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Computational method for determining the static stiffness of the saw blade

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Abstract: *Computational method for determining the static stiffness of the saw blade.* This article describes how modeling and calculation of stress and strain of the saw blade with a complex body geometry using computer programs aided for design.

Keywords: wood cutting, circular sawing machine

INTRODUCTION

Static stiffness of saw blades is one of the key factors determining the effects of cutting. Its knowledge is therefore essential both at the design stage saws, as well as at the stage of its operation.

The difficult construction of the saw blade resulting from different kinds of shapes, sizes and quantities: chip grooves, as well as notch: compensating, cooling, soundproofing and scrapers causes to determine the saw blade stiffness of the most used experimental methods [Wasielewski]. These methods are simple and precise and therefore readily applied. But the main drawback of this method is that we have a real saw.

At the stage of analysis, for example, the impact of saw blade construction and its attachment to the stiffness, however, is more useful computational method for determining the static stiffness of a saw blade. The complex construction of saw blade makes, however, that theoretical designation the static stiffness is possible only using numerical methods.

SAW BLADE MODELING

For the numerical calculations was used saw blade model created in ProEngineer [DUCHNICZ]. During modeling aplied several simplifications:

- saw blade has a uniform thickness throughout the cross section (not included thicker blades and knives, scrapers),
- saw blade shall be made of the same material (not considered into account that the scraper blades and knives are made of cemented carbide),
- saw blade attachment is via: collars (fig. 1a) (does not take into consideration the manufacturing deviation of collars), or take of the six degrees of freedom on the outside diameter of collars (fig. 1b).

a) b)

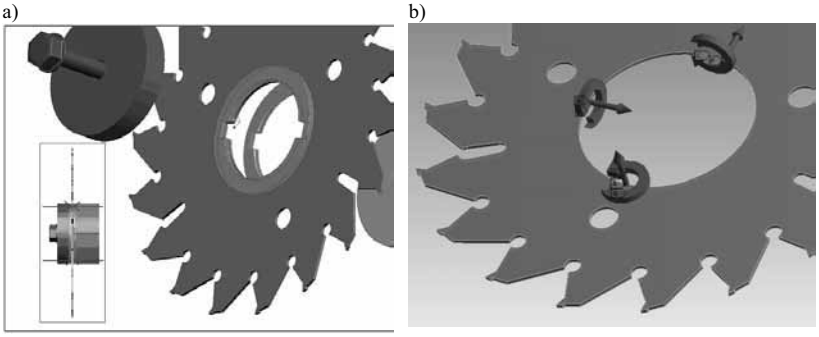

Fig. 1. Attachment of the saw blade: a) with collars, b) with take of the six degrees of freedom on the outside diameter of collars

The purpose of this simplification is to minimize the need for high processing power of computer, where one of the reasons is advanced stage and the number of geometric features considering example.

CALCULATION OF THE VALUE OF STRESS AND STRAIN

To determine the values of stress and strain or displacement saw blades use a commercial computer program ANSYS, which used for finite element method calculations.

In this program, defined the basic parameters of the saw blades material properties such as Young's modulus, Poisson's number and density. Next, was chosen structural model and defined the element mesh size divide. Next, model divided into finite elements fig. 2a and defined the boundary conditions such as fixed support and the load. The force value loading the saw blade adopted a value of F = 50N. This force implemented to the edge of the blades in the direction of the axis of rotation in the form of two parallel vectors each 25N, separated by a few millimeters fig. 2b. This load eliminates the relatively large, very often the maximum strain and stress, which could be undesirable, and thus cause an error of calculation. The effect of incorrect loading of a saw blade resulting from the implementation of a concentrated force to the blade shown in fig 2c. In this picture showing stress concentration at the applied force.

An example of the effects of stress and strain calculations of the saw blade shown in Figure 3. The presented method of presentation of calculation results and visualization of stress and strain or displacement of the body, allows not only determine their value in a certain points, but more importantly shows the size and extent of stress and strain of saw blade body.

