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AIRFLOW SIMULATION IN SOLIDWORKS FLOWSIMUTALION

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Creation of a model of air flow propagation of end mills for subsequent analysis of aerodynamic properties for materials by cutting.

To create a model of the distribution of an air flows, we need: 3D - model of the investigated object; 3D - model of the body that fixes the object. The next step is to create an assembly of the model under study (Fig.1).

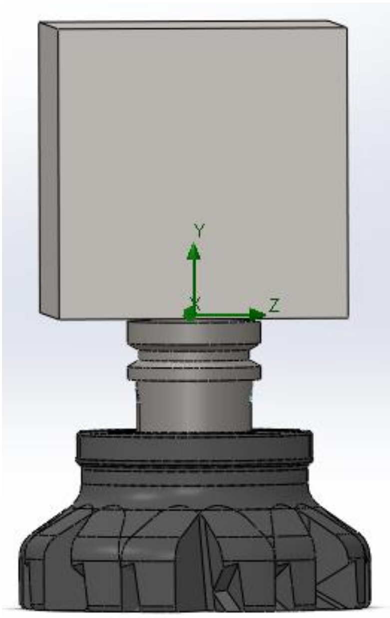


Fig. 1. – Assembling the model under study

Then we need to add a three-dimensional model, using a sketch and extrusion, select the area of rotation of the model under study (Fig. 2).

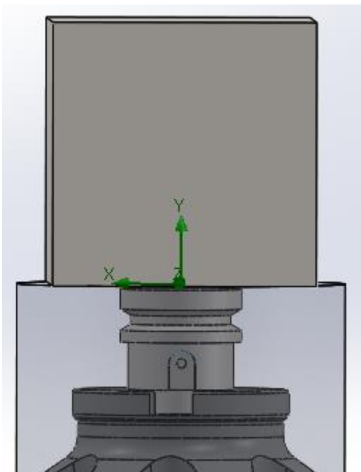


Fig. 2. – Assembly with the area of rotation

Then using FlowSimutation we launch the project master using the appropriate button. After that in the window that opens we select the metric system, the type of simulation (in our case, rotation), the type of gas or liquid. Next in a new project we set the area of rotation and the speed of rotation, using the created part, and the boundary condition that fixes our part (Fig.3).

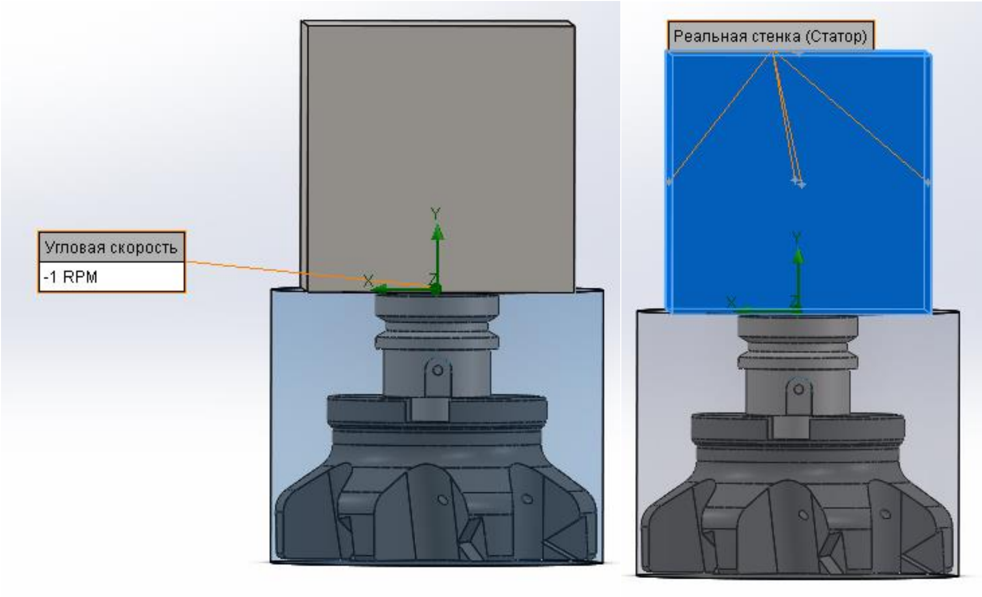


Fig. 3. – Domain of rotation and boundary conditions

After that our project is ready for modeling. We start the calculations using the appropriate button "Start". After completing the calculations, open the results section and add the flow trajectory for visualization (Fig. 4).

