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THE SELECTION OF CUTTING BODIES GEOMETRY OF ROTOR DREDGE REGARDING THE WORKING AREA CHARACTERISTICS

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ABSTRACT
The research in this study is based on search for optimal geometry of rotor dredge cutting bodies, regarding the working area. The influence of working area on more alternative solutions of cutting bodies geometry has been considered. Previous solutions of design of rotor dredge cutting bodies leave the space for further research and improvement in this area.
In research, actually in design of cutting bodies, the use of numeric methods and appropriate software solutions is inevitable. In this research the finite elements method has been used (FME).
Keywords: *dredge, cutting body, excavation resistance, finite elements method, modeling.*

1. INTRODUCTION
The process of excavation and scraping of working area often results in the process of cutting, so we have different geometries and tool materials which are used for cutting. In the analysis of process we mainly lean on the principles and thesis derived for metal cutting, therefore, some authors based their interpretations of this process on theories derived for metal cutting.
Dimensions of knife models are taken from the catalogue of a producer VEB Lauchhammerwerk, Takraf-Germany. Two models of cutting body have been analyzed in this study.
The model of cutting body type1 is shown in the Figure 1, and model of cutting body type2, in Figure

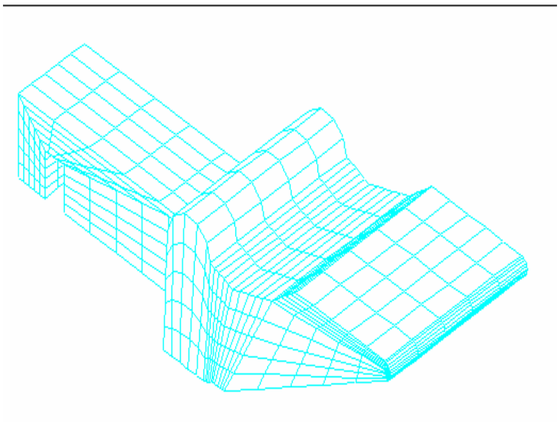


Figure 1. The model of object of study (type 1)

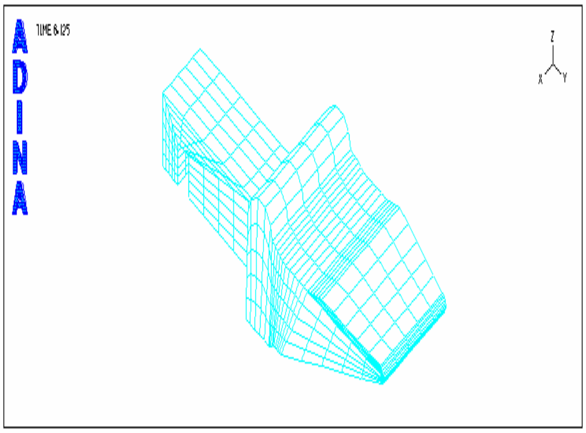
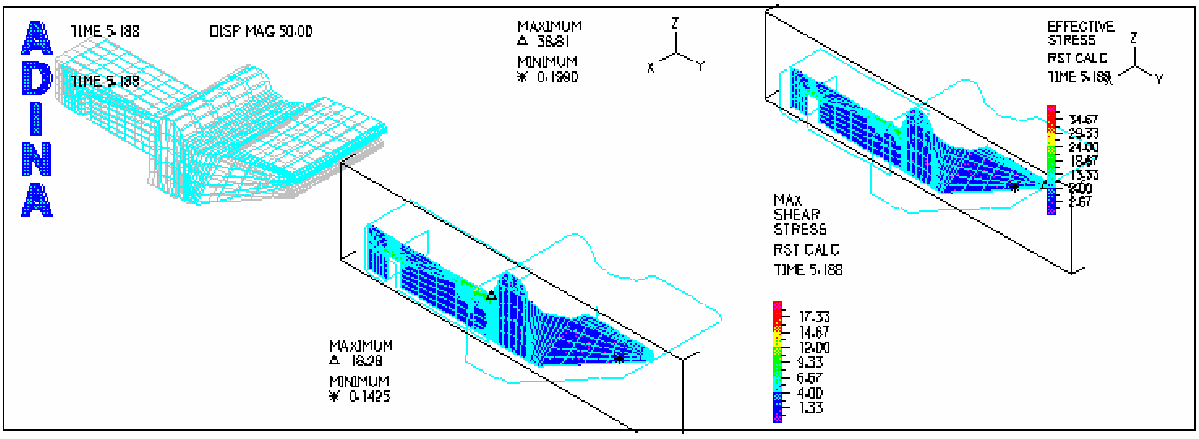


Figure 2. The model of object of study (type 2)

2. THE RESISTANCE MODELING

The working area where the dredge operates is of a complex geological composition, and the most abundant materials are coal, clay and sand. In this calculation, the focus was on determination of a maximum excavation force resistance in a particular working area. Figure 3 shows the stresses and deformations in the clay working area, for the cutting body type 1.



