

IMPLEMENTATION IN THE EDUCATIONAL PROCESS OF THE SOLIDWORKS SIMULATION

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The activity of engineers in today's professional reality is multifunctional. It includes the design of technological processes and the choice of technological equipment, control over the proper operation of technology, rational organization of interaction between people and technology, improving the efficiency of its use, etc. The rapid change of technology requires constant training of technical specialists. Therefore, the task of improving the efficiency and quality of higher engineering education is now more relevant than ever.

Educational standards of training of engineers are changing in line with new production needs. Therefore, graduates of technical colleges should have professional competencies of free ownership of computer aided design (CAD) systems: modern production requires specialists who own the technologies of software geometric modeling [1].

The main purpose of modern graphic training of mechanical profile engineers is 3D modeling. If necessary, the 3D model is converted to a 2D model, that is, a drawing of the product. To such CAD belongs SolidWorks [2]. It is focused on solving problems in the field of technical mechanics and mechanical engineering.

SolidWorks Simulation it is an appendix to SolidWorks. It is designed to solve the problems of mechanics of a deformed solid by the finite element method (ITU). It is a software for calculations of static strength and stability in linear and nonlinear formulation, eigenfrequency, optimization of shape of parts and assemblies in linear formulation, fatigue analysis and design behavior when falling. The program uses a geometric part model or SolidWorks assembly to form a design model. Integration with SolidWorks makes it possible to minimize operations associated with the specific features of finite element approximation.

The application of SolidWorks Simulation in the educational process will be considered on the example of the strength calculation of toothed of the crane lifting mechanism (fig. 1, item 1).

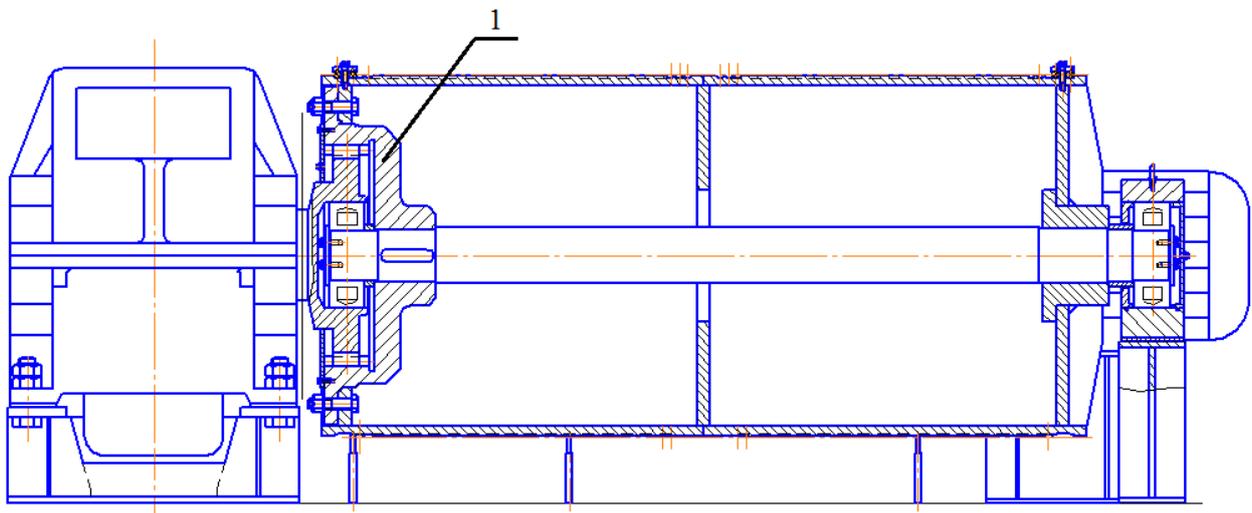


Fig. 1. General view of the mechanism of lifting the crane

There are machines in the system of lifting and transporting machines that work periodically – these are hoisting cranes. They have the basic device as a lifting mechanism. One of the most loaded parts in it is the gear hub. Therefore, for her we

will carry out a static analysis: from the SolidWorks library we will select the material of the hub – steel 45 GOST 535-88 (tensile strength 980 MPa). The definition of the hub supports and the application of the load are shown in fig. 2.