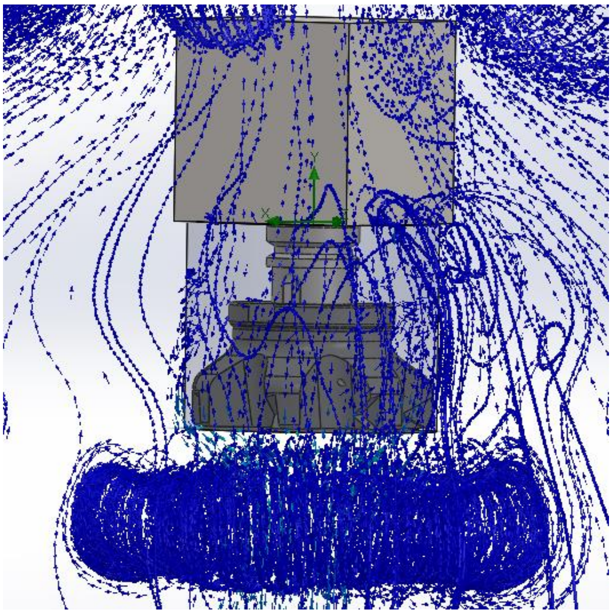


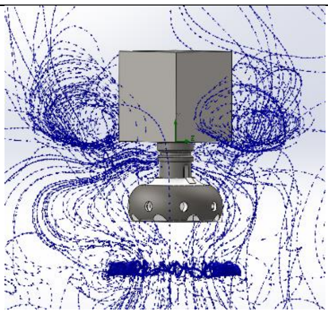
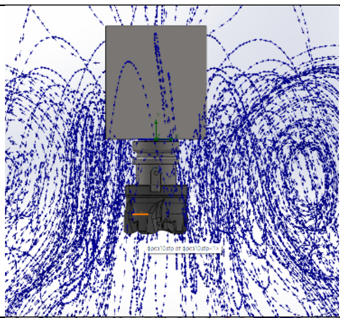
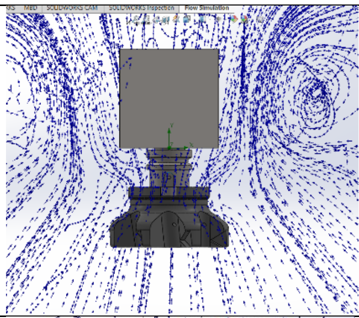
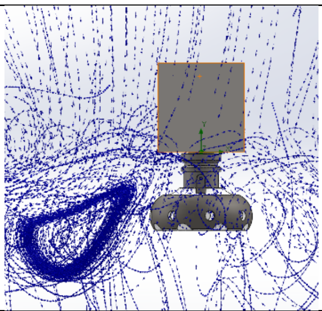
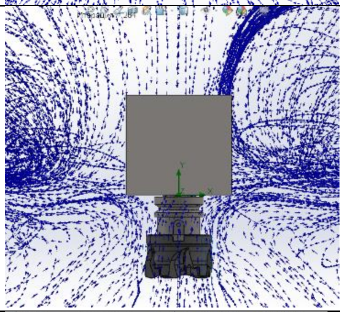
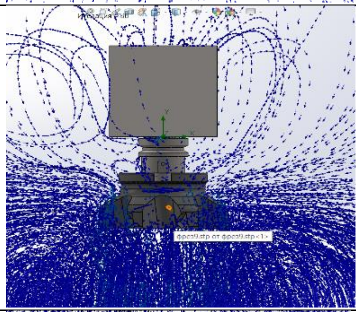
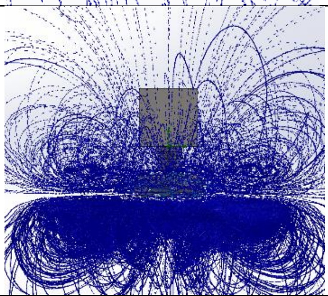
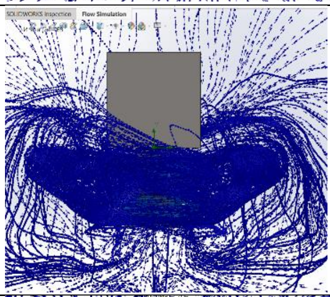
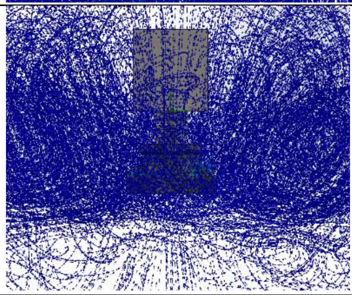
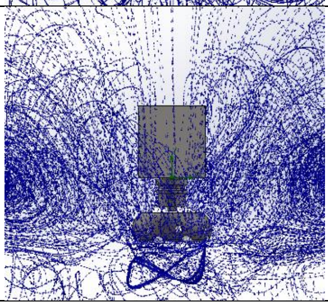
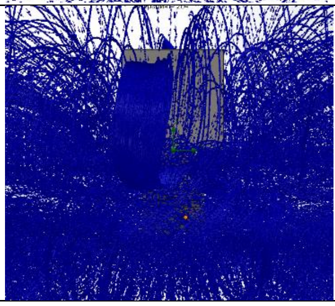
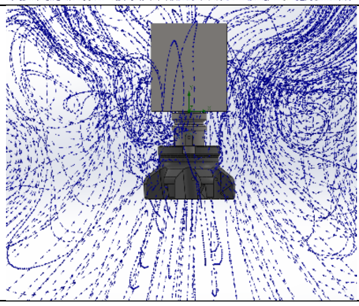
Fig. 4. – Distribution of air currents

