CAD APPLICATIONS IN DESIGNING AND MANUFACTURING DEVICES WITH ECCENTRIC

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ABSTRACT: *This paper presents a case study on the design of an eccentric mechanism device, made in SolidWorks. Analyzing the eccentric shaft through functions such as Mass Properties and Section View enabled detailed evaluation of physical and structural characteristics, optimizing the design and preparing the part for CNC machining.*

KEY WORDS: design, simulation, device, eccentric shaft

1. INTRODUCTION

Solidworks software allows the designer to select the material for the finished part or assembly from the software bill of materials, allowing the designer to view the weight and product surface. There are many optional plug-ins available for SolidWorks software. For example, plug-ins can be used to evaluate part durability. The durability of a design can be illustrated by applying a desired amount of force or product pressure in the software simulation section.

SolidWorks is a parametric 3D design software that allows the user to create three-dimensional objects, create complex drawings that contain one or more components. The term parametric means that the dimensions of the designed object can be changed later so that the modeling geometry changes. SolidWorks has three basic functions: part, assembly, and drawing. **Part** - The designer draws the geometry and sets the dimensions of the object in the part section.

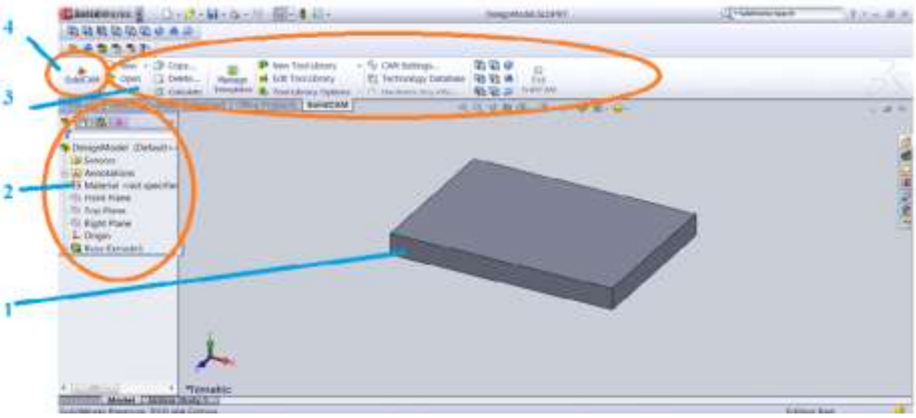

Fig.1. **Interfață SolidWorks**

Assembly - Assembly allows the designer to assemble individual objects or components by linking them together using the Mate function.

Drawing – The 3D part or assembly is shown as a 2D model, using both ANSI (inch) and ISO (mm) standards. In figure 1, you can also see the user interface of

SolidWorks, as follows: area 2 - the table with the orders for making the part is represented, area 3 - the order characteristics, area 1 - the part made up to a certain point, and in area 4 is the icon where you can switch from Solidwork to SolidCAM.

2. CASE STUDY

For the case study, a sub-assembly of a device was taken into account, the construction of which is a mechanism with an eccentric, figure 2. Sub-assembly comprising the following parts: eccentric support, half-bearing, eccentric shaft, clamping piece. All parts of the sub-assembly were made in SOLIDWORK and with the help of SOLIDCAM the processing programs for CNCs were made.

Each part of the subassembly shown was made and analyzed in SolidWorks. In this work, the shaft part with eccentric is presented in detail.

Figures 3 and 4 show the shaft with eccentric.

