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GEOMETRIC MODELING AND SIMULATION OF BUTTERFLY VALVE

Adil Muminović; Elmedin Mešić; Nedim Pervan
Faculty of Mechanical Engineering Sarajevo
Vilsonovo šetalište 9, 71000 Sarajevo
Bosnia and Herzegovina

ABSTRACT
Design process is basically the information process, because starting from the idea, performed using the data and knowledge, and ends with information about how to object to look and what behavior is expected during operation. Also, used and processed a large amount of data, which is a perfect area for the application of computers.
This paper presents basic principles of computer-aided design using an example of butterfly valve. Modelling was performed with CAD/CAM/CAE software package CATIA V5. Geometric modeling of parts and assembly of butterfly valve was performed in Sketcher, Part Design Assembly Design and kinematic analysis was performed in DMU kinematics module.
Keywords: design, geometric modeling, butterfly valve.

1. INTRODUCTION
Geometric modeling is a branch of applied mathematics and computational geometry that studies methods and algorithms for the mathematical description of shapes. Geometric modeling of mechanical parts using computers is much wider importance of graphic representation. In this regard, we emphasize several important feature of this design. Firstly, the possibility of composing elements from the simple shapes. This mode is significantly enhanced with the possibility of translation, rotation, cutting, etc. Secondly, the possibility of forming a library of shapes that repeat themselves. This allows us to design process is reduced to selecting and composing mechanical assemblies from already developed and saved forms. Finally, the third feature of this design is the possibility to convert the spatial shape of parts and assemblies in planar projection, according to the regulations of technical drawing. Below we will presents geometric modeling parts and assembly of butterfly valve in the CAD package CATIA.
A butterfly valve is a valve which can be used for isolating or regulating flow. The closing mechanism takes the form of a disk. Operation is similar to that of a ball valve, which allows for quick shut off. Butterfly valves are generally favored because they are lower in cost to other valve designs as well as being lighter in weight, meaning less support is required.

2. GEOMETRIC MODELING OF BUTTERFLY VALVE
Solid modeling was performed using of the basic tools ‘*Sketcher*’. The procedure was composed of creating a contour cylinder, setting constraint, shafting contours, making holes with and without threading, linear and circular copy. In our modeling the valve body, we used the following tools: *Profile or Line, Circle, Constraint, Pad, Pocket, Hole, Rectangular pattern i Circular pattern*.
The base model of the body is obtained by using the Circle tool in *Sketcher* module which is used for creating 2D basics of mechanical parts. (Fig. 1) It is important to note that sketched geometry in *Sketcher* module define using *Constraint* tool. Then, the basic form of the valve body we are formed in *Part design* module using *Pad* tool. (Fig. 2)

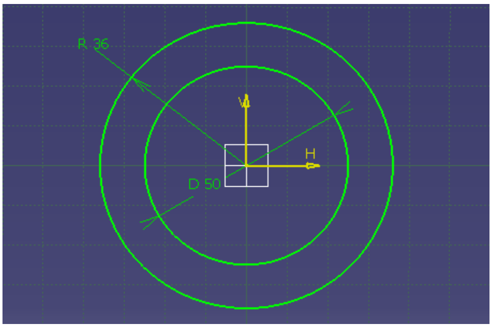

Figure 1. The basic contours of the valve body in Sketcher module

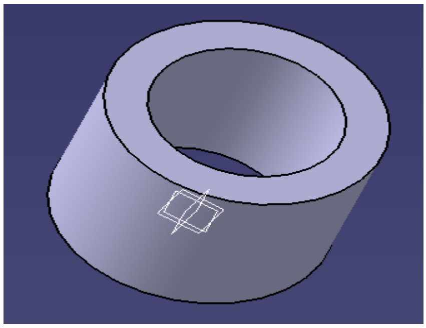

Figure 2. The basic form of valve in Part Design module

In the same way, we have created a flange on the body of butterfly valve, where we use the *Rectangular pattern* tool, to facilitate the creation of identical flange on the other side of the body of butterfly valve. (Fig. 3)

