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3D MODELING OF A DREDGING EQUIPMENT ATTACHED TO THE EXCAVATOR ARM

Abstract: *The paper presents an optimized constructive solution of a 3D modeled design for dredging equipment attached to the excavator arm. The project is a model for different types of dimensions required. By extension, this equipment can be a solution for equipping excavators in order to increase the field of use and exploitation.*

Keywords*: CAD, CAE, dredging equipment, excavator.*

1. INTRODUCTION

Dredging equipment using mud pumps is intended to extract mud from swampy areas or areas saturated with mud. Mud is a fluid made up of a mixture of argil and water.

Also, these submersible pumps can be used for:

- restoration and cleaning of watercourses, contaminated water basins;
- restoration and greening of fish ponds;
- cleaning of wastewater treatment basins;
- unclogging of dam dams of hydropower plants;
- restoration of canals and water basins for irrigation.

The optimization of the design of this type of equipment can be done with Solid Edge software which provides for engineers involved in the CAD, CAE, CAM systems solutions using an intuitive and unified product development and performing 3D design, analysis and digital manufacturing.

2. DESCRIPTION, COMPONENTS, OPERATION

Submersible pumps with cutter at the end of the pump are mainly used for dredging. Thanks to the cutter they have the possibility to work to penetrate deep and to extract the mud at the same time.

The working method is relatively simple, based on the absorption of the centrifugal pump of water and the material displaced (dug) by the dredging equipment. During the activity, the milling arm will move left - right (Figure 1) as in the case of a conventional milling and at the same time, at the end of each stroke, it will advance to the same cutting level with a determined step or will advance in depth. (Figure 2).