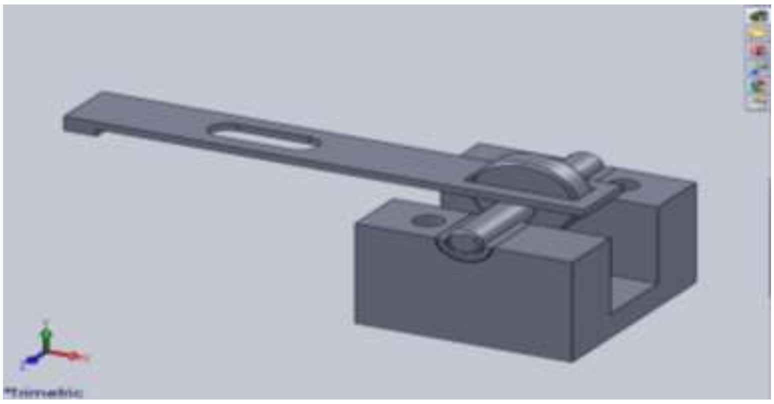

Fig.2. The eccentric device

Fig.3. **Eccentric shaft – XY view**

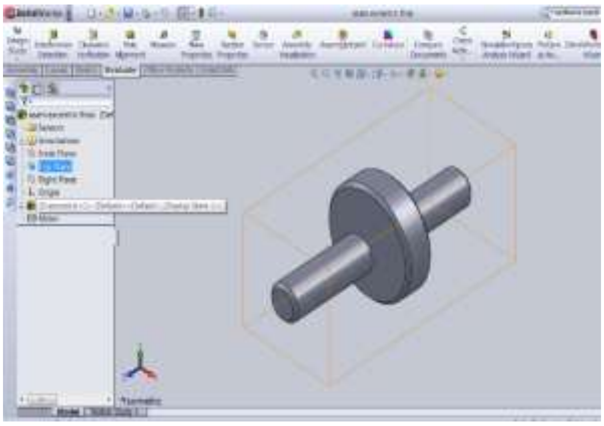

Fig.4. Eccentric shaft –XYZ isometric

The program provides, in addition to design functionality, the ability to determine various essential physical characteristics of the part using the MASS PROPERTIES command. This function allows the calculation of parameters such as volume and surface, essential aspects in the evaluation and optimization of the project, figure 5.

This image provides detailed information about the mass properties of a subassembly designed in CAD software (SOLIDWORKS). From the Mass Properties section, we can extract the following important data:

volume- data about the volume of the part, which is an essential value in the evaluation of material density and production costs; area- the total area of the part, useful for estimating the area required for finishing or painting.

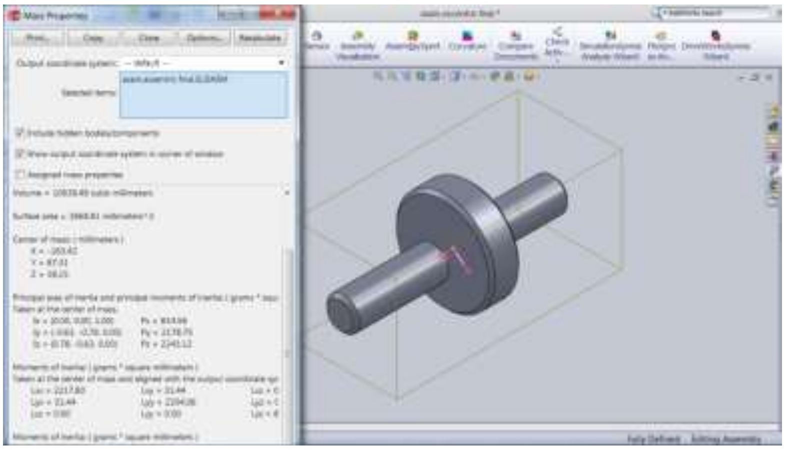

Fig. 5. Determination of the mass and volume of the part.

Center of Mass: The coordinates of the center of mass are specified in millimeters on the X, Y and Z axes. These are crucial in analyzing the stability and balance of the part.
Principal Moments of Inertia: Values of the principal moments of inertia (Pz, Py and Pz) are shown, providing information on the resistance to rotation about various axes, an important consideration for part dynamics within the subassembly/device.
Moments of Inertia: moments of inertia values relative to the coordinate system (Lx, Ly and Lz) provide additional detail about the behavior of the moving part, essential for dynamic simulations. This data can be used to evaluate the design in terms of stability, mass distribution and part behavior in various mechanical applications.

