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IMPLEMENTATION OF THE LATEST LEARNING TECHNOLOGIES BASED ON THE EXAMPLE OF SOLIDWORKS IN THE TRAINING OF COMPETENT SPECIALISTS

Annotation. *SolidWorks is a powerful tool for teaching design with subsequent performance calculations, which supports products at all stages of their life cycle. With its help, a device for fixing the cross-pieces was designed, and the SolidWorks*

Simulation application determined the maximum force that can be applied to one of its most heavily loaded parts – the clamp motionless.

Key words: *SolidWorks, device for fixing the cross-piece, clamp motionless, maximum force.*

Анотація. *SolidWorks – потужний засіб навчання проєктуванню з наступними розрахунками працездатності, за допомогою якого здійснюється підтримка виробів на всіх етапах їх життєвого циклу. За його допомогою спроєктоване пристосування для закріплення хрестовин, а у додатку SolidWorks Simulation визначена максимальна сила, яку можна прикласти до однієї з найбільш навантаженої його деталі – притиску нерухомого.*

Ключові слова: *SolidWorks, пристосування для закріплення хрестовин, притиск нерухомий, максимальна сила.*

Introduction. The modern information and educational space cannot be imagined without the use of the latest learning technologies in the education system, among which information and communication technologies (ICT) are of particular importance. Their potential is huge, but they are not used in full [1; 2].

Creating an educational space equipped with ICT is a difficult task, but it should play a key role in preparing citizens to participate in the information society. ICT acts as a mechanism of access to high-quality and continuous education, while using new models and electronic learning environments [3].

The analysis of the use of ICT for educational purposes showed that their introduction into the education system changes the culture of the educational process, and these changes are complex, because it is the level and quality of the education received that affect the competence of specialists of various profiles. In this regard, the role of methodological, systemic, interdisciplinary knowledge, necessary for the rational and meaningful use of information to solve new, non-standard problems, is significantly increasing [4; 5].

Currently, it is a generally recognized fact that it is impossible to manufacture complex knowledge-intensive products without the use of computer-aided design

(CAD) systems. Modern CAD/CAE systems not only make it possible to shorten the time of introduction of new products, but also have a significant impact on production technology, allowing to increase the quality and reliability of manufactured products. As a result, the competitiveness of the enterprise increases [6].

One of these systems is SolidWorks – a powerful design tool, the core of an integrated enterprise automation complex, which supports the product at all stages of the life cycle in full accordance with the concept of CALS technologies [1; 6].

The main purpose of SolidWorks is to provide an end-to-end design process, engineering analysis and preparation for the production of products of any complexity and purpose, including the creation of interactive documentation and ensuring data exchange with other systems [7; 8].

Analysis of the latest research. Technical rearmament, preparation for the production of new types of machine-building products, and modernization of production facilities include the processes of designing and manufacturing technological equipment [9]. Its purpose is to provide, expand and change the technological capabilities of the equipment.

The technological equipment includes devices that are used for basing, securing and controlling the processed parts on various technological equipment.

For example, the main working surfaces of the crosspiece (item 11 in fig. 1) are four mutually perpendicular trunnions (spike) with central holes. They have high requirements for accuracy, roughness and mutual placement of surfaces. Therefore, for the mechanical processing of the crosspiece, a special device was designed for its fixation, the assembly drawing of which is shown in fig. 1.

The aim of the article. The purpose of this work was to determine the maximum force that can be applied to one of the most heavily loaded parts of the designed device for securing the cross-pieces – clamp motionless (item 3 in fig. 1) with an allowable margin of strength [n] = 3 using the 3D system application solid-state parametric modelling SolidWorks – SolidWorks Simulation [5; 6].