Slika 3. Figure 3 Stress and deformation disposition in clay, type 1

3.THE RESULTS OF STUDY

Table 1. The extent of destruction force of working area for type 1 and type 2

Cutting body (N/cm²)	Sand	Coal	Clay
Type 1	87,5	57,5	25,74
Type 2	5,5	57,2	30,62

For determination of cutting body working parameters and for the selection of shape, it is necessary to define and to analyze the critical points. In this case, the extents of pressure and maximum sliding stresses have been selected. Figures 4 and 5 shows the stress disposition in cutting bodies for the given lithological elements:

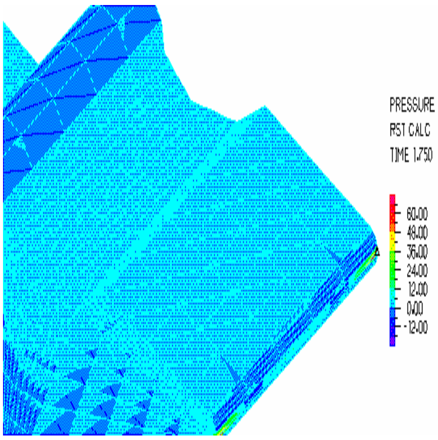


Figure 4. Model cutting body 1 – sand

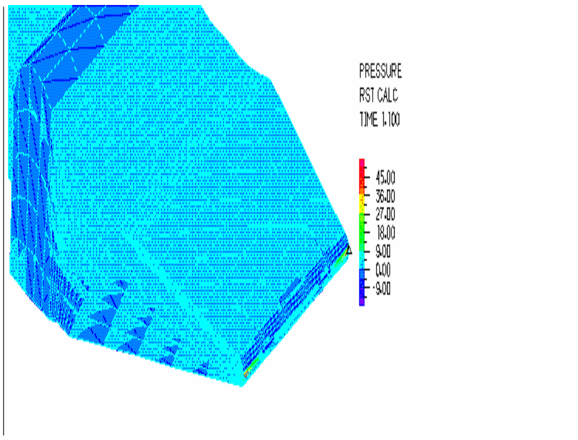


Figure 5. Model cutting body 2 – sand (pressure)

According to the size of sliding and pressure parameters, it can be seen that the extreme values are on the edges of cutting body and they are from 200 kN/cm² to 32 kN/cm², depending on the shape of cutting body and type of lithological element.
The pressure size on a cutting body indicates on the sensitive points on the cutting body, and in that area it is necessary to strengthen the material or to construct that particular part of cutting body from some other more quality material. Experience-based data shows that this part wears the most. From the results of calculation it is notable the difference of force size for different types of knives. For example, our results have shown the less stress in clay for the cutting body type 1, while in the sand it is opposite.

The implementation of these orientations can have the significant influence on calculation of total cutting force. For the dredge with shovel of six cutting bodies (6 cutting bodies on the shovel, the width of cutting bodies is
85mm and 95mm and the width of space between is 280mm and 230mm) we can calculate required power for the dredge.

Table 2. Calculated force value for the dredge power calculation

Material	**Excavation force model type-1 (kN)**	**Excavation force model type-2 (kN)**
Sand	105	66
Coal	690	685
Clay	463	367

4. CONCLUSION

The information and data obtained in this research indicate on the difference between the data from "in situ" measurements, laboratory test and calculation results. The variation between obtained and calculated parameters occurs because of idealization of models (compact environment, without cracks and discontinuity) from one side, and way of measurement and interpretations of specific values from the other side.
Discrepancy between the data gained in the laboratory and by measurement is up to 20%, and variation of the data, between the measured and calculated is up to 12%.
In this study we came to the following data: installed dredge power on a surface coal mine PK Dubrave is 500kW, and required power, according to the calculation is 700kW (for coal). With this power, the number of cutting bodies should be less, and that would affect on the dredge capacity. For dimensioning of shovel for the rotor dredge, the number of cutting bodies must be taken into consideration, as well as their arrangement and calculated force size which affects on the cutting body. As an extreme case it is assumed that all cutting bodies are under the action of maximum force (which has been taken into consideration in power calculation), but it is also necessary to consider the eccentric case of load (stress). For optimal selection of cutting bodies and rotor dredge, it is necessary to know the characteristics of working area and their influence on work of all dredge components.

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