MINISTRY OF EDUCATION AND SCIENCE OF THE REPUBLIC OF KAZAKHSTAN


School of Industrial Automation and Digitalization
Department of Industrial Engineering

Made by: Karzhassov Zhassulan

# Creation of unnamed aerial vehicle design in CAD/CAM systems

**DIPLOMA WORK**

Specialty 5B071200 – Mechanical Engineering

Almaty 2020

MINISTRY OF EDUCATION AND SCIENCE OF THE REPUBLIC OF KAZAKHSTAN

School of Industrial Automation and Digitalization
Department of Industrial Engineering

**APPROVED FOR DEFENSE**

Head of the Industrial
Engineering Department, PhD
_____Arymbekov B.S.
“____”_____2020

# DIPLOMA WORK

Topic: "Creation of unnamed aerial vehicle design in CAD/CAM systems"

5B071200-Mechanical Engineering

Performed by Karzhassov Zhassulan Kairatovich

Reviewer
_____
_____
"_____" _____2020

Scientific adviser
Candidate of Technical Sciences,
Associate Professor
_____Isametova M.E "

"_____" _____2020

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**TASK**
**for completing the diploma work**

For student: Karzhassov Zhassulan Kairatovich
Topic: " Creation of unnamed aerial vehicle design in CAD/CAM systems "
Approved *by the order of university rector №762-b from "27" January 2020*
Deadline for completion the work *"24" May 2020*
Initial data for the diploma project: Basic information about unmanned aerial vehicle
Summary of the diploma work:

a) *Construction of unmanned aerial vehicle;*
b) *CAD/CAM systems;*
c) *The design process of the drone;*

List of graphic material: Graphical representations of details of unmanned aerial vehicle
Recommended main literature:

1. Tarasov, E. V., Methods of designing aircraft. E. V. Tarasov, V. M. Balyk - Moscow: Издательство МАИ, 2000.
2. Itskovich G. M. et al. Course design of machine parts. 6th edition., revised. M., "mechanical engineering", 197015 Ivanov B. C. 'Fatigue destruction of metals. - Moscow: Ме-таллзфгиздат, 1963.
3. Shcheverov, A. N. Design of unmanned aerial vehiclest / A. N. Shcheverov. - M.: Машиностроение, 1978.

## THE SCHEDULE

For the diploma work preparation

| Name of sections, list of issues being developed | Submission deadlines to the scientific adviser | Notes |
|---|---|---|
| General information about CAD/CAM systems | 20.02.2020 | Task completed |
| Information about unnamed aerial vehicle | 15.03.2020 | Task completed |
| Usage of CAD/CAM systems | 30.04.2020 | Task completed |
| Designed in CAD/CAM systems unmanned aerial vehicle | 25.04.2020 | Task completed |

## Signatures

Of consultants and standard controller for the completed diploma work, indicating the relevant sections of the work (project).

| The section titles | Consultant name (academic degree, title) | Date | Signature |
|---|---|---|---|
| Main part | Candidate of Technical Sciences,Isametova M.E | 25.04.2020 | |
| Normcontrol | Candidate of Technical Sciences,Isametova M.E | 15.05.2020 | |

Scientific adviser _____ Isametova M.E

The task was completed by student: _____ Karzhassov Zh.K.

Date: “15” May 2020

# АҢДАТПА

Бұл дипломдық жұмыстың мақсаты өрт сөндіруге бағытталған CAD/CAM жүйелерінде пилотсыз ұшу аппаратының моделін құрастыру және құру процестері қарастырылды.

Өрт сөндіру мақсатында осы ұшу аппаратын пайдалану өрт сөндіру қызметі жұмысшыларының өміріне қауіп төндіреді. Қашықтықтан басқарылатын ұшу аппараты үшін негізгі міндет оттың көп таралуын болдырмау болады. Қазіргі уақытта дерттер осы салада адамдарды толық алмастыра алмайды, бірақ тапсырманы айтарлықтай жеңілдетеді деп айтуға болады. Жүк көтергіштігі аз болғандықтан, негізгі жану ошақтарын өтеу міндеті бар жоғары тиімділік SAT-119 құралы пайдаланылатын болады.

