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UNIQUE WAYS OF CHECKING FLIGHT SAFETY ON FIRST STAGES OF DEVELOPMENT*A. A. Filippova*

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This article describes a project that can be used as an example to learn how to develop airplane wing models using special programs. The use of 3D printing in the implementation of the project is considered.

Keywords: 3D printing, wing, aerospace engineering, digital model, Charles Hull.

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**УНИКАЛЬНЫЕ СПОСОБЫ ПРОВЕРКИ БЕЗОПАСНОСТИ ПОЛЕТА НА ПЕРВЫХ
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В статье описан проект, на примере которого можно учиться разрабатывать модели крыла самолета, используя специальные программы. Рассмотрено использование 3D печати при реализации проекта.

Ключевые слова: печать 3D, крыло, Аэрокосмическая инженерия, цифровая модель, Чарльз Хулл.

Introduction. It is never easy to build anything quickly with good quality, more so an airplane. It is a very responsible job, because lives of many people depend on how well the airplanes are developed. Scientists came up with a very unique way of testing the security of flight before the airplane actually flies – 3D printing. It is one of the most widely spread topics of the 21st century is 3D printing and its use in different areas. One of such areas is Aerospace Engineering. 3D printing is used in testing the airplane wings. I was lucky to witness such a process and even be a part of it in one of my school classes.

Basics. First of all, we need to fully understand what 3D printing is. 3D printing is a manufacturing process that creates three dimensional object by incrementally adding material until the object is complete. A 3D printer is a machine that can take a digital 3D model and turn it into a tangible 3D object. In order to create something a person needs 3D printer, needed materials, such as ink for 3D printer, which looks like a roll of plastic string, and imagination. Anything can be created using 3D printing technology. Some people managed to create live sized corralls, edible food, and even different parts of body! Today I will only concentrate on the creation of a part of an airplane wing though.

Background history. 3D printing is not a new topic nowadays. It was first introduced to the world in 1984 by Charles Hull under the name of “Stereolithography”. A couple years later he received a patent. He was very passionate about what he was doing and soon enough he created a company “3D Systems” and created what was then known as a “stereolithography machine”. A new and improved version of such machine, “SLA-250”, was released in 1988. Its principle of operation is still used.

Project steps. I will be concentrating on my own experience of working on the project. The whole project consisted of three main steps: creation of a model of the part of an airplane wing (airfoil) digitally, creation of the airfoil out of styrofoam, and 3D printing.

First step. In order to create a model of an airfoil I used a special NASA-designed application called “FoilSim” (Image 1). It allowed me to see the shape of the airfoil, the airflow around the part, and most importantly - the coordinates for the airfoil. This application was relatively easy to use, and it did not take too much work in order to change anything in the design because it automatically changes the coordinates of the part.

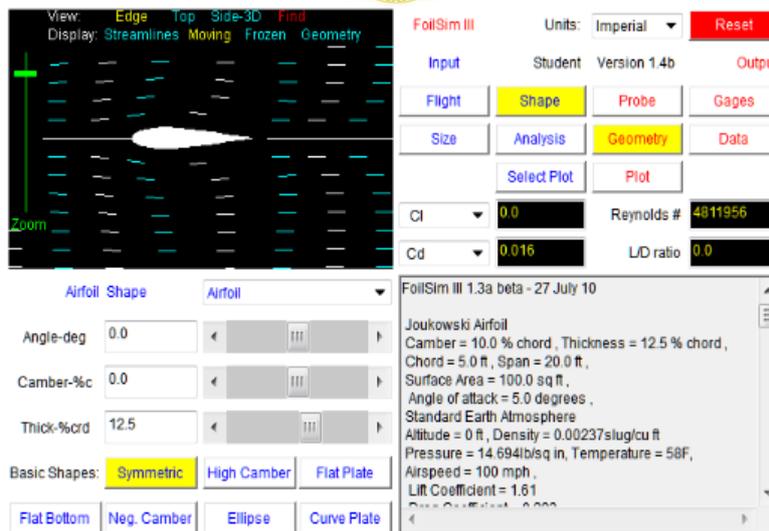


Image 1. “FoilSim” application

Рис. 1. Приложение” FoilSim”

Second step. In order to see the airfoil more clear, I used the coordinated from the “FoilSim” application and pasted them into the “Excel” document. Doing so created a dotted graph which helped me to see the symmetry of the airfoil (image 2).