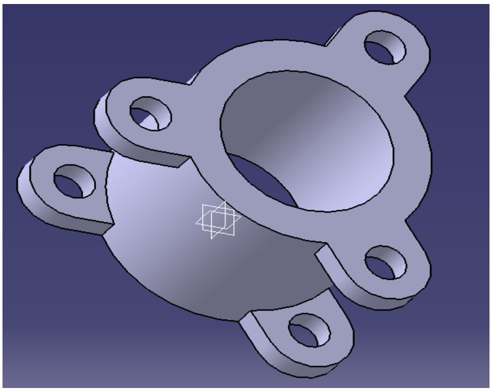

Figure 3. Model of the valve body with flanges

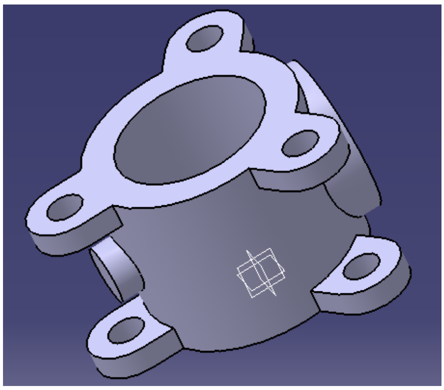

Figure 4. Edge of bearings on the outside of the valve body

On the valve body there are two bearings for the valve shaft. First, we need to create edge of bearings on the body of the butterfly valve. In the same way as we have created a flange on the body of valve, thus we have created edge of bearings, using the *Sketcher* module where we draw the basis of bearings, and then using the *Pad* tool in module *Part design* have created cylinder on the outside of the valve body. (Fig. 4)

The next step in geometric modeling of the valve body is creating a hole for the shaft. For creating a holes we have used a tool *Pocket*. Before using the tool *Pocket*, it is necessary to draw contour of hole in the *Sketcher* module, and then we define the depth of hole using a tool *Pocket*. (Fig. 5)
The final step in geometric modeling of the valve body is creating a threaded holes. For creating a threaded holes we have used a tool *Hole*. After defining the one of threaded hole, using the tool *Circular Pattern*, we were performed a circular copy of threaded holes. (Fig. 6)

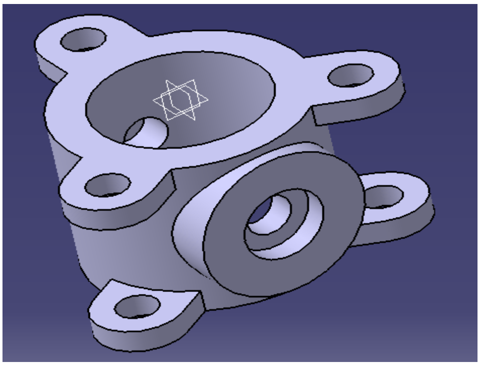

Figure 5. The holes for the shaft on the valve body

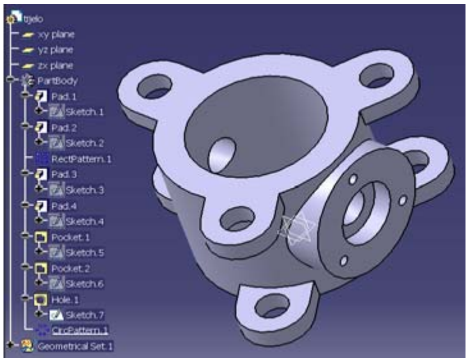

Figure 6. The final appearance of the body of butterfly valve

In a similar way we were performed the geometric modeling of shaft and lever for butterfly valve in *Sketcher* and *Part Design* module, where we used the following tools: *Profile* or *Line*, *Constraint*, *Shaft*, *Thread*, *Pad* ,*Pocket*, and *Hole*. (Fig. 7 and 8)

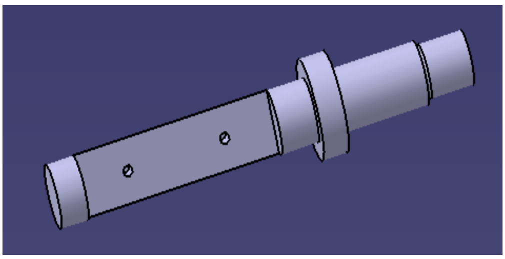

Figure 7. The shaft of butterfly valve

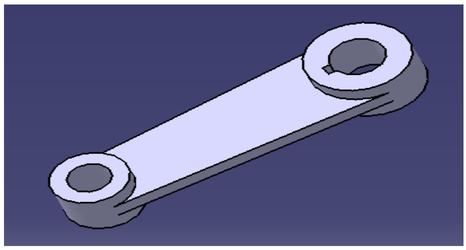

Figure 8. The lever of butterfly valve

After we performed geometric modeling parts of butterfly valve, it is necessary to assembly the parts in *Assembly Design* module, where we used the following tools: *Manipulation, Fix Component, Coincidence Constraint, Contact Constraint, Offset Constraint*, and *Catalog Browser*.

