NUMERICAL STUDIES ESTABLISHING CONSTRUCTIVE SOLUTION FOR A SPECIAL CHAMFERING INSERTS USING FINITE ELEMENT METHOD

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ABSTRACT: *The paper presents a study of the stress of a special chamfering inserts by finite element method using ANSYS software. The finite element method (FEM) is a method of virtual analyzing of stress or of specific movements in different structures, which is based on their division into discrete elements, connected by setting imaginary points, called nodes. The studied chamfering inserts represents the proposed solution for a new model of boring and chamfering heads. These chamfering inserts have a star shape with symmetric axial plane that allows them to be used on both sides and to be fastened with screws.*

KEY WORDS: ANSYS, tension, Finite Element, chamfering inserts.

1. INTRODUCTION

Concept of drilling, boring and blunt tools, experienced rapid development in recent years which has led to new constructive solutions.
Currently, the manufacturers of cutting tools offer modular construction for tools which, for the same tool, are able to adapt support with different inserts for different processing.
These tools are composed of plates consisting of exchangeable edged mounted directly on the tool body or intermediary bodies.
Based on the results of a study regarding developing a new constructive solutions of a modular cutting tool, the paper presents a numerical studies establishing constructive solution for a special chamfering inserts using finite element method.
The study was done for a radial insert mounted on the front side. The insert shape is special and is fixed with central screw. For this constructive version, several solutions have been proposed.
After several analysis there were selected two solutions presented in Figure 1 and in Figure 2.

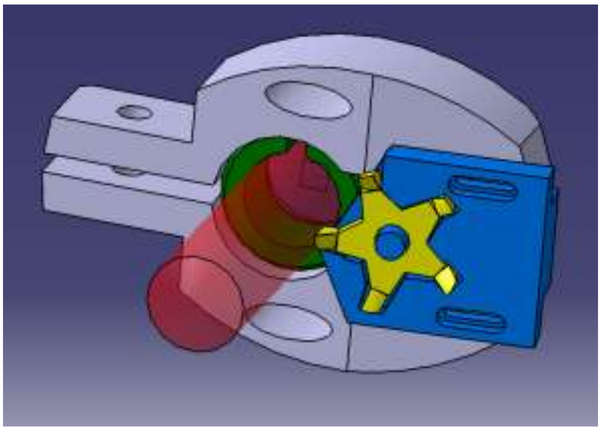

Fig. 1. Constructive tool solution for beveled and drill - with adjustable support with a special form of inserts (star-shaped).

Constructive solution was made based on the needs of the design theme and it aimed to increase the number of inserts edged. Also, it follow to implement the principle of modularity to the "level" of the drill and the principle of adjusting the chamfering edge.
In Figure 1 is presented a constructive solution for tool and beveled drill - with adjustable support with a special form of inserts (star-shaped).
In Figure 2 are presented an other solution.

Fig. 2. Combined cutting tool - type Sandvik drill with chamfering modul with square insert with spout for chamfering, frontal located, fixed central with screw.

The aims of this paper is to present the best solution of a chamfering inserts using the finite element method for the two constructive solution presented in figures 1 and 2.

2. STUDY CASE

The study will start for the constructive tool solution which use plates with five edges, and has a star shape.

In designing a modern cutting tools for machining drilling and chamfering operations, numerical studies were conducted by the following steps:

- There were imported the models realized in CATIA, which are saved as .stp file type, in order to be read by ANSYS software;
- Loads were established; these data are basically in the process and cutting forces or constraints that links data port abutting insert-insert cutters;
- It was done the assembly meshing;
- It was realized the analysis with Finite Element Method (FEM);
- It was presented the results.

Exemplifying method was performed for the constructive solution shown in Figure 2 (star inserts with five cutting edges).

The ensemble insert - port insert was imported from CATIA software. Loading insert is appropriate to a cutting force of Fc= 800 N, which are equable distributed over an area corresponding to the chip area.

- Advance is fz = 0.3 mm/rotation;
- Depth of cutting is 4 mm.

Propping was done based on proper alignment of the rear end faces (3 degrees of freedom are taken), a guide base located under the cutting tooth (2 degrees of freedom are taken) and a support base located on the back side of a tooth. (Figure 3.)

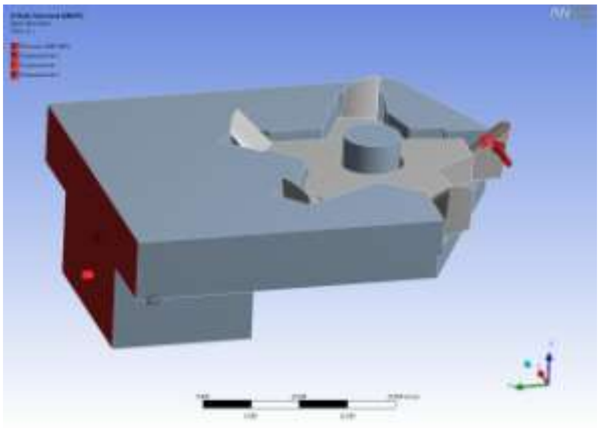

Fig. 3. Loads and constraints applied

This guidance system is preserved through a clamping force placed on the front surface.