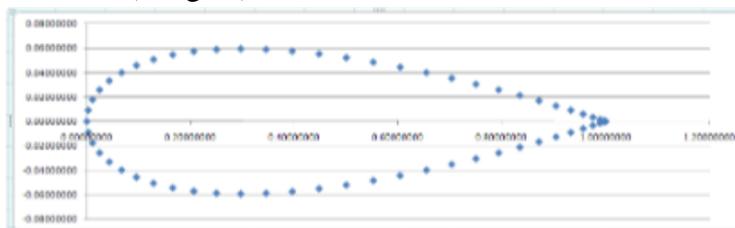


Image 2. Dotted graph

Рис. 2. Пунктирная линия

In order to create a 3D model I used an “Autodesk Inventor” program. This program also allowed to to create a template of the airfoil to prepare for cutting it out of Styrofoam. The template needed to have two holes on each side so it could be attached to the styrofoam block. After creating the holes in the template I printed it, glued to the aluminum sheet, and cut the template out (Image 3).

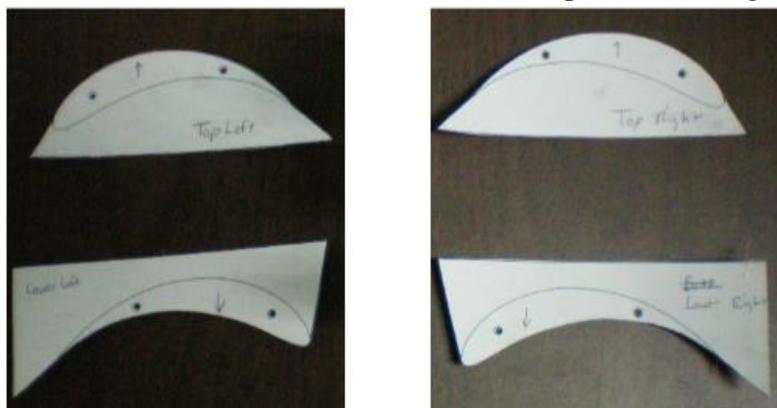


Image 3. Cut out template

Рис.3. Вырезка шаблона

After that, I attached the template to the styrofoam block using four small nails. Then, using the foam cutter which has a very hot metal string I cut out airfoil (Image 4).

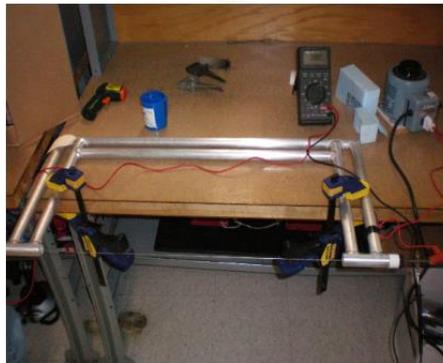


Image 4. Styrofoam cutter

Рис. 4. Резак для пенополистирола

In order to test how well the “wing” will fly I needed to place it into a wind tunnel. However, I needed to glue a special metal mounting tab to the bottom of the airfoil (Image 5). This helped me to make sure that the airfoil was securely attached in the stand in the wind tunnel.



Image 5. Airfoil with the mounting tab

Рис. 5. Крыло с монтажной петлей

Final step. The final step consisted of 3D printing of the previously tested airfoil. It was very interesting to observe the printing process. The printer did the hardest job of actually creating the detail for us. Some of the digital adjustments needed to be made because the 3D printed airfoil was going to be tested in the wind tunnel again after printing. The metal mounting tab that was glued to the styrofoam model needed to be recreated in the “Autodesk Inventor” program so the printer could print it as a part of the 3D wing (Image 6).



Image 6. Printed model of an airfoil

Рис. 6. Напечатанная модель аэродинамического крыла

Advantages and disadvantages of using 3D printing in schools. This experience was definitely unforgettable and I feel very lucky that I had a chance to create my own 3D part of a wing. In my opinion,

one of the greatest advantages of using 3D printing in schools is that students actually get to see the final product and how it turns out in real life as well as its functionality. The process itself involves students greatly which contributes to developing problem solving skills and creativity. The only disadvantage is the cost. There is a great variety of 3D printer models, however even the simplest ones can cost up to 20000 rubles.

Conclusion. All in all, I think that we are very lucky to live in such time that allows people to use 3D printing in many areas, because it can be very beneficial. In the end, the plastic model is a lot cheaper, than, for example a detail made out of glass or metal. This field still has imperfections, but there are many scientists who work on implementing 3D printing for peoples' benefit.

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