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MACHINE TOOL DESIGN AND STATIC BEHAVIOUR ANALISYS CASE OF STUDY FOR A DRILLING AND BORING MACHINE

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ABSTRACT
The aim of this paper is to present the finite element analyse of a machine tool used for drilling and mboring processes. The 3D model was made using technical possibilities of I-DEAS and Algor and the analyse was done using the ABAQUS soft. At the end there are presented the obtained results.
Keywords: finite element method, machine tool, modeling

1. SOLID MODEL
The main aim of the 3D design is to obtain a system that is very close to the real model considering the imposed functional conditions. In the machine tool design the parts are calculated for a proper strength and the stress level in each part is imposed to do not exceed material accepted values.
A machine tool, particularly one that is used for drilling and boring processes (Figure 1), is made of many parts that generate an assembly. All parts are connected through screws, keys and pegs that have to be modelled. In the same time it is necessary that the level of contact stress to do not exceed the admitted value and is very important that from the phase of design to be known if parts of the machine lose the contact between them.

Figure 1. Machine toll for drilling and boring

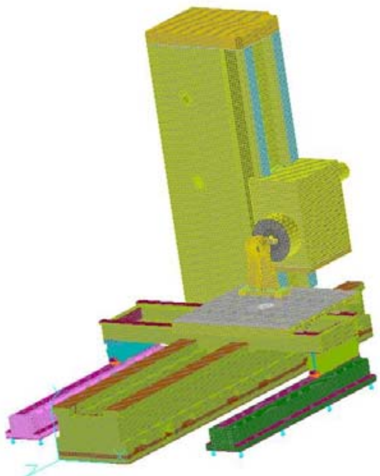
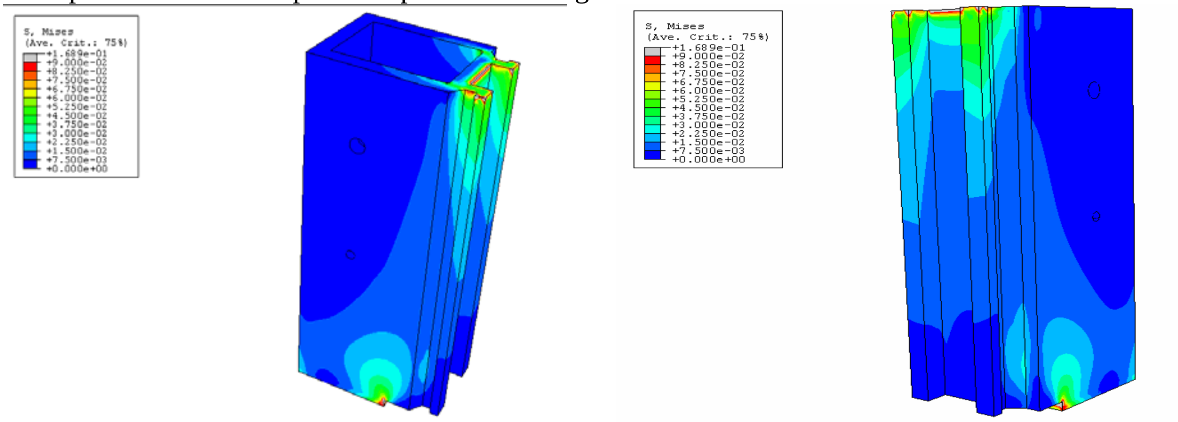


Figure 2. FEM model

After the design of the parts, done using I-DAES, they were meshed. Some of the parts were meshed as surface mesh and other were meshed as volume. Al these mesh operations were also done in I-DEAS. In the next step the parts were exported in ALGOR where pieces that have surface mesh were re-mesh as volume mesh and all parts were put in their right position. At the end the assembly consists of approximately 110.000 elements (Figure 2)

