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*Research Paper*

# The perspective of using 3D-modeling in the designing of technological solutions for chassis design

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**Abstract**

In the modern world 3D-technologies plays an important and significant role in almost every spheres of human life. This is particularly pronounced in industry. Perspectives of using these technologies allow optimizing the production of products of varying complexity, reducing production time and reducing the possibility of defects in the early stages of designing. For the showing the application of 3D modeling its application in vehicle designs considered in this paper. For this purpose a vehicle chassis is designed and then the tension distribution of chassis in the bump condition and its analysis are provided.

***Keywords***: *3D-Modeling; Designing; Computer Three-Dimensional Modeling; Chassis Design.*

## 1. Introduction

Mechanical engineering is one of the most significant and complicated branch oh industry. It shows development level of science and technology in the country. This branch includes such components as military-industrial complex, aircraft industry, shipbuilding industry, rocket-and-space industry, etc. Possible work without modern and computerized designing and high-technology in none of these directions [1-4].

Earlier any manufacturing based on drawings and hand calculations. Nowadays the modern technology not only allows transferring a drawing from paper to computer but making it volume. These technologies are called 3D-modeling and products after this process are called 3D–models. 3D–models are widely spreading. It is actively used in a design, architecture, a mechanical engineering, etc. Engineer who works with 3D–models are called designers.

At a 3D designing decreases number of mistakes in the project by reasons is:

1) Visibility of the result on the stage of designing
2) Types of drawings based on numerical scheme, so situation with different information are absent.
3) At designing of the assembly elements there is an opportunity of assembly checking and detection of mistakes.

To study the load–displacement characteristics of SPWs, Sabouri-Ghomi and Roberts carried out a series of cyclic quasi-static tests in 1991 on 16 unreinforced thin panels, some of which had openings, at small scales [5], [6]. The frame had hinge joints, and the plate was connected to boundary members by bolts. The loading and unloadingoperations were carried out along the diagonals for creating pure shear. All of the panels showed adequate ductility and a capability for dissipating a large amount of energy. They also presented a theoretical method for calculating the shear capacity of the steel plate shear walls, named the Plate and Frame Interaction (PFI) method.

Kharrazi et al. [7] have proposed a theoretical model named Modified Plate and Frame Interaction (M-PFI) for the shear and bending analysis of ductile steel plate shear walls. In this model, the behavior of steel plate shear walls was divided into three different parts: elastic buckling, post buckling, and yielding. Considering the interaction between shear and flexural behavior of steel shear walls, the M-PFI model describes the behavior of SPW systems, and a good compatibility with different experimental results is accessible.

The SPSW has been studied by many researchers, in 2011 Chan et al. studied on stiffness and strength of perforated steel plate shear wall (Figure1.). In this paper they attempted to reduce such demand by introducing perforations to thicker panels. The effect on stiffness and strength was investigated through nonlinear finite element technique. Results demonstrated that under monotonic loading perforations reduce strength and stiffness of the system. In particular, perforations on panel promote more uniform stress on panels and reduce deformation demand on surrounding frame elements. The effect on strength and stiffness is quantified and a simple linear reduction function is proposed [8-11].

## 2. Research method

Local or full 3D–models can be used as well on conceptual designing as so on designing for computer engineering analysis. For example, strength analysis of hull model from plastic allows to determine its weak spots and to make changes in the construction of hull. If required more detailed analysis of design solutions on the basis of 3D–model with help of 3D-printer the prototype of detail can be created very quickly for analysis.

Such solutions of quickly prototyping are a lot of. These solutions differ as well principles of create of prototype as so used materials.

Nowadays a conversion from drawing to 3D–models condition for several reasons:

1) The best visual image of the product. Working in the three-dimensional environment help to designers reduces working time. Detailed visualization of product render help on the all subsequent stages of project development. For example,

from the model you can automatically obtain an image of all the components in disassembled form and to use it in assembly instructions. Engineers of the program "Autodesk" says: «Having a three-dimensional model, we can quickly explain its mechanism. Since everyone is dealing with a three-dimensional construction the stages of verification and approval of the project faster ». Images getting from 3D models are more visual than 2D drawing projections.