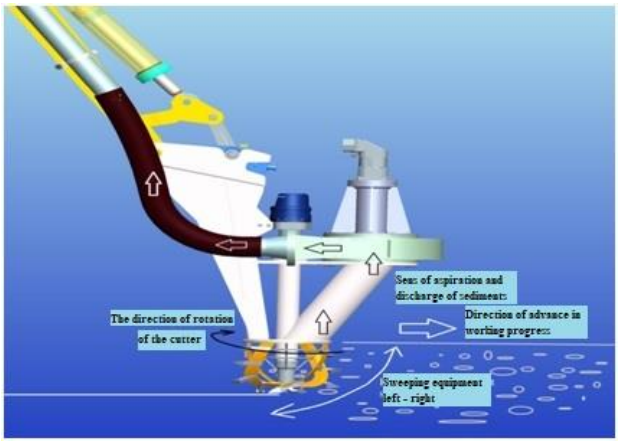

Figure 1 Dredging equipment

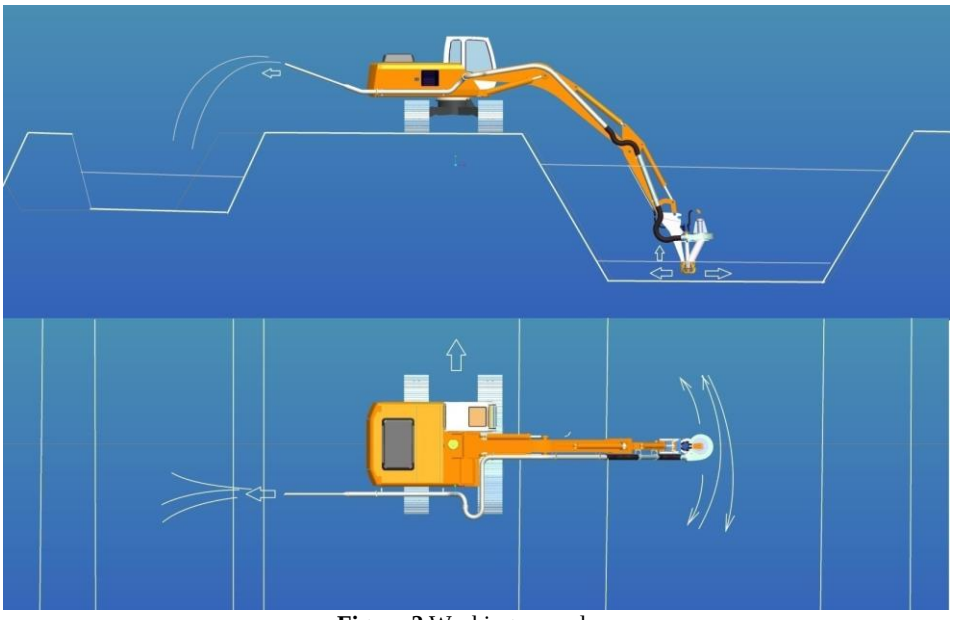

Figure 2 Working procedure

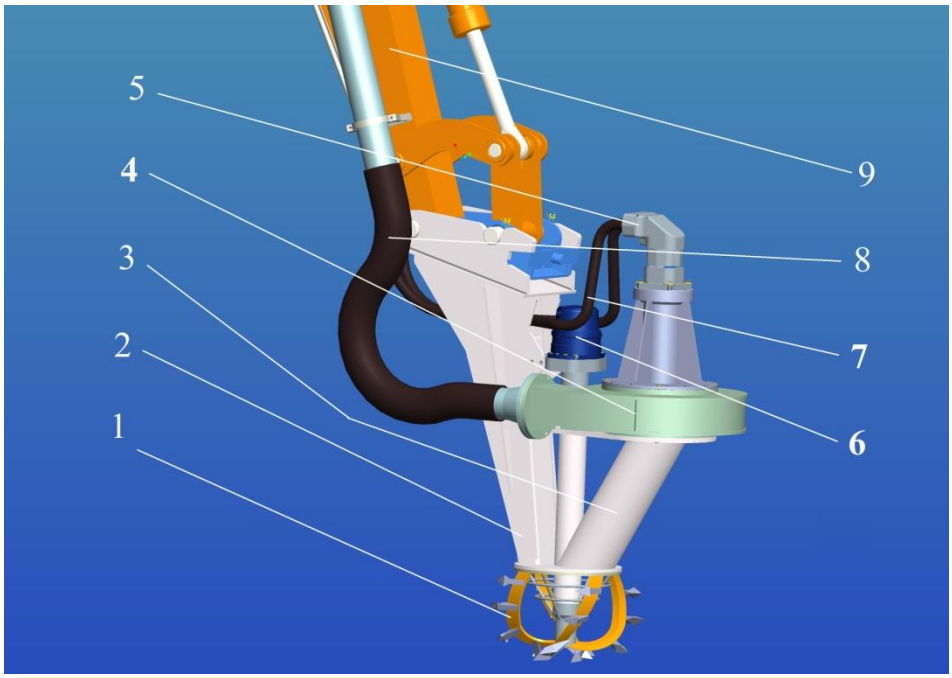

Figure 3 Dredging equipment

In Figure 3 is represented a dredging equipment with the following structure: item 1 is a cutting cutter with the role of dislocating the working material; item 2 is a cutting support which is the assembling base; item 3 is an absorption nozzle and facilitates the entry of excavated material into the pump; item 4 is a centrifugal pump which absorbs and transports the excavated material; item 5 is the hydraulic pump engine which provides working energy; item 6 is the slow hydraulic engine and converts hydraulic energy into mechanical energy; item 7 are hydraulic hoses which facilitate the transport of hydraulic energy; item 8 are couplings and transport pipe that ensures the evacuation of the excavated material; item 9 is the drive arm that ensures deep drive.

In Figure 4 is represented a section thru the centrifugal pump with the following structure: 1-pump housing; 2-pump rotor; 3-screw; 4-wedge; 5-drive shaft; 6-presetupa; 7-hydraulic engine support; 8-sealing ring; 9-screw and Grower washer; 10-bearing; 11, 13-elastic ring; 12-spacer; 14, 15-locking washer and crenellated nut; 16-keyway; 17-drive coupling.