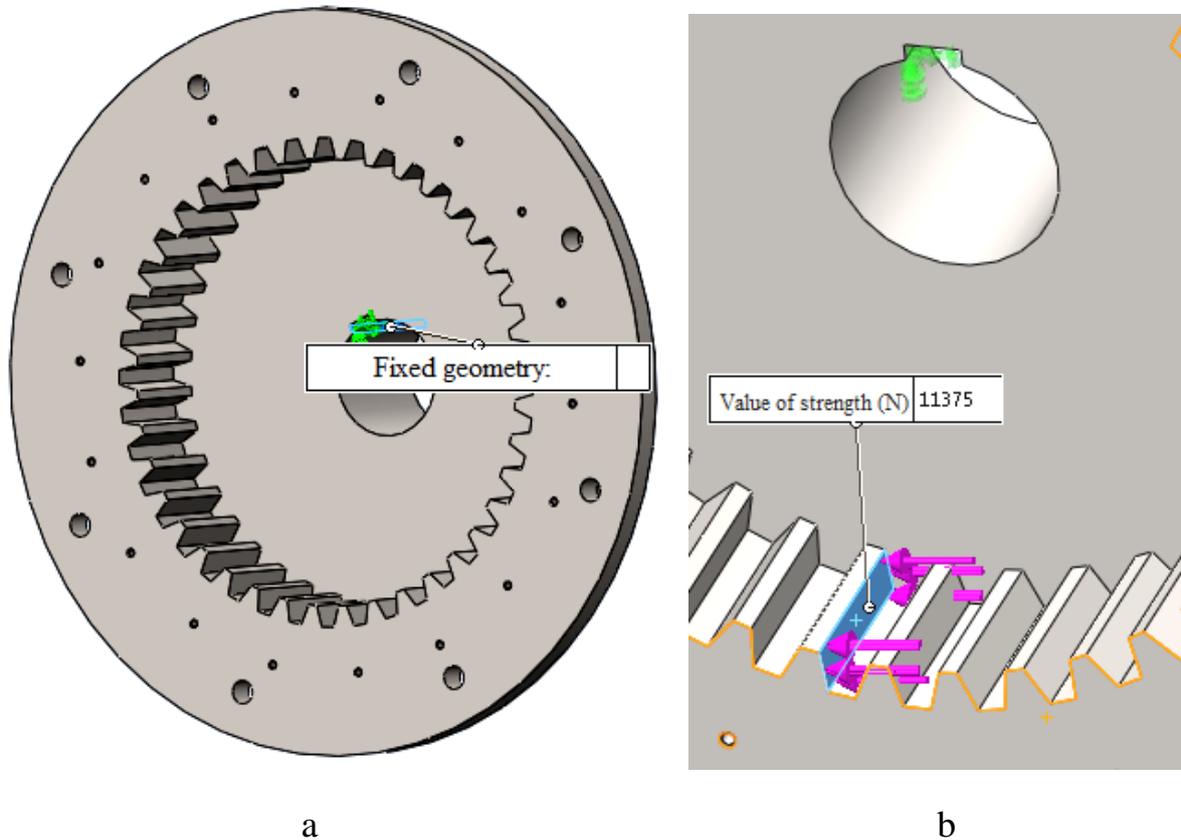


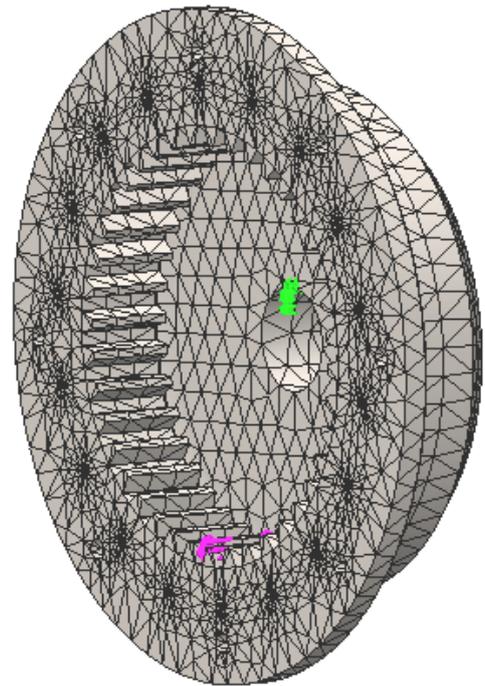
Fig. 2. Definition of hub supports (a) and appendix of loading (b)

The variety and complexity of the geometric shapes of the lifting mechanism parts require application to analyze the stress-strain state of numerical methods such as ITU. Its essence lies in the approximation of a continuous medium with an infinitely large number of degrees of freedom by a set of subregions (or elements) having a finite number of degrees of freedom. There is a relationship between these elements.

The finite element analysis program considers the model as a network of discrete interconnected elements (mesh). ITU predicts model behavior by comparing information (from all elements that make up the model — fig. 3).

Study name	Static analysis (-Default-)
Grid type	Solid grid
Partition used	Standard grid
Auto grid compaction	Turned off
Jacobian points	4 points
Item size	44.4288 mm
Tolerance	2.22144 mm
Grid quality	High
Total nodes	30026
Total elements	17537
Maximum aspect ratio	18.774

a



b

Fig 3. The parameters of the grid (a) and its reflection on the solid (b)

The following calculations set: the maximum stress that occurs in the hub, $\sigma = 383,804$ MPa (node 26998); maximum resulting displacement $h = 1.36248$ mm (node 20250); maximum equivalent deformation $\delta = 0.000719131$ (element 13065); a minimum safety margin of $k = 2,16256$ (node 26998) above the permissible $[k] = 1.5$.

Thus, the calculations guarantee the strength of the hub, and the use of numerical modeling in the educational process increases the ability to set educational tasks and control the process of their implementation. By changing some of the input parameters in numerical modeling, you can track the changes that occur with the model. The main advantage of the method is that it allows you not only to observe, but also to predict the result of the experiment under some special conditions.

The got results confirm actuality undertaken a study at determination of maximum possibilities of the hub. Consequently, a properly set up and managed process for students to master the methods and means of machine design stimulates their interest in a deeper and creative study of fundamental and specialized disciplines. As a result, they will raise their educational and professional rankings.

And training specialists who have the CAD tools and are able to solve specific problems of modern production, allows to intensify the educational process.

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