THE STUDY OF THE WORK PROCESS MADE BY THE CUTTER WITH VERTICAL ROTOR, USING COMPUTATIONAL SIMULATION

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Abstract: *For the cars construction, the designing of the car and the projection of the component parts in the most improving conditions, it assures the quality transfer, by the functional and qualitative totalisation. The integration of this methods in the current projection it is proved by the fact that all the important programs of structure analyze have the capacity to import the geometry of the studied object by the modelation programs as Solid Works is. The method of the finite elements allows the analyze of physical phenomena which can be described with the help of the mathematical model made by differential equation systems with initial conditions and with limits(the big programs of structural analyze have added also phenomena which can be modeled by certain types of simple equations, linear or not, on-differential). The deforming phenomena of the solid shapes, the determination of thermical field and electromagnetically field, the analyze of the speed and pressure field into a fluid, it constitute only a part by the applicative potential of the numerical modelation method with finite elements. In view of obtaining some relevant data in different stages of functioning of the product, it was used the geometrical molding of the experimental pattern by using an assisted designing program (CAD) specially designed, named SOLID WORKS. This program has to assist the planner engineer in a more rapid making of documentation, in arranging information on domains, in making reports etc. The document created allows, in the future the reuse of the information it contains. The work of designing and developing, and the costs associated with design changes are increasing as the project is going to it's final stage, but are much lower in the designing phase when the decisions for optimum solutions are taken. To choose the best solutions of many proposed variants, the team of project needs to have access to relevant information regarding the whole product. For these purpose was needed the making of the three-dimensional pattern applied to the entire ensemble.*

Key word: *work process, vertical rotor, simulation*

INTRODUCTION

The introduction projecting and especially in assist- designing of computer, at large scale, of some methods of numerical calculation(the method of meadow grass elements, the method of frontiers…etc)was multiple motivations. In many cases, the traditional methods of calculation, their hypothesis and solutions are overfull field (event hoe, almost always they are a reference point for correctness of some solutions obtained through complicated methods),it doesn't offers a satisfied fusibility or lead to exaggerating oversize. The same traditional methods can't include a series of functional and constructive aspects, or they stop at difficulties of analytical order. In those conditions, the method of meadow grass elements or/and frontier elements had evaluated parallel whit the technique of estimation, materializing in numerous specifically programs.

In designing, the computers usage isn't efficient only in the condition in which the designer use the package of specialized general programs state elaborated, which they don't know in detail.

The 3-D model it doesn't mean only the three-dimensional representation. Being something superior of the three-dimensional representation of the objects edges, a solid can be

obtained through a variety of adding and/or moving off of elementary "shapes"(sometimes similar with technological adding/moving off of material),remaining solid regardless of its geometrical shape complexity. At this solid joins certain properties (the density, the inertia, the strength) and it represent an intelligent conduct during the evolution process of its shape, and its relation with neighboring objects for the ensemble forming has certain cleverness. The parameterization supplement frequently the main facilities of the programs based at the solid s modelation and it presume the associations of the solid, but also presume the defining of certain rules which obey the entity shape. Such an object form actually a variation model: modifying the parameter values is obtaining constructive variants of the same conceptions.

For designing complex products it is necessary to use new design concepts, to make up a database, which can be accessed and used at any time. The parameters considered to be relevant are identified during analysis and are used as opening data for the selection of viable solutions.

In view of obtaining some relevant data in different stages of functioning of the product, it was used the geometrical molding of the experimental pattern by using an assisted designing program (CAD) specially designed, named SOLID WORKS.

This program has to assist the planner engineer in a more rapid making of documentation, in arranging information on domains, in making reports etc. The document created allows, in the future the reuse of the information it contains. The work of designing and developing, and the costs associated with design changes are increasing as the project is going to it's final stage, but are much lower in the designing phase when the decisions for optimum solutions are taken. To choose the best solutions of many proposed variants, the team of project needs to have access to relevant information regarding the whole product. For these purpose was needed the making of the three-dimensional pattern applied to the entire ensemble.

To realize the three-dimensional model, first where modeled three-dimensionally all the parts which make the ensemble then where grouped on sub ensembles and in the end put together.