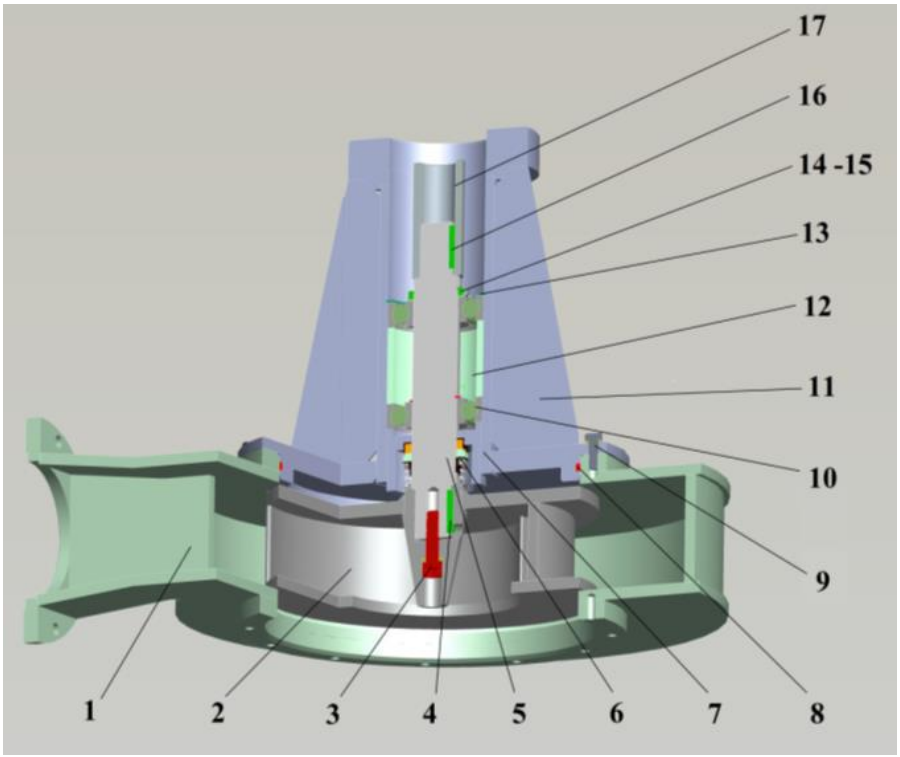

Figure 4 Section thru a centrifugal pump

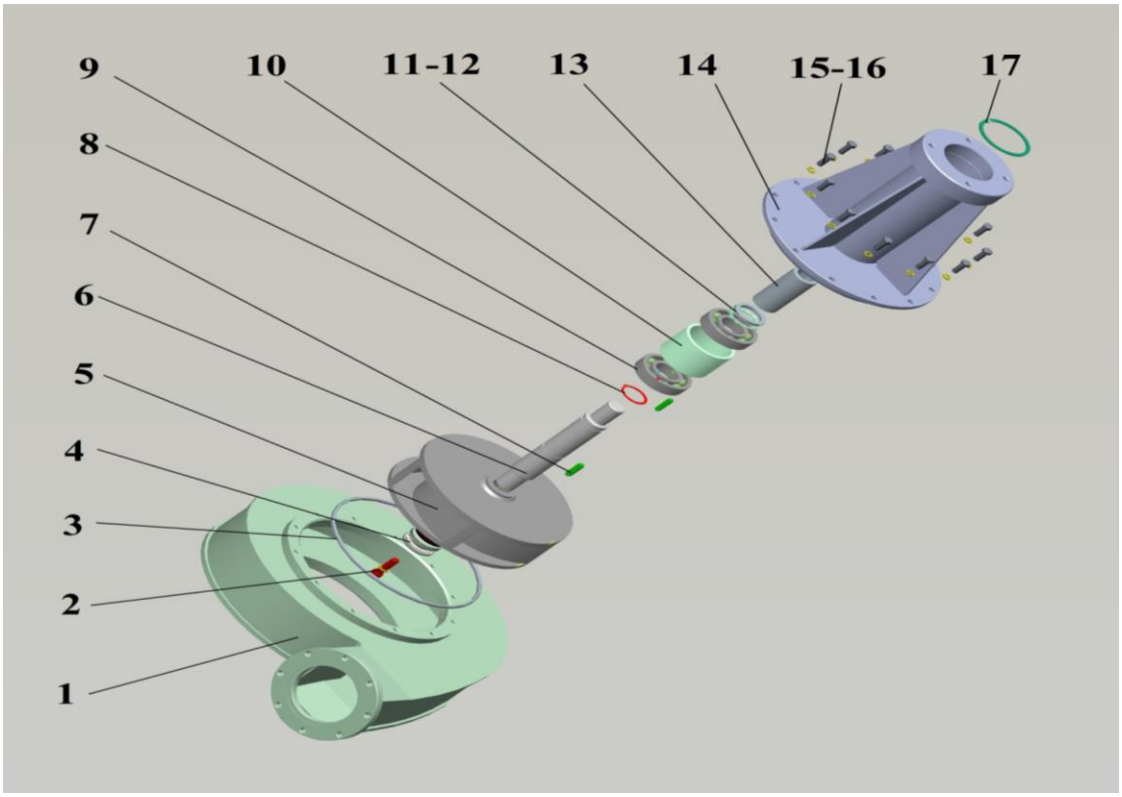

Figure 5 Centrifugal pump - expanded view

In Figure 5 is represented an expanded view of the centrifugal pump with the following structure: 1- pump housing; 2-screw; 3-sealing ring; 4-presetupa; 5-pump rotor; 6-drive shaft; 7-keyway; 8-elastic ring; 9-bearing; 10-spacer; 11, 12- locking washer and crenellated nut; 13- drive coupling; 14-hydraulic engine support; 15, 16-screw and Grower washer; 17-elastic ring.

Pump characteristics are:
- flow, Q=400 m^3/h
- pumping height, H=10 m
- recommended rotation, n=1450 rot/min.

Figure 6 represents the cutting cutter with the following structure: 1-driving sleeve; 2-propeller blade; 3-tooth; 4, 6-ring; 5-rod; 7-basic ring.