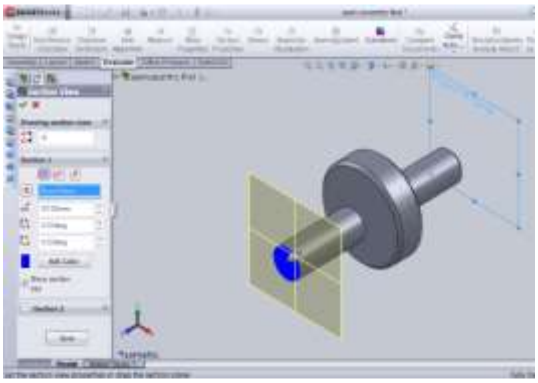

Fig.5. Section in the piece in frontal view

In addition, the program allowed the creation of detailed sections of the part through the SECTION VIEW command, which facilitates the analysis of the internal structure and configuration of the components, thus contributing to a thorough understanding of the project, figure 5. This figure shows a cross section of the shaft part with eccentric made in the CAD software, using the Section View command. From this image, we can extract the following information: Section view - the section plane is defined on the front plane (Front Plane), cutting the subassembly to a depth of 67.00 mm.
This view allows examination of the subassembly's internal structure, including shape, dimensions, and any voids or spaces. Detailed analysis - through sectioning, material distribution, wall thickness and how the component parts are interconnected can be assessed. This is essential for assessing the structural strength and weight of the part.
Section plane settings - left command window provides control over section position and angle.

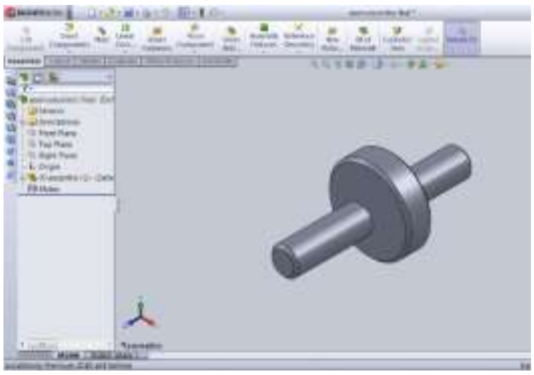

Fig.6. Using the ASSEMBLY and MATE

commands

In this case, the angles are set to 0°, indicating a section perpendicular to the frontal plane. Clarity of View - Sectioning the part allows engineers to observe internal details without altering the structure of the 3D model, making it a useful method for pre-production design inspection.

This cross-section is useful for checking design features

which are not visible in the external view module and help in the functional and structural analysis of the subassembly. To be assembled with other parts, choose the ASSEMBLY command and the MATE command, fig.6. This image shows an isometric view of a subassembly created in CAD software, with no sections or internal details exposed. From this view, we can extract the assembly condition information. Note the Mate section in the model browser, suggesting that constraints have been applied to align and fix the position of the components within the subassembly. These constraints are important for maintaining the structural and functional integrity of the model in assembly.

We also have viewing perspectives, the isometric view facilitates the evaluation of the three-dimensional aspect of the subassembly/device and allows a clear perception of the proportions and arrangement of the components. Along with the commands shown for the eccentric shaft part, we have other commands that are used to make the parts correctly. One of these commands refers to drawing deviations and tolerances. These can be done with the help of the geometric tolerances command and contribute to the precision and compliance of the part with the technical standards. If we are interested in making a statistic of the commands used to make a piece, we can access the feature statistics command. This gives insight into their frequency and complexity.

3. CONCLUSIONS

Making the eccentric shaft in SolidWorks involves several essential steps and technical considerations.

The following conclusions can be drawn from what has been presented:

The technical specifications regarding the dimensions, but also the material, are necessary

Creating the 3D model requires a basic sketch, but also how to achieve the eccentricity of the part

Modeling functions are required, generally extrusion or revolution functions for accurate shaft shape Structural analysis can be done through simulation and dimensional tolerances can be checked

It can generate 2D and 3D drawings that provide detailed information on dimensions, tolerances and manufacturing specifications.

All of these conclusions are intended to guide the process of designing an eccentric shaft in SolidWorks, ensuring that all important aspects are taken into account to achieve a quality end product.

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