It was performed mesh model. (Figure 4.) The models were automatically discretized using free-mesh method.

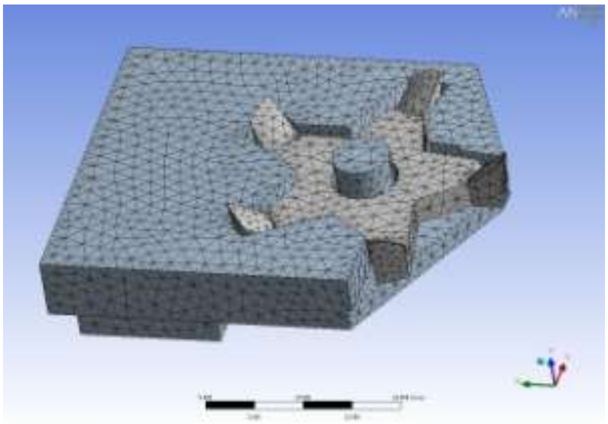

Fig. 4. Meshing the model stellate insert and its support

With loading and constraints proposed by presented meshing was performed a static analysis. The results are shown below.

In order to analyze the stress distribution throughout the insert support was used the equivalent stress calculated by the ANSYS software with the von Mises criterion.

Figure 5 highlights the equivalent nodal tensions for the test performed. In this case the maximum tension is 1215,8 N/mm2 (MPa).

The safety factor has a minimum value of 3.2079 making it within acceptable limits.

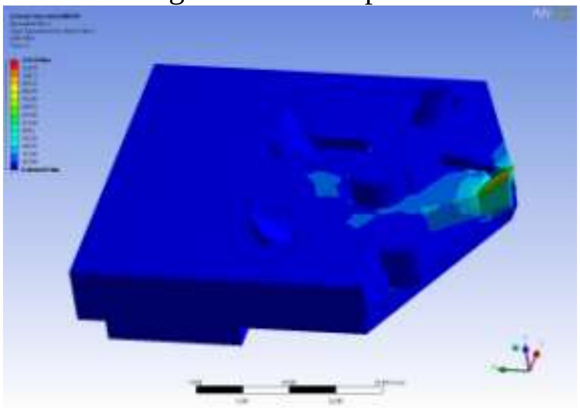

Fig. 5. Appropriate tensions equivalent for the analyzed model – according with the charge

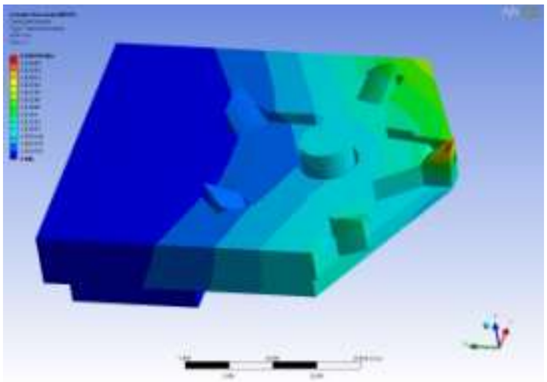

Fig. 6. Tensions of total movement

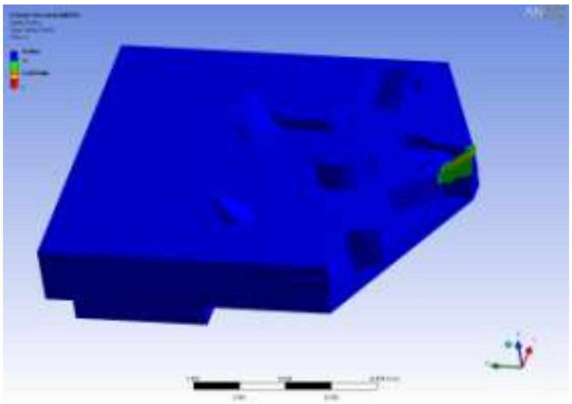

Fig. 7. Safety factor

Stress distribution σ_1, σ_2 and σ_3 are presented in figure 8, figure 9 and figure 10.