The designing program used allows the regeneration and modification of any component in the ensemble and correlates with connived sub ensembles. The program also allows us to use a library of operations or editing pieces, having the possibility to open any piece for editing.

MATERIAL AND METHOD
The constructive modeling of the active component part
The study has been effectuated for two types of rotor having the diameter by 400 mm respectively 500 mm.

We continue detailing the steps that we followed for every single case.

The curl with 400 mm diameter

In the figure 1 there are shown the dimensions of the knife that has been modellated. We chose a L shaped knife having the following dimensions:
➢ the length of the knife: 120 mm (100 mm the active part)
➢ the depth of the knife: 7 mm
➢ the width of the knife: 90 mm
➢ the depth of the knife: 7 mm
➢ the working width of the knife: 90 mm

After the dimensional modeling of the knife it was necessary to establish the material for manufacturing, for determine the mass properties (fig. 2). The soft calculate automatically depending on the material properties, weight, volume, surface, weight center, inertia axes, inertia moments etc. (fig. 3)

Fig.1 Sequence from Solid Works soft with the knife dimensions

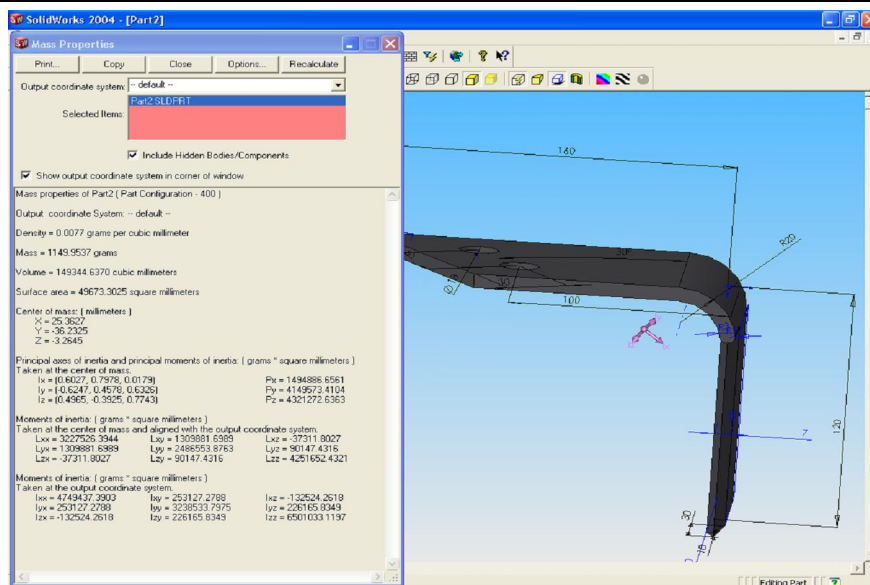Fig.2 Establishing the material of the knife

Fig.3 Print screen with the mass properties

Then we continue the assemblation of the vertical rotor of the cutter and its modeling. It has been modellated a rotor with 4 knives with the diameter of 400 mm (fig. 4).
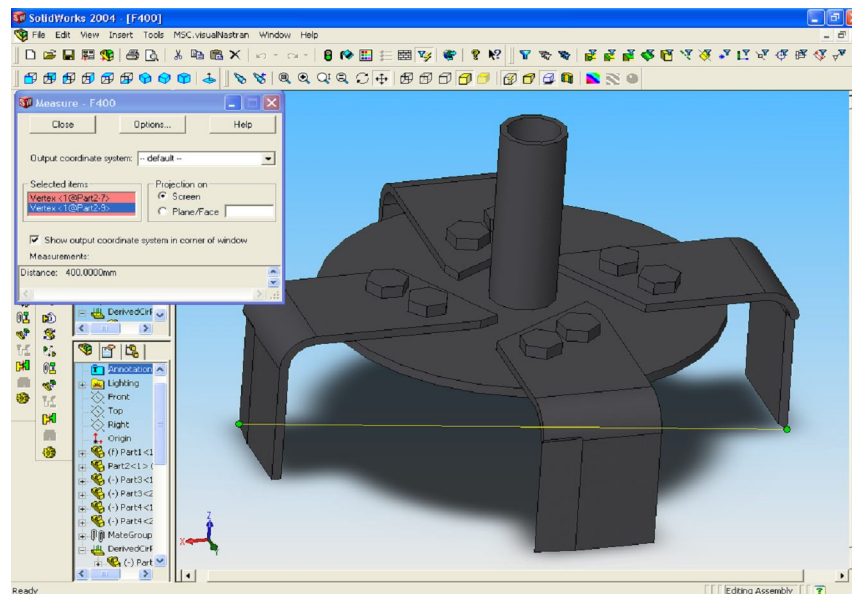