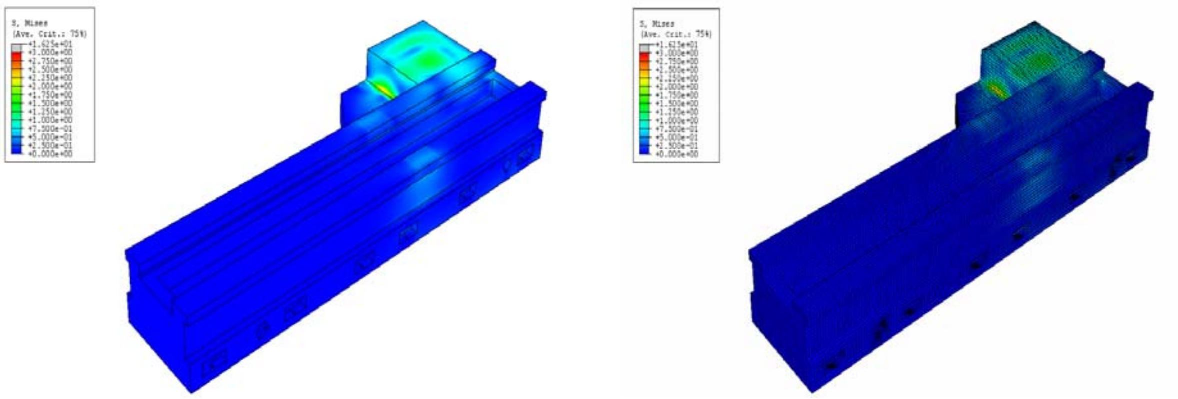
2. ASSEMBLY FINITE ELEMENT ANALYSIS

Based on the real model there defined the pairs of contact surfaces, the screws as beams, the base screws as 3D model, the pegs and keys were modeled as points connected with equations.
The finite element analyse was done using ABAQUS program. The level of von Mises stresses developed in some of the parts are presented in Figures 3 ÷ 8.



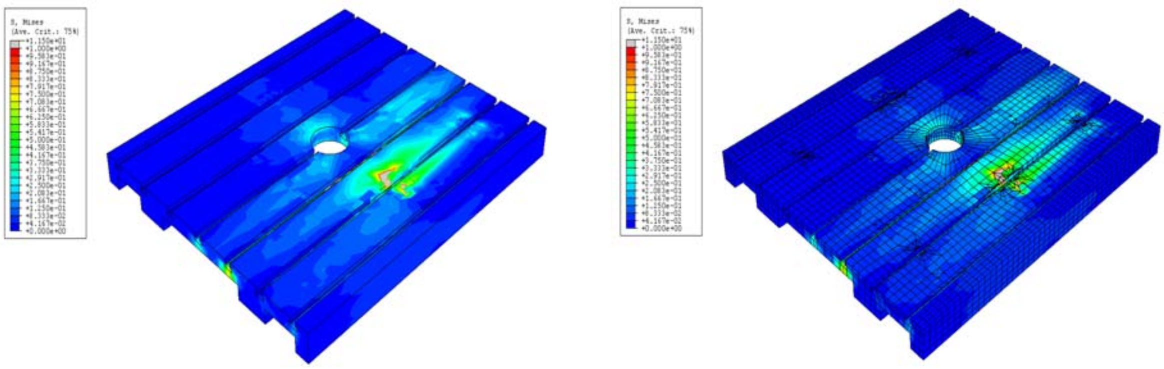
a) b)

Figure 3. Machine toll column: a) left view; b) right view



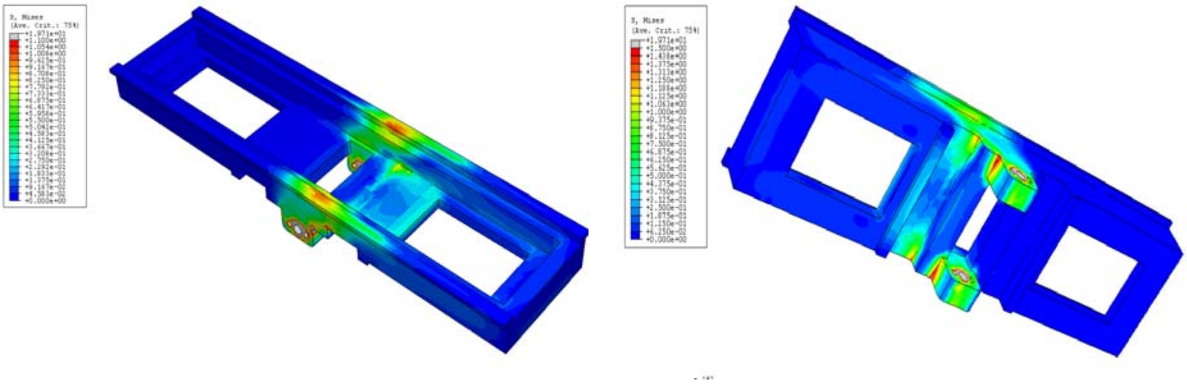
a) b)

Figure 4.Base block of the machine tool: a) von Mises stresses distribution; b) finite element model.



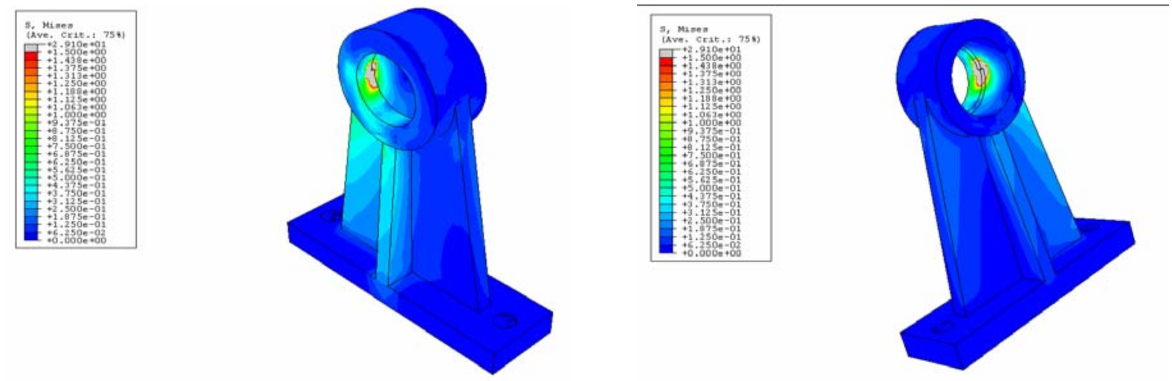
a) b)

Figure 5.Working table of the machine tool: a) von Mises stresses distribution; b) finite element model.