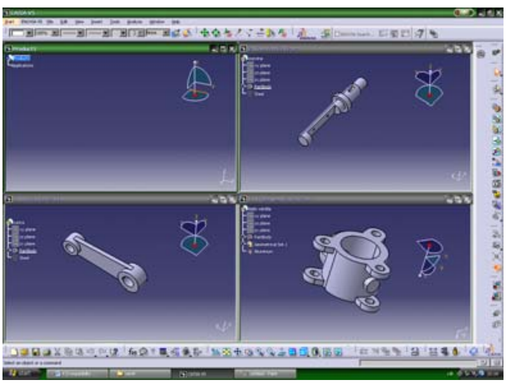

Figure 9. Assembly Design module with open Parts and Product.

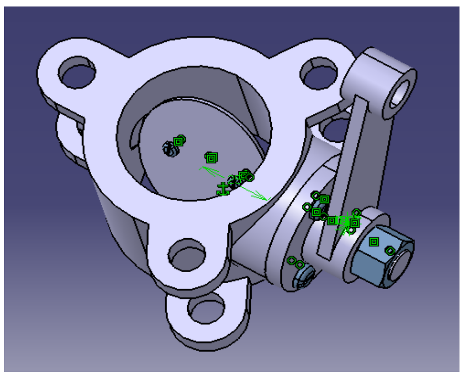

Figure 10. The final appearance of butterfly valve in Assembly Design module

First, it is necessary to open up all parts from which we want to create an assembly. (Fig. 9) After that, we perform positioning of components using *Manipulation* tool. The next step is to define the exact relationship between the selected two parts, where we used the following tools: ***Fix, Coincidence Constraint, Contact Constraint, Offset Constraint i Angle Constraint.*** The last step is to add standard elements from the *Library*. (Fig. 10)

3. SIMULATION OF BUTTERFLY VALVE

Simulation of butterfly valve we were performed in *DMU Kinematics module*. (Fig. 11). Using command *Assembly Constraints Conversion* can be automatically set up the most commonly used compounds based on existing constraints from the *Assembly Design* module. After the formation of the mechanism, it is necessary to set the degrees of freedom of the mechanism. Now, our mechanism is ready for simulation, which we perform using *Simulation* tools from the tool palette *Simulation DMU Generic Animation*. (Fig. 12)

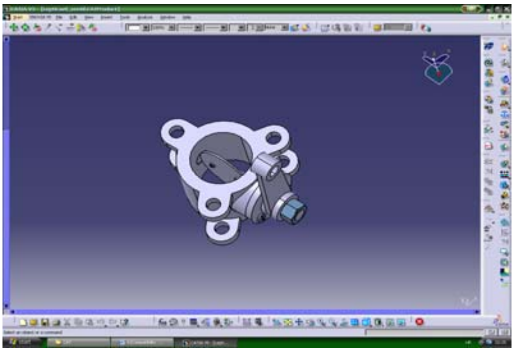

Figure 11. The butterfly valve in DMU kinematics module

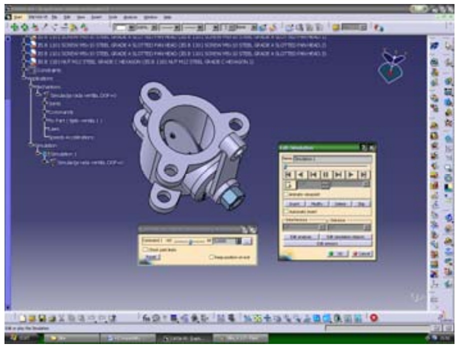

Figure 12. The final appearance of butterfly valve in DMU Kinematics module

4. CONCLUSION

For the solution of geometric modeling and simulation of butterfly valve we used the software package CATIA V5, which is one of the leading integrated CAD / CAM / CAE software systems in the world. This paper describes the application an interactive approach to solutions of this problem using the module: *Part Design*, *Assembly Design* and *DMU Kinematics*. All used modules of CATIA V5 software package are integrated into one unit. Thus, it is possible to automatically update the changes, which were made in some of the modules, through complete application. *Assembly Design* module provides a flexible and intuitive tools that allow the formation of assemblies based on the components and subassemblies. In *DMU Kinematics* module can be performed simulations of assemblies, which are related to kinematics, while dynamic analysis in CATIA V5 software package are not possible.

5. REFERENCES

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