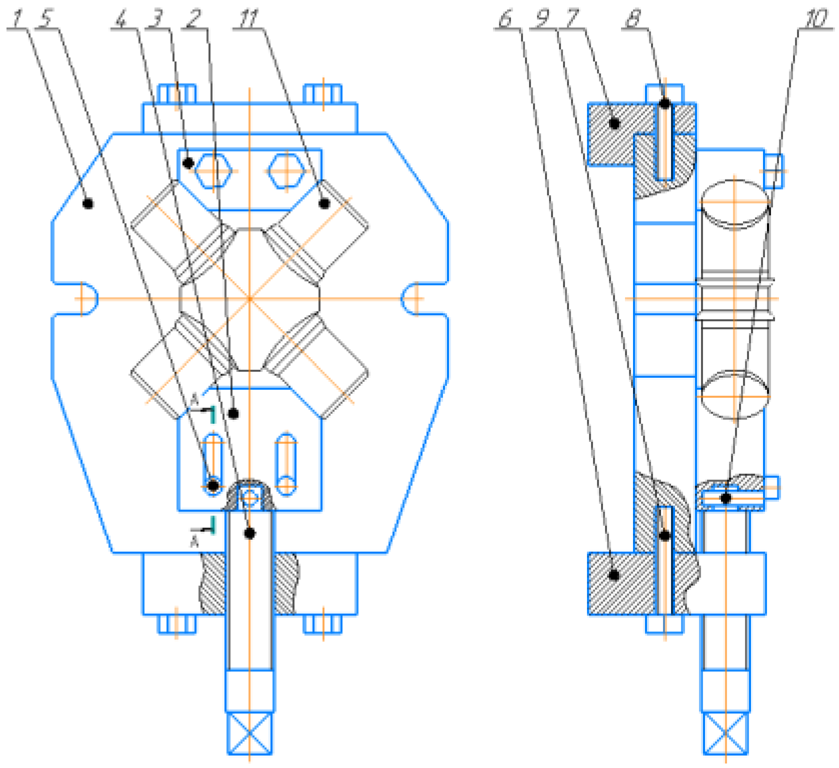


Fig. 1. Assembly drawing of the device for fixing the crosspieces,

1 – base,

2 – movable clamp,

3 – clamp motionless,

4 – screw,

5 – guide;

6 – riser;

7 – leg;

8; 9 – bolts;

10 – pin;

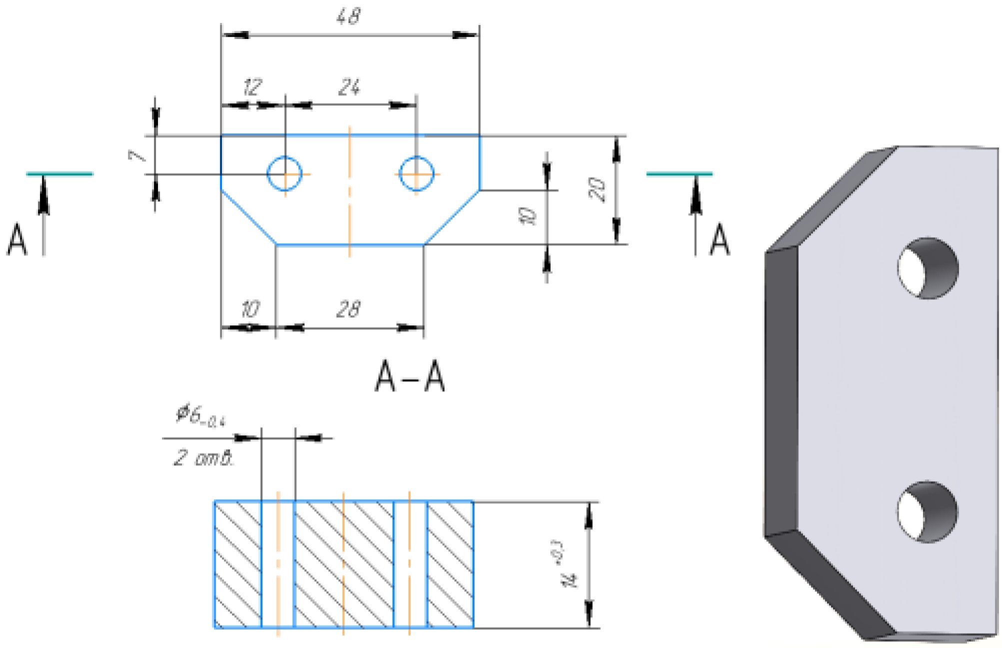
11 – cross-piece.

Research Methodology. The main stages of solid-state design in SolidWorks:

– construction of a sketch;

– creation of a three-dimensional model (fig. 2 shows a drawing of the clamp motionless and its 3D model);

– creation of assembly units (fig. 3 shows the device for fixing cross-piece).



a b

Fig. 2. A drawing of a clamp motionless (a) and its 3D model (b)

The next stage of the calculation is the static analysis of the fixing clamp motionless in SolidWorks Simulation.

