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APPLICATION OF INFORMATION TECHNOLOGIES FOR CALCULATION OF ENGINE REPAIR STAND

The modern level of development of society dictates the need to introduce educational innovative technologies (IT) into the learning process. Today, scientists note that the main shortcomings of modern education are the lack of sufficient life competence among students and the inability to use the acquired knowledge in practice, especially in non-standard situations.

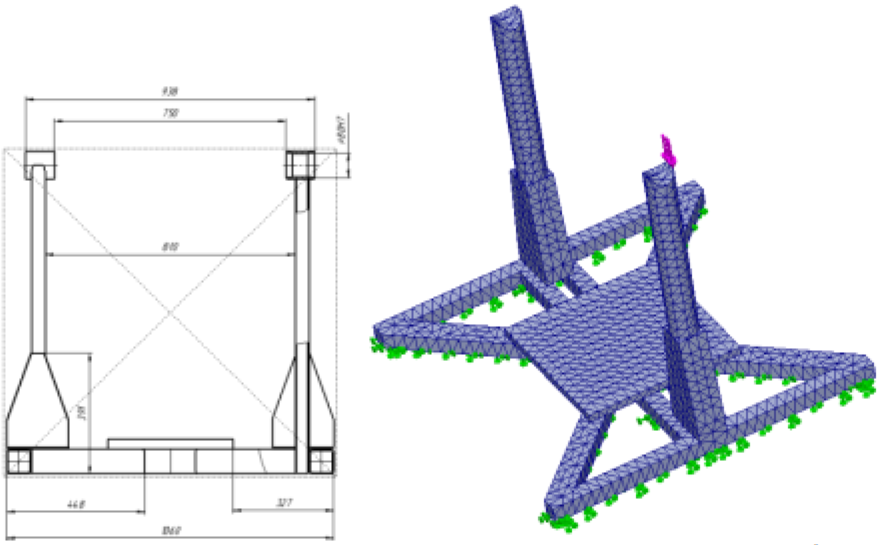
The mechanisms for applying IT are based on the following conceptual provisions: cultivating interest in innovative developments; creating a creative atmosphere and accumulating innovative ideas in permanent student scientific circles; developing innovative and investment diploma projects with mandatory plagiarism checking, etc.

The use of computer IT (in particular, one of the CAD/CAE systems – a software product for creating solid-state graphics SolidWorks [1, 2, 3] and its built-in module for strength calculations SolidWorks Simulation [4, 5, 6]) in engineering calculations of automotive products allows significantly reducing the time for preparing developed projects and improving the quality of technical documentation.

Thus, the authors [7] designed (SolidWorks) and calculated (SolidWorks Simulation) a stand for engine repair. The power unit is fixed on it after being removed from the engine compartment of the car, which simplifies the process of its cleaning, inspection, disassembly, troubleshooting and repair. The stand also serves as a base for further assembly of the power unit and transportation if necessary.

In this work, the maximum load that the rotating beam of the stand will withstand in the event of a violation of safety precautions during its operation (installation of the engine with a skew on one of the ends of the rotating beam) was determined with a planned safety factor of $n = 2$. It was established that the rotating beam will withstand a load of 1965 N. However, to determine the operability of the considered stand, it is necessary to examine its other component parts.

Therefore, in this work, the static strength of the stand frame was tested (fig. 1, a):



a b

Fig. 1 – Assembly drawing of the frame (a) and its 3D model with fixing, load application and mesh display on a solid (b)

– a 3D model of the frame was created in SolidWorks (fig. 1, b);

– in SolidWorks Simulation, its material was assigned (steel 40 DSTU 7809 2015: tensile strength 570 МПа, yield strength 270 МПа);

– fastening was carried out and the loading area was set (F = 1965 N, fig. 1, b);

– created a finite element model of the frame (fig. 1, b: standard mesh, jacobian points for high quality mesh – 4 points, element size – 34,1224 mm, tolerance – 1,70612 mm);

– developed algebraic equations that relate the reaction to the material property, anchorages, and loads; after arranging the equations into a general system, the unknowns were found (fig. 2).

Analysing Fig. 2, we see that the maximum values of stresses, displacements and deformations are much smaller than the permissible values, i.e. the strength parameters of the frame ensure its static strength (the minimum safety factor n = 26.45, which is greater than the accepted [n] = 2).

Name	Type	Min	Max
Stress1	VON: von Mises Stress	2,503e-10N/m^2 Node: 14946	1,040e+07N/m^2 Node: 190

Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	0,000e+00mm Node: 316	3,762e-02mm Node: 190

Name	Type	Min	Max
Strain1	ESTRN: Equivalent Strain	1,919e-21 Element: 2562	2,949e-05 Element: 3391

Name	Type	Min	Max
Factor of Safety1	Automatic	2,645e+01 Node: 190	1,000e+16 Node: 10

Fig. 2 – Von Mises stress, total displacements URES and deformations ESTRN, margin of safety FOS of the frame model

But it is necessary to provide for skewing of the frame (as in work [7], but due to unscrewing the bolts securing it to the floor – aig. 3).

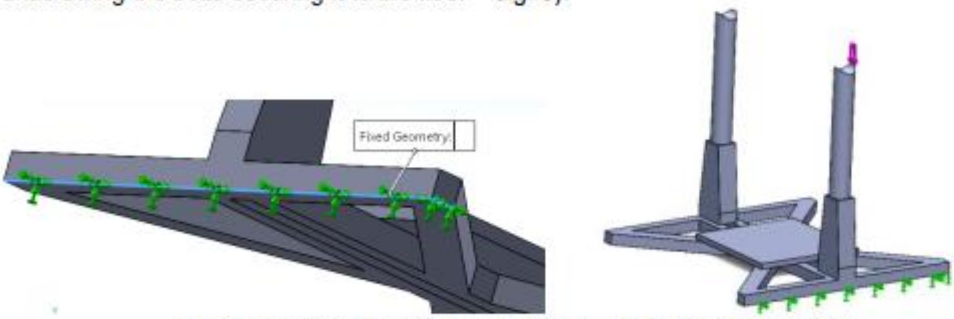


Fig. 3 – Display on the 3D model of the fastening of a skewed frame

After repeated calculations, it was found that the minimum safety factor decreased to n = 14.71.

Thus, the use of the SolidWorks CAD system and its application - the SolidWorks Simulation CAE system – confirms the relevance of the research conducted.

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