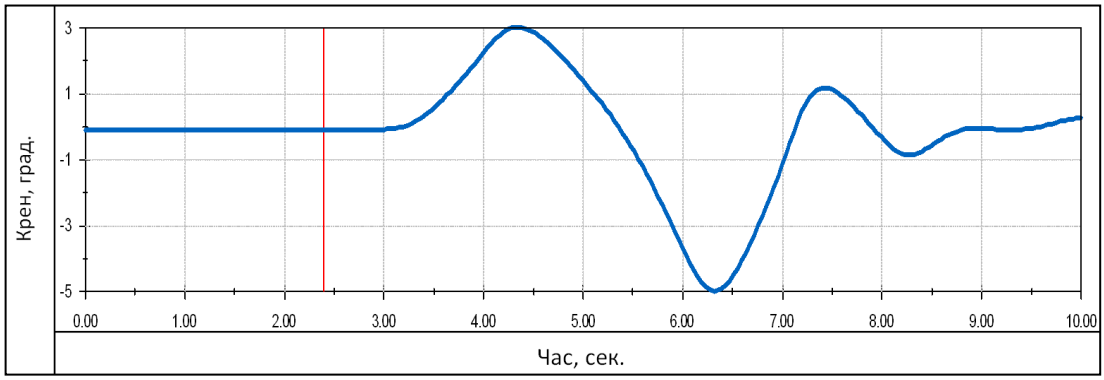

Fig. 4 The roll of car body with the FLLM suspension executing “the evasive maneuver”

Testing “the evasive maneuver” of the same car with the FLLM suspension we found out that the maximum angle of roll was 4 degrees (Fig. 3-4), that was one degree less than with the standard suspension. According to the results of our experiment we can make the conclusion that the vehicle with the FLLM suspension maneuvers more stable in equal conditions.

The next stage is to study the parameters of the IZH-2715 car with the mentioned suspension on the road.