With FlowSimutaltion, we can analyze and compare the air flows generated by different cutters. For experience, select milling cutters: 1-End milling cutter, 2-Milling cutter FF FWX D066-05-22-08, 3-Milling cutter HP F90AT D50-4-22-19.

For testing, select angular speeds: 1 rpm, 10 rpm, 100 rpm, 1000 rpm.

Let's compile a table with the results of all experiments. The table shows the direction of the air flow depending on the angular velocity.

Table 1. – Study of the dynamics of the work of cutters in the air

Speed of rota-tion	Milling cutter 1	Milling cutter FF FWX D066-05-22-08	Milling cutter HP F90AT D50-4-22-19.
1 rpm			
10 rpm			
100 rpm			
1000 rpm			

Description. Milling is one of the most common processing methods. In terms of productivity, it surpasses planing and in the conditions of serial production is second only to external pulling. The kinematics of milling processes are characterized by fast rotation around its axis and slow feed movement. The feed movement during milling can be rectilinear-translational, rotary, helical.

For milling cutter 1: at a speed of 1 rpm, a small amount of air flow is noticeable, most are projected onto the machining plane, but a significant part is chaotically scattered. With an increase of speed, we see an increase in number of air flows, they are mainly located on the projected plane, their trajectory resembles a torus. However, at 1000 rpm, we see that most of the air flows are scattered, and a distinct frieze outline is formed at the base.

For the FF FWX D066-05-22-08 cutter: at 1 rpm, air currents are sucked in, after which they create vortices on the sides of the cutter. As the speed increases to 10 rpm, the radius of the vortices increases, while the amount of air flows changes insignificantly. However, when the speed rises to 100 rpm, the amount of air flows increases significantly. The streams are highly concentrated around the frieze. This is due to the shape of the teeth. Having increased the speed to 1000 rpm, we observe a colossal amount of air flows. They form a huge torus around the cutter.

For the HP F90AT D50-4-22-19 cutter: at an angular speed of 1 rpm, a rather small number of threads are formed, relative to the rest of the cutters, however, after increasing the speed to 10 rpm, the picture changes significantly. The number of air flows increases, while the direction remains the same, the flows rise from top to bottom, spraying in a vertical plane along a parabolic trajectory. When the speed increases to 100 rpm, the air flow is redirected. There is a swirling uplift, rather concentrated, relative to the other cutters. The vortex shape is a torus. However, with an increase in the rotation speed to 1000 rpm, the speed of movement of the flows themselves increases, thereby distributing them less densely, but at a distance significantly greater than in other cases, the number of flows, in turn, decreases.

Conclusion. During the work we learn the methodology for studying the direction, quantity, speed of air flows, aerodynamic streamlining of end mills was studied. All calculations, the creation of a model of the movement of air flows were carried out in the SolidWorks software with the FlowSimulator plug-in installed.

REFERENCES

1. Методология исследования работоспособности фрезерных и осевых режущих инструментов на основе 3D прототипирования / Н.Н. Попок, С.А. Портянко – Вестник ПГУ, сер. В. Промышленность. Прикладные науки. 2020 г. – с. 29-39.