

## COMPUTER GRAPHICS IN MECHANICAL ENGINEERING

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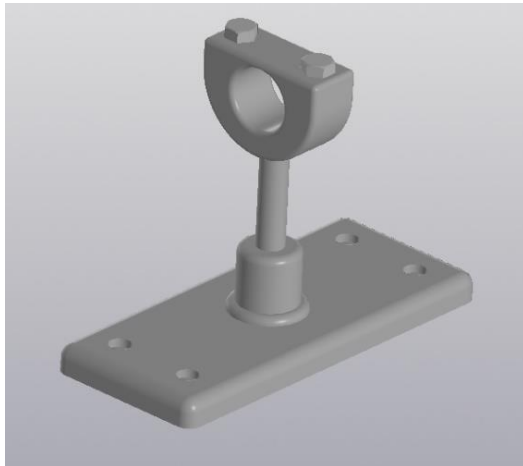
Mechanical engineering as a branch of applied engineering dates back to the 18th century, when such devices as weaving machines, spinning machines, and steam engines were first produced by people [1]. Since then, mechanical engineering has developed rapidly, and at some points in the world history, it has undergone revolutionary changes. Such events include the creation of the steam engine, the industrial revolution of the 18<sup>th</sup>-19<sup>th</sup> centuries, the second industrial revolution of the 19<sup>th</sup>-20<sup>th</sup> centuries, scientific and technological progress in the 20<sup>th</sup> century, and the globalization of the 21<sup>st</sup> century.

Regarding scientific and technological progress and globalization, it was during these periods that people realized the prospects of using computer graphics in mechanical engineering. The first significant impetus for this was the development of CAD from IBM. Already in the 1980s, solid modeling began to be used everywhere. And in 1982, Autodesk released its development – the CAD product Autocad. In 1995, SolidWorks Corporation released the SolidWorks program [2].

All these events led to the understanding of the fact that it is practically impossible to imagine modern mechanical engineering without close interaction with computer graphics and all opportunities offered by this practical engineering tool. However, actual implementations of computer graphics are multifaceted and therefore its various aspects of influence on mechanical engineering will be considered separately below.

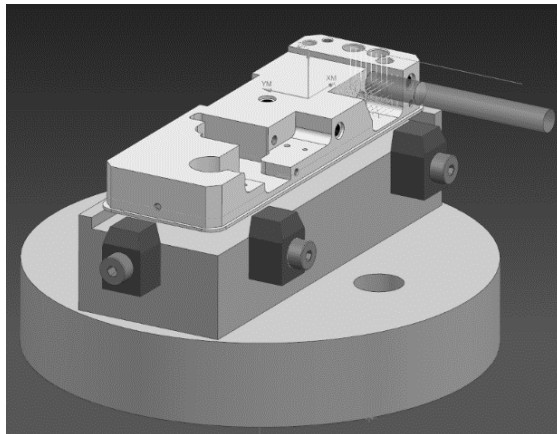
*CAD (computer-aided design) systems* are software that automates the work of a design engineer and allows solving problems of designing products and drawing up technical documentation using a personal computer [3]. In other words, such programs optimize, speed up and improve the work of any design engineer including mechanical engineers dealing with the design of various machines. The most common CAD systems are SolidWorks for 3D modeling and AutoCAD for 2D drawing. In Rus-

sia, they created and patented their own CAD system – KOMIAC-3D, which has already found its users (Fig. 1).



*Figure 1 – The simplest assembly in KOMIAC-3D*

*CAM (computer-aided manufacturing) systems* automate calculations of tool paths for processing on machines and provide the issuance of control programs using a computer (Fig. 2) [3].



*Figure 2 – Examples of developments in CAM systems*

Automated programming of CNC machines has significantly accelerated and optimized production. And this is not surprising, because the CAM system can cope with the creation of a control program for manufacturing a detail on a CNC machine several times faster than a professionally trained operator [4].

However, computer graphics is used to prepare data in a digital format not only for CNC machine tools, but also for 3D printers, which allows the production of details with high precision and close tolerances.

*CAE (computer-aided engineering) systems* are designed to solve various engineering problems, such as calculating structural strength, analyzing thermal processes, calculating hydraulic and pneumatic systems and mechanisms [3]. CAE systems permit virtual testing of engineering designs under various conditions applied, which helps identify potential problematic issues early in the design process. CAE systems have proven their effectiveness in testing products for safety and durability, and some engineering projects have begun to be implemented in a more optimal way.

*Visualization* is the creation of high-quality images and animations that help to better understand the design and functionality of a product and present engineering ideas more vividly and accessibly. Visualization is a very useful engineering tool for any mechanical designer, because thanks to it you can clearly and graphically understand what and how will work, you can find problems and errors, make any production process more efficient, which will ultimately lead to an improvement in the production process.

## References

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