Fig. 4 The modellation of the vertical rotor with knives using the soft Solid Works
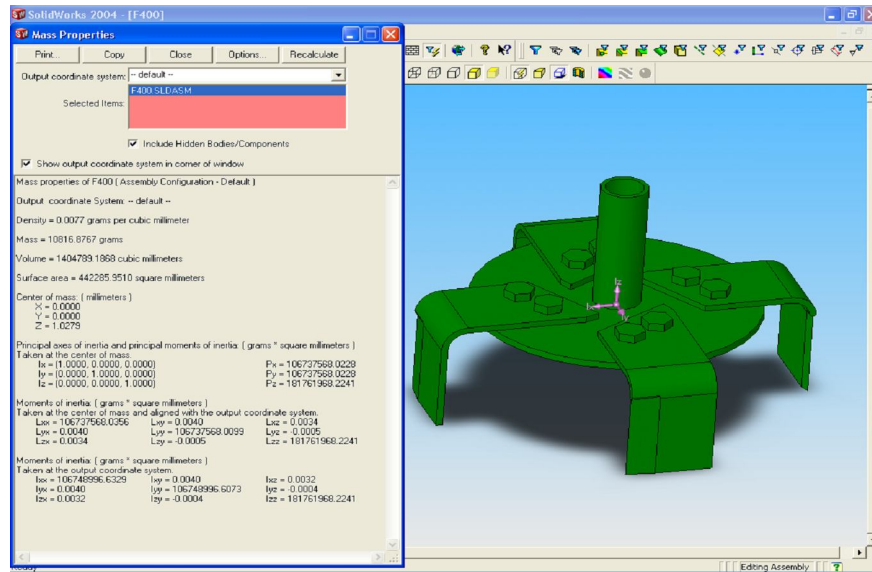
Fig.5 Print screen of the mass properties of the rotor

The same in the case of the knife it calculates, depending on material, weight, volume, weight center, and inertia moment etc for the whole rotor (fig. 5).

There were established also the properties of the rotor with 6 knives and diameter of 500 mm. (fig. 6)
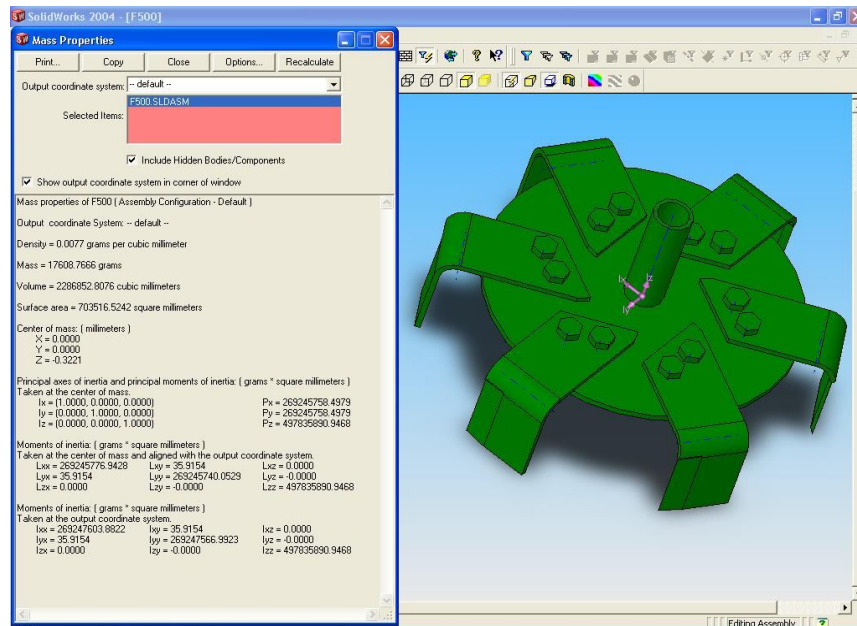
Fig. 6 The mass properties of the rotor with 6 knives and diameter of 500 mm