2) Automated getting of working drawings. One of the most important advantages of 3D modeling is the fast formation of drawings. Types in different projections are created automatically, thanks to the close connection of two-dimensional and three-dimensional spaces.
3) An easiness of making changes. In the three-dimensional model easy to make changes and the drawings automatically will be re-created after the updating command of the drawings. Three-dimensional SAPR allows to use the available time, that allows to shorten the execution time of the project cycle.
4) Integration with other applications. Thanks to the fact that in 3D models much more engineering information is saved than in standard drawings, Another important advantage of modeling solid bodies is the possibility of using the simulation results in the following stages. Developers of products can analyze strains by the finale element method; also perform kinematic and variation analysis which allows identifying possible design errors in the early stages of the production cycle.
5) Reduction of designing time. For most designers the most important advantage is the shortening working time of project because this is the most important factor in the competition. A typical statement of the head of the project organization: "We must to offer more tight deadlines, or the order will go to competitors". Another result of the reduction in terms is the acceleration of the return on investment.

Computer 3D modeling in animation and graphics makes it possible not only to evaluate external characteristics, but also to work out in detail the internal mechanism with provision designed for performing engineering calculations or managing 3D printers.
The introduction of such high-tech solutions into modern manufacture allows:

- To save resources;
- To increase the production capacity of the company;
- To simplify the technological process;
- To shorten the working time;
- To improve product quality.

All these advantages cause the transition of industrial enterprises to the conversion into the production process of 3D-modeling. This, in turn, requires an increase in the number of specialists in this field on the job market.

## 3. Result of 3D modeling in vehicle design

In this paper 3d modeling of vehicle chassis and suspension system are proposed to evaluate the vibrational performance of the vehicle under various road inputs.
In the first section as shown in figure 1, the chassis is modeled in the ABAQUS software then its vibrational analysis due to vertical displacement of 20cm is proposed.