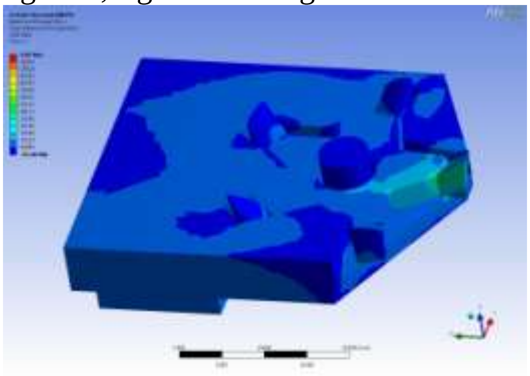

Figure 8. The main stress distribution σ1

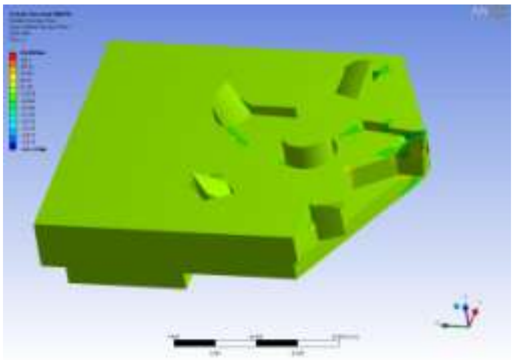

Fig. 9. The main stress distribution σ2

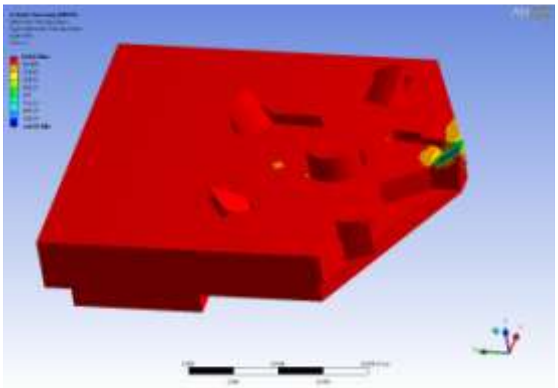

Fig. 10. The main stress distribution σ3

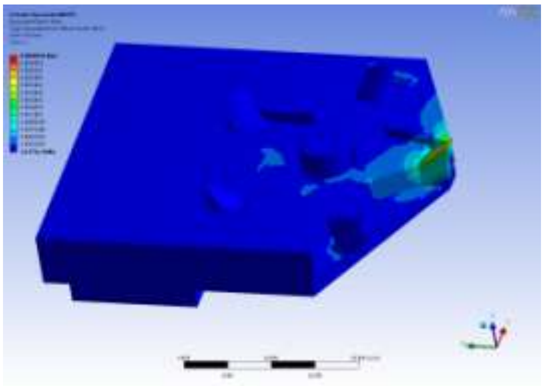

Fig. 11. Equivalent strain

In order to analyze the first constructive solution there were calculated the tensions of total movement (Figure 6.), the safety factor (figure 7), the main stress distribution σ_1, σ_2 and σ_3 (figures 8, 9 and 10) and the equivalent strain (figure 11).
Using the same procedure there were analyzed the square inserts with beak for chamfering.
Applying Finite Element Method to the square inserts, it highlights a fairly large amount of stress and equivalent strains to the top edge flexible inserts. (Figure 12.)

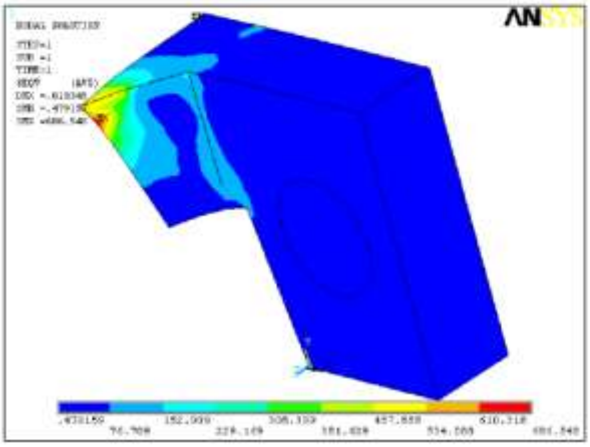

Fig. 12. The state of tension in the square insert with beak for chamfering clamped on the front part

As a first conclusion it result that nodal displacements under Ox direction has low values, both for star or square inserts.
Maximum stress (it is marked with red) occur – in the case of square insert to the middle of the cutting edge, and in the case of star insert most stressful part is the cutting tip.
Analyzing the tensions from insert, the easiness of tool change, the number of available cutting edges and the safety of collision of cutting edges that are not active at a time, it was concluded that the best solution is the one with the star inserts, presented in figure 13.

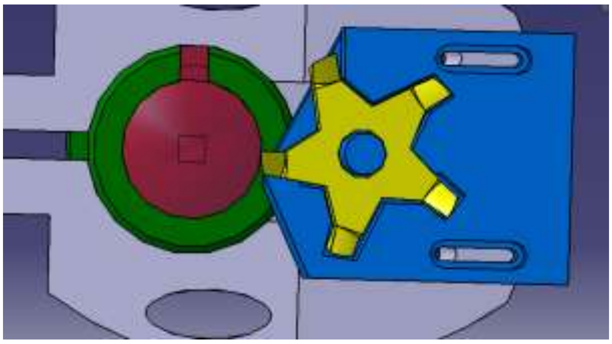

Fig. 13. The design solution selected

3. CONCLUSION

Shaping the cutting process is always up to date in the light of technical and economic advantages. Research on modeling and simulation led to the development of modeling methods among these being modeling with finite element method. The method used in this study facilitated relatively quickly getting a result that allowed choosing between solutions. Solution (s) may be verified from the functional point of view, but also in reliability while cutting process (process simulation).

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