The kinematics of the vertical rotor
Establishing the theoretical specific dependences

The kinematics of the active organ of the cutter, vertical rotor type was studied using the computer, and the soft MSC-Visual Nastran, simulating the motion of the active organ in the trees line, choosing for this a functions such as (fig.7):

$$y(t) = mean + \frac{amplitude}{2} \sin\left(\frac{2\pi \cdot t}{period} + phase\right),$$ (1)

In which it was considered the amplitude being 1,period-2,mean-0,phase-0.

So the function which approximate the best the motion of the active organ of the vertical rotor type has the form:

$$y(t) = \frac{1}{2} \sin\frac{2\pi \cdot t}{2} = \frac{1}{2} \sin\pi t$$ (2)

The movement of the cutter was considered to be done in the long of the Ox axis, having the work speed constantly $v_x = 0.56$ m/s.
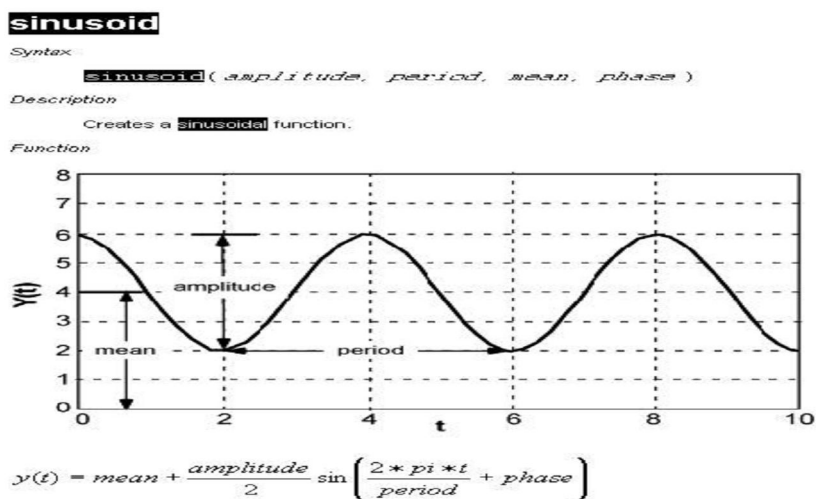

Fig. 7 The function which approximate the best the motion of the cutter's rotor

Simulating the real conditions

After the transfer in the kinematics analysis soft MSC Visual Nastran, there were imposed motion conditions for the rotor. From the figure 8 it is seen a motion after a sinusoid of the rotor, on the Y axis, the speed motion $v_z = 0,56$ m/s, the rotative speed being constantly $w_z = 250$ rot/min.