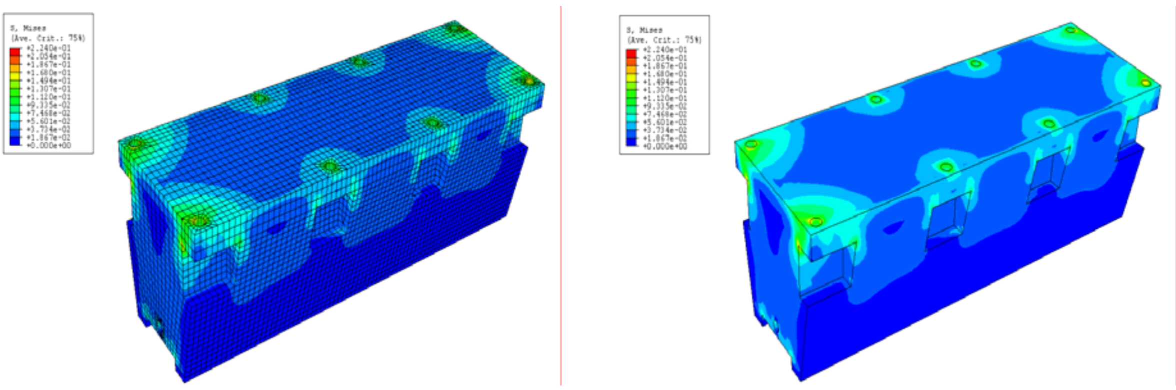
a) b)

Figure 5.Transversal table: a) upper view; b) bottom view.



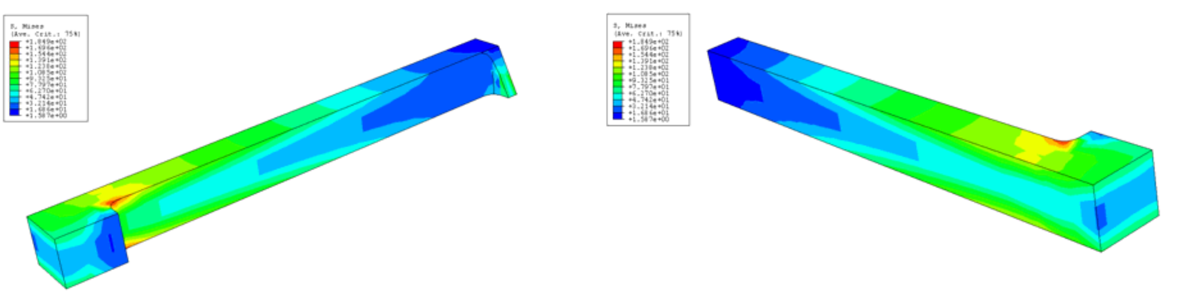
a) b)

Figure 6. Manufactured piece: a)left side view; b)right side view.



a) b)

Figure 7.Transversal table base block: a) finite element model; b)von Mises stresses.



a) b)

Figure 8. Reamer : a)left side view; b)right side view.

3. CONCLUSIONS

Based on the obtained results presented above one can conclude that:

- The level of von Mises stresses is situated in the limites of material strength and the analysis confirm that there are no problems during the manufacturing process;
- The deformations are very small as a result of the massive structure of all component parts. These deformations there were not presented in the paper because they are not relevant as value;
- Some of the parts can be redesigned in terms of minimise the structure

The method of finite element is very useful for the engineer designer because can offer an image of the stress levels and deformations and so one can take the proper decisions to solve all possible damages.

4. REFERENCES

[1] Constantinescu N. Ioan, Danet V. Georgeta: Metode noi pentru calculul de rezistenta, Editura Tehnica, Bucuresti, Romania, ISBN 973-31-0094-3, 1989.

[2] Pascariu Ioan: Elemente finite. Concepte. Aplicatii, Editura Militara, Bucuresti, Romania, 1985.

[3] Rao S. S..: The Finite Element Method in Engineering, Second Edition, Pergamon Press, ISBN 0-08-033419-9, 1989

[4] *** : ABAQUS Reference books. User guide.

[5] *** : ALGOR Reference books. User guide

[6] *** : I-DEAS Reference books. User guide