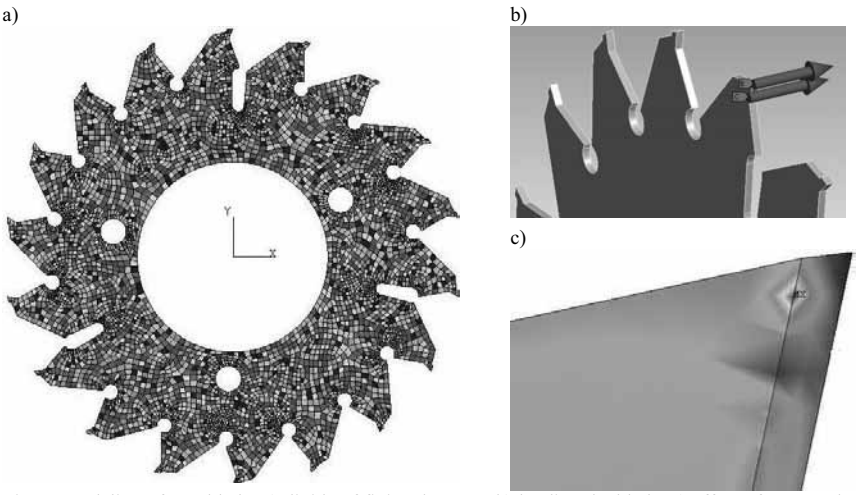

Fig. 2. Modeling of saw blade: a) divide of finite elements, b) loading the blade, c) effect of stress calculation, in the case concentrated force loading

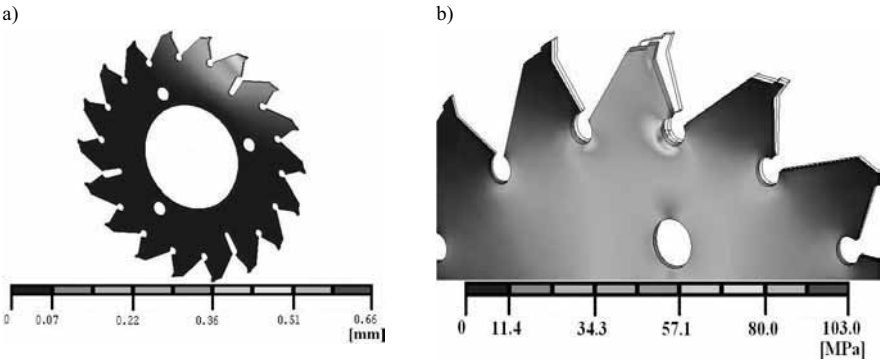

Fig. 3. Results of the calculations in the form of visualization: a) displacement, b) stress

Due to the specific construction of a saw blades, which one of the dimensions is much smaller than the other, modeling of saw blade geometry was carried out using two types of structural models: the first is the solid model and the second is the shell model. The first model have eight-node elements were built in the shape of cubes, while the second model have eight-node element in the shape of squares. The calculations of the same saw blades with both structural models showed that both models can be used. The difference between the values of strain for both structural models is approximately few percent.

The low stiffness of saw blade allow also simplify the modeling of the saw attachment, which can be limited to receive six degrees of freedom on the outer diameter of collars. Comparative calculations performed for the same saw blades mounted in the clamping collars (fig. 1a) and without collars (fig. 1b) showed displacement differences a few percent.

SUMMARY

Presented an algorithm to create the structural model and model to calculating with using the commercial ANSYS computer program used for numerical calculations by finite element method enables the determination of deformation, stress and stiffness of saw blades with difficult body geometry for which it is impossible to perform analytical calculations. In addition, conducted numerical calculations, it possible to 3D visualize the results of calculations which significantly simplifies their interpretation.

REFERENCES

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Streszczenie: *Obliczeniowa metoda wyznaczania sztywności statycznej piły tarczowej.* W niniejszym artykule opisano sposób modelowania i obliczeń odkształceń i naprężeń pił tarczowych o złożonej geometrii korpusu z wykorzystaniem komputerowych programów wspomagających projektowanie.

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