Research results. When conducting a static analysis of the clamp motionless model, the following are determined:

– the material of the part (steel 20KHN3A DEST 4543-71 – fig. 4);

– limitations (fig. 4, b);

– external loads (the clamping force depends on the size of the cross-piece and the type of operation performed on the device – fig. 4, c).

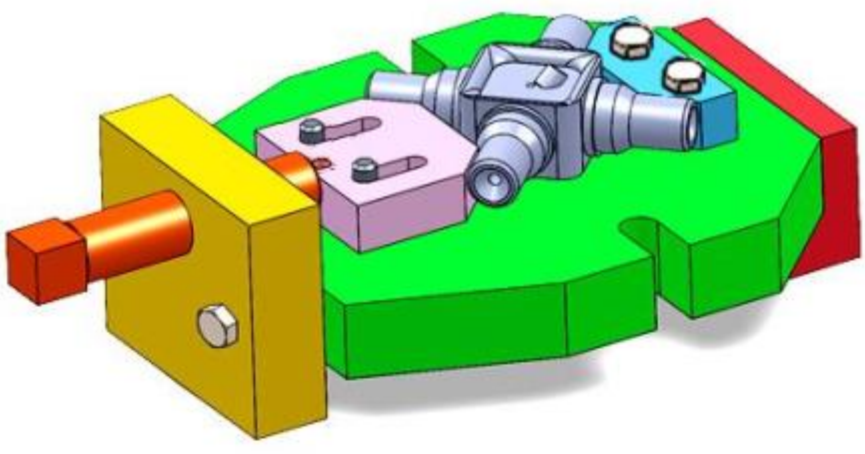


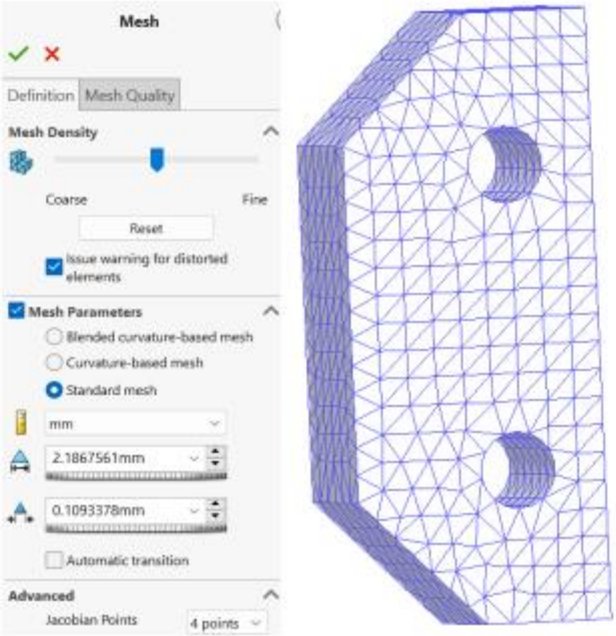
Fig. 3. Device for fixing cross-pieces

a b c

Fig. 4. Designation of the clamp motionless material (a), its limitations (b) and the application of external loads (c)

The following stages of checking the strength parameters of the clamp motionless:

– the grid of the model is created (fig. 5);



a b

Fig. 5. Grid parameters of the model (a) and its display on a solid body (b)

– the stiffness matrix was constructed and the synthesis of the finite-element model from its individual elements was carried out (taking into account the conditions for fixing the fixed pressure at nodal points);

– the obtained system of algebraic equations was solved and the components of the stress-strain state of the clamp motionless (fig. 6).

It was established (fig. 6) that the maximum Von Mises nodal stresses, displacement URES and deformation ESTRN for the clamp motionless are $\sigma = 244.9$ MPa (node 11124), $h = 0.00911$ mm (node 435) and $\delta = 0.0008159$ mm (element 3758), respectively, that is, they do not exceed the permissible values. At the same time, the minimum margin of safety is located at node No. 11124 and is n = 3.001, which is more than the permissible [n] = 3.