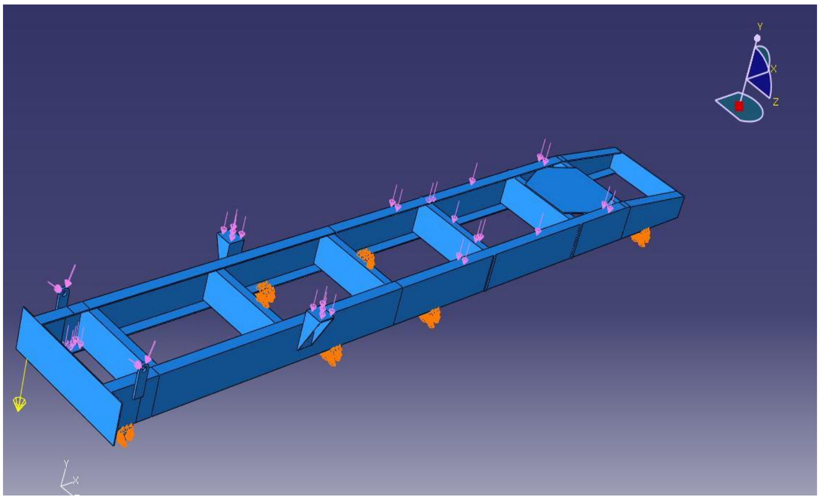

**Fig. 1:** Vehicle Chassis Modeling.

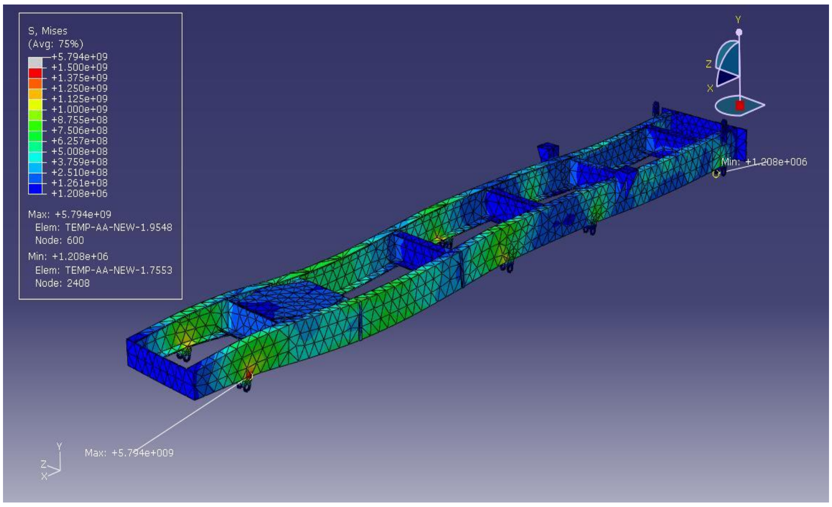


**Fig. 2:** Chassis after Loading, Analyzing and Displaying Critical Tensions.

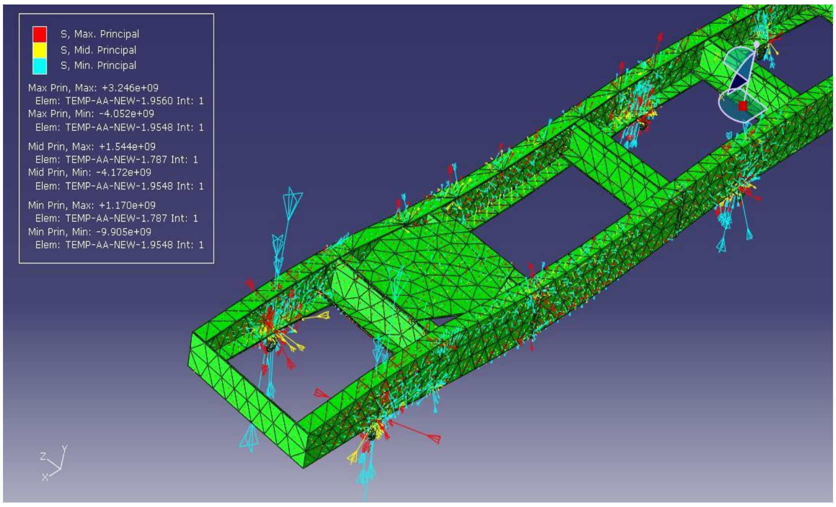


**Fig. 3:** Distribution the Stress Tensor on the Chassis in A Static State.

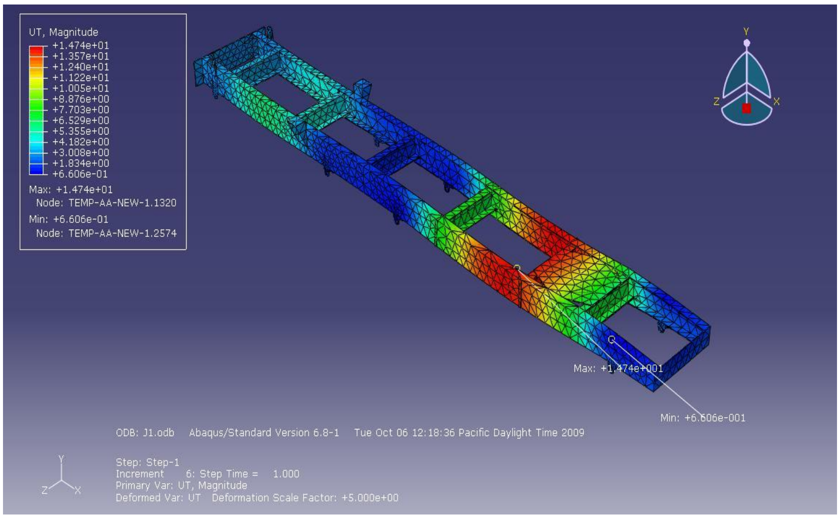


**Fig. 4:** Displacement Values of Chassis Points after Loading.

As the figure above shows, the points under the load carrying by the chassis are more critical than the other chassis points, and the maximum tension occurring in this location is 5.794 Giga paschal. Figure (3) also shows how the stress tensor is on the chassis.
In the second step, the purpose is to find the maximum displacement of the chassis under the desired loading. Figure (4) shows the change of location of the chassis.
As seen, the maximum displacement is 1.5 mm, which is a decent amount for chassis stacking.

## 4. Conclusion

The main objective of this paper was to introducing the application of 3d modelling by the computer aided software's such as CAD/CAM and ABAQUS in the designing the vehicle. So the chassis of truck for by considering the bump was modeled in Catia and then it imported to the ABAQUS for the tension analysis. Results shows the effectiveness of 3d modeling in the designing of mechanical components, which can be results in less cost and time in the design process.

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