Improving reliability of the trucks

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Abstract – In the article the ways of increasing competitiveness automotive technique and providing opportunities improving them by analyzing information about defects with principle of "feedback" are analyzed. Used methodology of systems allows to organize interaction between systems of firm service and production system to improve efficiency of interaction.

Key words – automotive technique, increase of reliability, system of firm service, frame of the truck, stress-strain state.

Current market trends dictate their terms to use commercial vehicles and is not uncommon when to achieve consumer's wishes during the process of designing or upgrading vehicle family designers combine conflicting objectives (e.g., reduced vehicle weight while increasing its carrying capacity, etc.). In fact, the finished product is presented in the form of a certain range of cars, where each car model is designed for its own purpose (Fig.1).

Fig.1 Trucks, special trucks and chassis of KAMAZ: 1 – dump-truck; 2 – chassis for superstructures (add-ins); 3 – tractor; 4 – mixer truck; 5 – crane truck; 6 – board platform truck; 7 – autoconcrete pump

In determining the scopes of efficient use of trucks, including special trucks, practically ignored the actual level of reliability of the vehicles, the impact to the efficiency on the route as a whole. However, the operation of trucks has numerous cases of failure, damage and destruction of parts, assemblies, structure elements, which noticeably reduces the efficiency of the use.

To improve the quality of products, its competitiveness is important at the design stage reasonably and in a short time to select among variety solutions the best that would fit the bill. Therefore design engineers are increasingly using the possibilities of different computer-aided design systems (CAD/CAM/CAE/PDM-systems) that reduce the time of the release of the new family, to improve performance of the truck, as well as reduce the cost of revision.

The structure of failures on KAMAZ trucks in 2010 (Fig.2) is such that the part of frame's failures among others seemingly small. But considering the facts that the truck frame is:

- the main supporting design structure which takes all the stresses of driving on the roads and ground,
- the basis for securing vehicle components and assemblies,
- produced for the total lifecycle of the vehicle before it charge off,

it should be noted the insufficient level of reliability and durability under a variety of loading conditions. This was caused by the fact that the failure of the frame as a result of damage or permanent deformation of its single parts associate with the time-consuming and expensive types of work for its repair or replacement, as well as unplanned downtime of the vehicle.

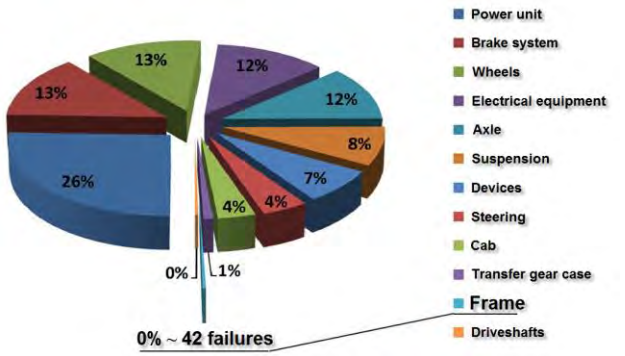

Fig.2 Structure of KAMAZ trucks failures in the warranty period during the 2010

Chassis of wheeled vehicles in operation are subject for random loading because of the impact of road irregularities, variable motion resistance forces, oscillation processes occurring in the body systems, suspension, transmission assemblies and other factors. Therefore stress of design elements characterized by random changing strains over time.

It is noted that the brealdown of the frame elements during operation originates from the action of limit static loads and fatiqung effects.

Frames of KAMAZ trucks take certain forms that vary in minor limits, depending on the purpose of a vehicle as a result of many years of experience in design and vehicle operation (Fig.3).

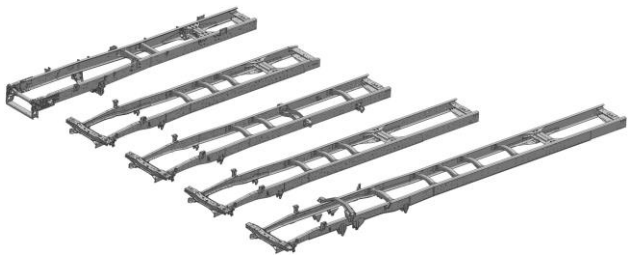

Fig.3 Some models of KAMAZ frames

For comprehensive analysis of the frame's structure design it is advisable to evaluate the stress-strain state in all loading modes that occur in the operation, and not just in limit modes. They may have different effects (over a long period of time) and smaller amplitude values. Such loads considered when determining the fatique strength of the structure, so analysis is also very important.

In the current circumstances the role of computational methods in providing structural strength steadily increased as the need to reduce design time and accelerating organization of mass production and because of the high cost and complexity of experimental researches.

Traditionally to obtain information about the characteristics and properties of the vehicle are widely used experimental researches which at the design phase is not always available. In this case, decisions are based on the experience of creating similar structures, the theoretical analysis and calculation methods. Experience of implementing new vehicle family showed that the expensive, labor-intensive, long-term tests in a number of cases with a reasonable theoretical approach can be replaced by modeling the processes of loading.

Among the many methods of modeling the stress-strain state of parts, in the first place, we should note the finite element method. He has great potential and broad capabilities assessment of stresses in structures with the complex shape. However, the results with acceptable accuracy can be obtained only by using a quite reasonable. The accuracy of the method is influenced by many factors:

- completeness and accuracy of the input data;
- simplifications in the accepted assumptions;
- the degree of perfection of design models (including the methods of accounting of loads, boundary conditions, the object's shape and material properties);
- choise of types of finite (boundary) elements;
- the quality of meshing the elements;
- characteristics and study of numerical algorithms;
- the reliability of the software;
- the computational power of computers.

The system of firm service, which is inherent at the global automotive brands, allows to create united information environment, through which possible to track the entire lifecycle of the vehicle from the moment of its design to utilization. Creating such a system makes it possible to organize the collectionand analysis of the causes of failures and defects that occur during the operation of the vehicle, i.e. definition of design defects and violations of the technology of production of trucks that were not identified during the design and testing of prototypes.

Analysis of statical information of failures reveals the "weak" spots of structure. A record of such information makes it possible to carry out further verification calculations by changing the scheme of loading. Such calculations will identify the causes of failures, finding at what loading is possible such a failure. It will make adjustments to the existing structure, making recommendations to the operation, and also take into account the possibility of a set of situations in the development of new models of vehicles.

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