The kinematics parameters are studied for the tiptoe of the knives, respectively for the center of the rotor and in the figure 9 being shown the coordinates of the points for which the kinematics calculation is done. To the left of the image there are posted the analyzed parameters: positions, speeds, accelerations, angular speeds and angular accelerations.
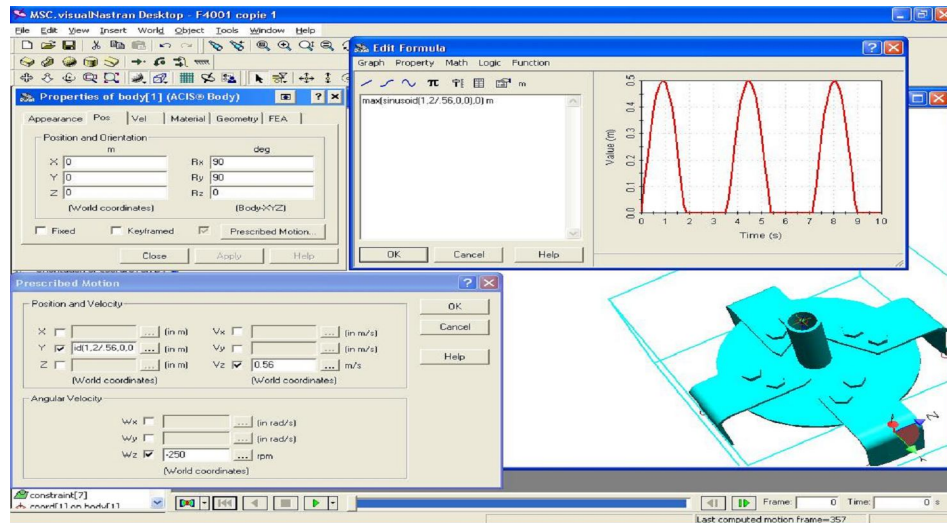
Fig.8 Sequence from MSC Visual Nastran soft with establishing the conditions of modulation
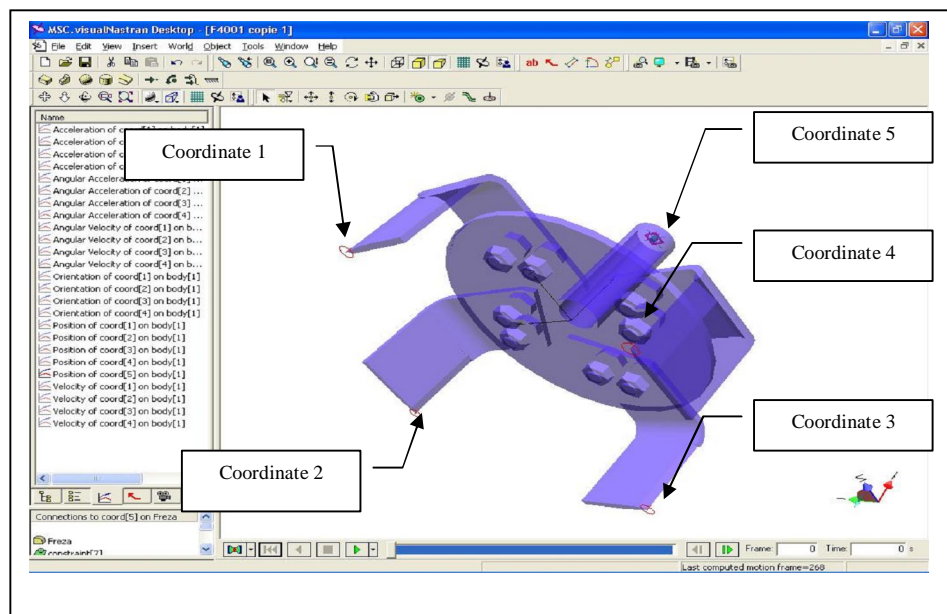

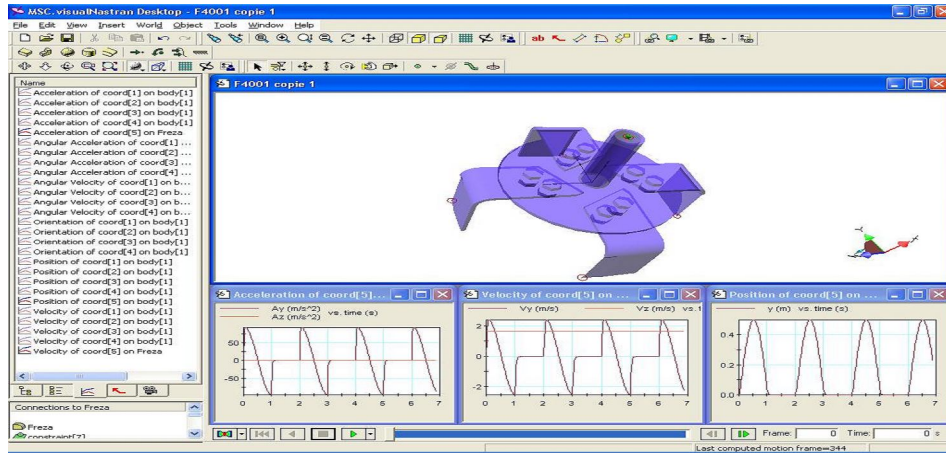Fig. 9 Print screen from MSC Visual Nastran soft with establishing the kinematics parameters studied

