

## **THE USE OF SOLIDWORKS AS AN INFORMATION TECHNOLOGY IN EDUCATION**

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The rapid development of information technologies and the active computerization of all sectors of the national economy lead to a growing demand for highly qualified specialists. Such professionals must not only respond to current market requirements but also clearly understand the prospects for the development of their chosen field, forming competencies with consideration of future changes and challenges.

It is particularly important for the training system to stay ahead of current trends, as the complexity of technologies in production is increasing much faster than the rate at which workers' qualifications improve in specific fields. Therefore, the educational process should be focused on developing flexible thinking, the ability for continuous self-development, and effective adaptation to the dynamic conditions of the professional environment

The use of information technologies in education makes it possible to optimize content and modernize the methods and forms of organizing academic activity, ensuring a high scientific and methodological level of teaching. Their application provides broad opportunities for significantly improving the quality of the educational process, enhancing both the level of knowledge acquisition and overall interest in learning.

One of the tools of information technologies is computer modelling, which attracts increased interest due to its ability to analyse physical processes that characterize the stress-strain state of solid bodies. In this context, the 3D solid parametric modelling system SOLIDWORKS [1] and its add-in, SOLIDWORKS Simulation [2, 3], are used. This software product uses the geometric model of a part to generate a computational model. Integration with SOLIDWORKS makes it possible to minimize operations associated with the specific features of finite element approximation (the finite element method is currently the standard for solving solid mechanics problems using numerical algorithms).

The objective of this work was to investigate the shaft-gear of the rear axle of a MAN TGA truck (stress, deformation, displacement, and safety factor) using SOLIDWORKS Simulation.

The material used for manufacturing the shaft-gear is 20KhGR steel (DSTU 7806:2015). The aim of the study was to evaluate the possibility of replacing the shaft-gear material with a cheaper alternative—20 steel (DSTU 7809).

After creating the shaft-gear model in SOLIDWORKS, the initial material selected from the SOLIDWORKS library for its manufacturing was DIN 1.6523 steel

(20NiCrMoS2-2), an analogue of 20XTP steel, followed by AISI 1020 steel as an analogue of 20 steel.

The calculation procedure was as follows: application of boundary conditions, appendix of loads, meshing of the shaft–gear model into finite elements and their assembly (mesh parameters: element size 9.52242 mm, tolerance 0.476121 mm, high mesh quality, total nodes 23,579, total elements 14,878, maximum aspect ratio 21.009), solving the resulting system of algebraic equations to determine the components of the stress–strain state (Table 1), material replacement, repetition, and analysis of the calculations.

Table 1 – The results of the shaft–gear model study

Steel	Tension Von Mises (max.), $\sigma$ , MPa	The resulting displacement URES (max.), $h$ , mm	Equivalent strain ESTRN (max.), $\delta$ , mm	Margin of durability FOS (min.), $n_{min}$
20XTP	79,372 Node 16637	2,397e-02 Node 19166	2,001e-04 Element 5668	7,441e+00 Node 16637
20	89,333 Node 16678	2,271e-02mm Node 18798	1,714e-04 Element 14004	3,936e+00 Node 16678

Since the minimum safety factor for the shaft–gear made of 20KhGR steel is  $n_{min} = 7,441$ , and for 20 steel it is  $n_{min} = 3,936$ , both of which exceed the allowable value  $[n_{min}] = 1,5$ , the replacement of 20KhGR steel with 20 steel for manufacturing the shaft–gear does not compromise its operability.

#### References

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