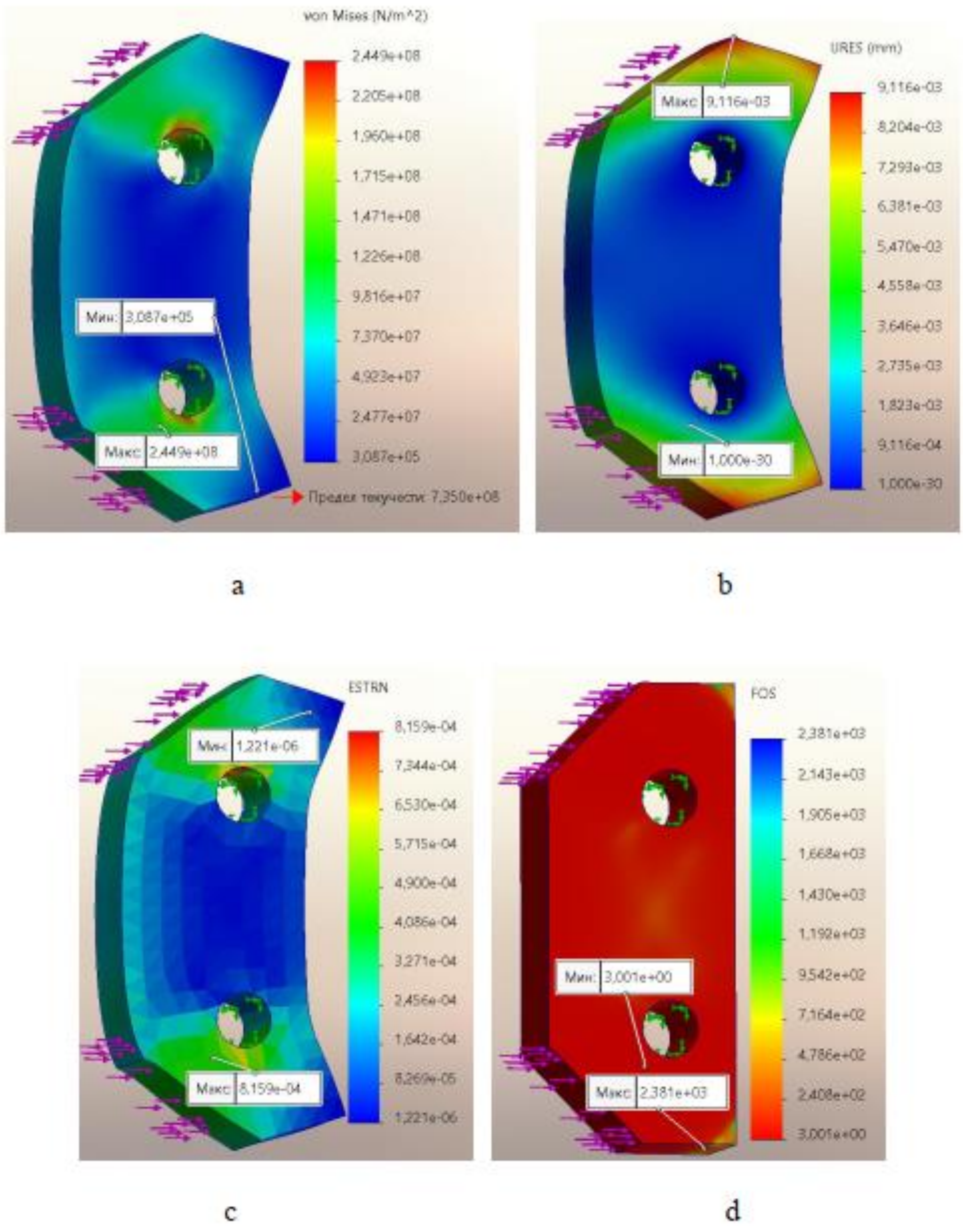


Fig. 6. Calculation results of von Mises stresses (a), total displacements URES (b), total deformations ESTRN (c) and margin of safety FOS (d) of the clamp motionless

Conclusions. For the considered pressure of the stationary device for securing the crosspieces, the maximum force that will not lead to violations of safety techniques (at the minimum permissible margin of strength [n] = 3) will be 12077 N. The obtained results confirm the relevance of the conducted research. But, in order to determine the working capacity of the device in question, it is necessary to examine its other constituent details

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