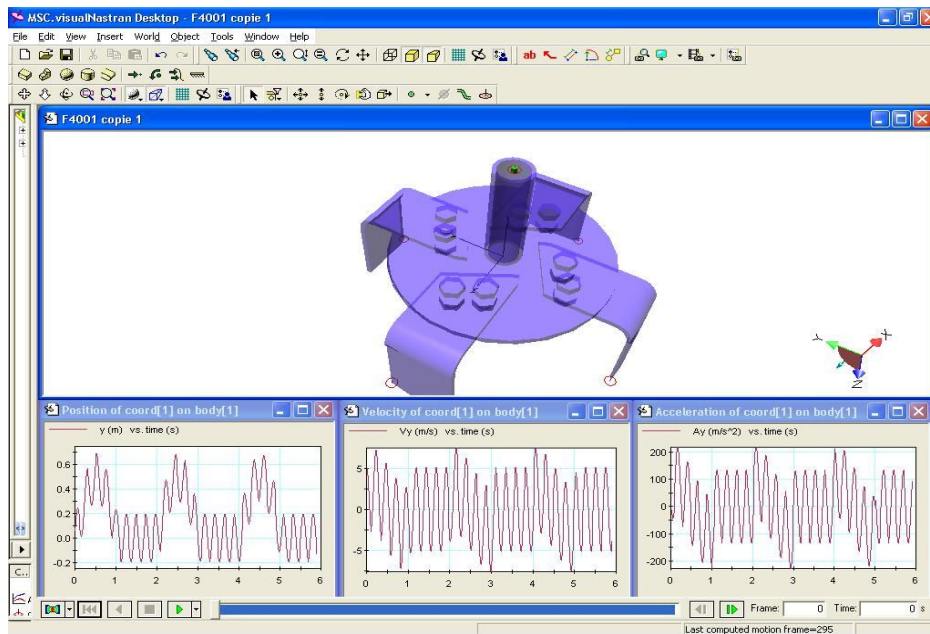Fig. 10 Positions, speeds and accelerations for the coordination of the rotor's center

Fig. 11 Positions, speeds and accelerations for the coordination of a knife (coordinate 1)

In figures 12, are traced the trajectory of the studied coordinates corresponding to the three speed stages of work for the milling machine with vertical engine of 400 mm diameter and 4 knives.
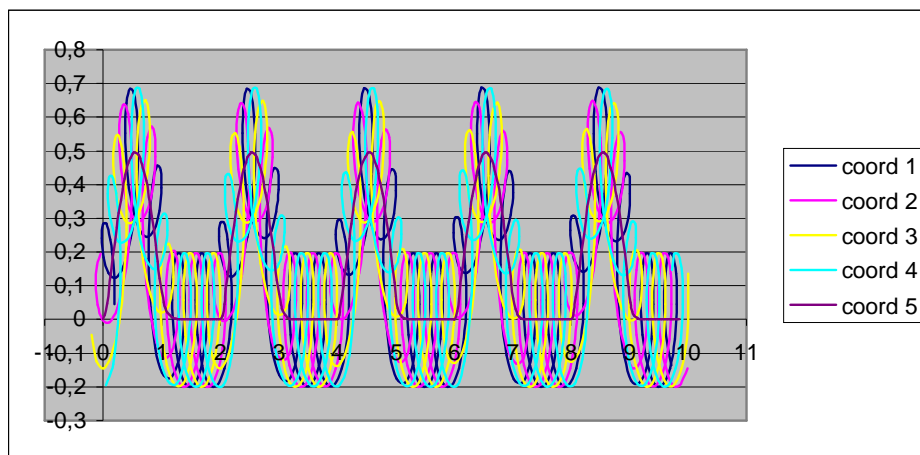
Fig. 12 The trajectories of the studied coordinates for the l speed stages

For the previous changes corresponding to the I, I_R and II speed stages it was imposed as a constant parameter of entry the same period of time.

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