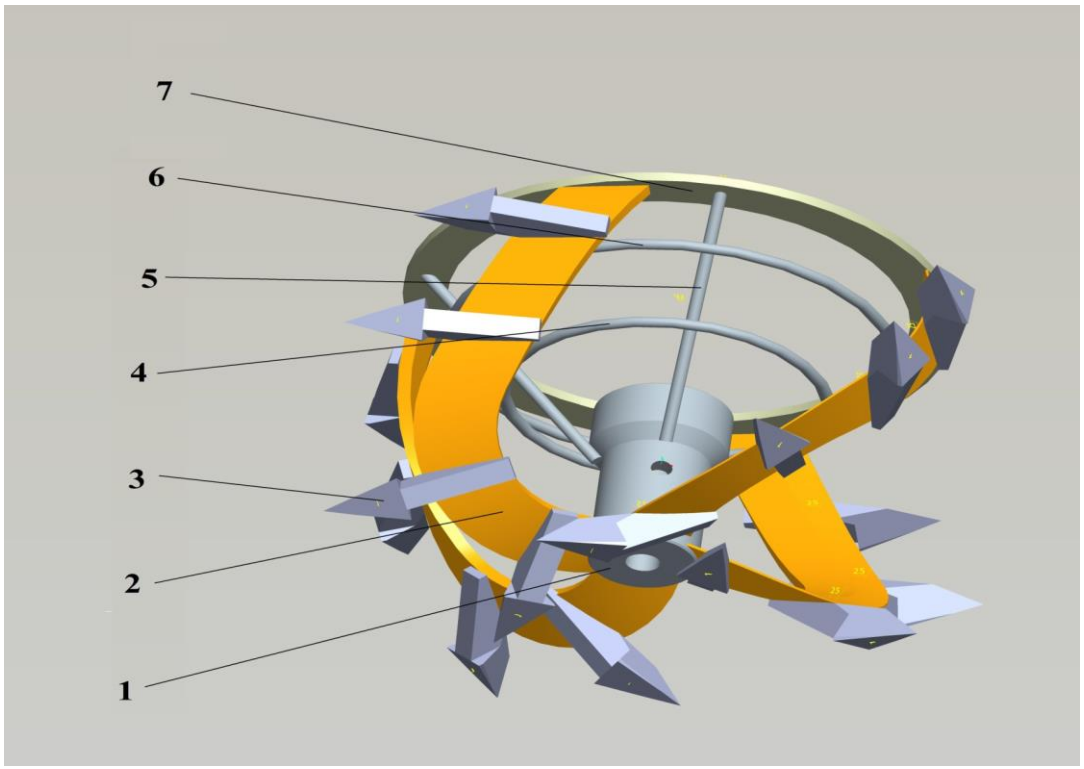

Figure 6 The cutting cutter

The most important and at the same time the most requested part of the presented dredging equipment is the drive shaft of the cutter for which a static analysis will be performed.

In order to have the certainty that the designed shaft will correspond to the functional role, the end of the shaft will be loaded in which the milling cutter is mounted with a moment 3 times higher than the one developed by the hydraulic motor, ie 300Nm. The moment will be applied right in the wedge channel which will make it possible to drive the cutter, the grooved end will be immobilized and the guide surfaces of the shaft will be constrained cylindrically (see Figure 7)

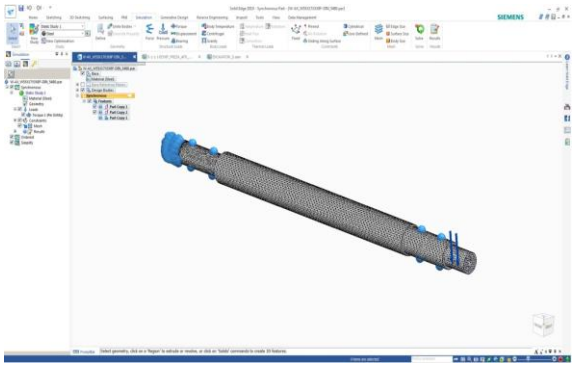

Figure 7 Cutting cutter shaft with constraints, loads and discretized

After the launch of the software in the first phase, the loading is displayed as a result and with the indication of the critical areas if necessary (Figure 8)

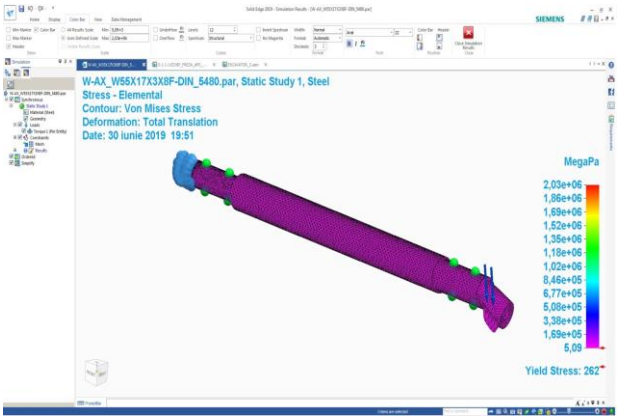

Figure 8 Load of „stress”

Deformations are shown in Figure 9.

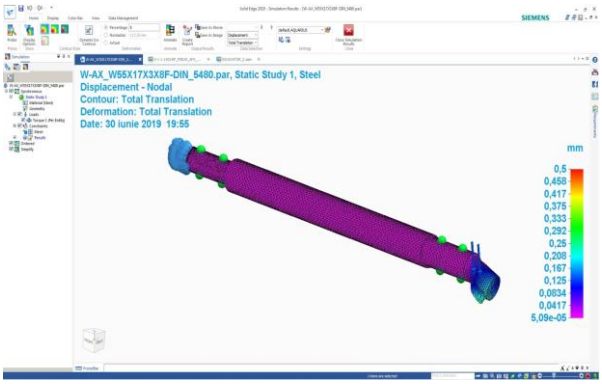

Figure 9 Deformations

3. CONCLUSIONS

The following elements may be considered innovative in this paper:

- the 3D model allows the parameterization of an equipment necessary for the dredging works as well as for the exploitation;
- the constructive solution of this type of equipment allows the evacuation of a quantity of mud and a reduced volume of water.

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