Қазіргі әлемде осы салада дрондарды пайдалану тәжірибесі қолданылып жатыр, бірақ қазіргі уақытта олардың өлшемдері өте үлкен және ені мен салмағы 160 килограммға жуық 2.8 метрге жетеді, бұл маневр мен басқару жеңілдігін айтарлықтай төмендетеді. Өз кезегінде дипломдық жұмыста қолмен басқару пульті бар шағын өлшемді ұшу аппараты қарастырылады.

# АННОТАЦИЯ

В данной дипломной работе были рассмотрены процессы конструирования и создания модели беспилотного летального аппарата в CAD/CAM системах, цель которого направлена на пожаротушение.

Использование данного летального аппарата с целью пожаротушения значительно снижают риски для жизни рабочих пожарной службы. Для дистанционно управляемого летального аппарата основной задачей будет предотвращение большего распространения огня. В настоящее время нельзя сказать, что дроны в полной мере смогут заменить людей в данной сфере, но значительно облегчат задачу. Ввиду небольшой грузоподъёмности будет использоваться средство высокой эффективности SAT-119, с задачей погашения основных очагов возгорания.

В современном мире уже используется практика использования дронов в данной сфере, но на данный момент их размеры очень большие и достигают 2.8 метров в ширину и весом около 160 килограмм, что значительно снижает манёвренность и легкость управления. В свою очередь в дипломной работе рассматривается летательный аппарат небольших размеров с ручным пультом управления.

# ANNOTATION

In this diploma work were considered the processes of designing and creating a model of an unmanned aerial vehicle in CAD/CAM systems, the purpose of which is aimed at firefighting.

The use of this type of aircraft for firefighting purposes significantly reduces the risks to the lives of fire service workers. For a remotely operated aircraft, the main task will be to prevent more fire spreading. Nowadays it's hard to believe that drones will fully replace people in firefighting activities, but they will make the task much easier. Due to the small load capacity of drone, the SAT-119 high-efficiency product will be used, with the task of extinguishing the main fire centers.

In the modern world, the practice of using drones in this area is already used, but at the moment their size is very large and reaches 2.8 meters in width and weighs about 160 kilograms, which significantly reduces maneuverability and ease of control. In turn, the diploma work considers a small-sized aircraft with a manual control panel.

**CONTENT**

# INTRODUCTION

Mechanical engineering-serves as a fundamental industry, plays a special role in the process of scientific and technological progress. The development of industry and the national economy, as well as the increase in the rate of equipping them with new technologies, largely depend on the level of development of mechanical engineering.

Industrial enterprises are an important chain in the development of the state and increase its welfare. In this regard, it is necessary to improve the quality of design of industrial enterprises, to carry out construction on more progressive economic projects. One of the most important tasks in the field of design is to increase the level of industrialization of construction.

The main purpose of this diploma project is designing a drone in CAD/CAM systems. The ICAO (International Civil Aviation Organization) Assembly approved a specific definition for the drone. A drone is an aircraft without a pilot, in which the flight process is performed without an aircraft commander on Board, either completely remotely controlled from another location, for example from the ground, from board of another aircraft, from space or completely autonomous.

## 1 Integrated CAD/CAM systems

Automatic design systems are classified as computer software used for the production and design of products. They are fully a complex set of software, technological, technical and information tools, as well as design documentation, the main purpose of which is considered to be the automation of design processes. Implementation of this task a reality allows to significantly increase the efficiency of engineers ' activities and reduce time and financial costs for the development and implementation of new products, as well as to raise the design to a new level of quality and competitiveness.

### 1.1 What is the CAD system

CAD systems were developed for the purpose of 3D modeling of various constructions and automatic design of drawings. The process of designing using computer technology involves the use of computer systems as the subject of product design and development. High computer technology and the ability to correct errors during the production of the drawing significantly increase the efficiency of this activity. Computers within a decade have been able to replace drawing boards and paper drawings, because they are highly advanced technology that can perform complex three-dimensional modeling and design, while not using paper and pen. When creating a model in such a system, you can view it from any angle and under various types of light, which makes it possible to correct shortcomings of the object before creating it. Drawings can be split into several separate elements and replaced if necessary. In the process of creating can be completely rebuilt from the ground up. The result of this system is a drawing, brought to final refinement with the applied dimensions. Finished drawings can be printed out and used in the production process, or information about the shape of the part can be re-designed into production instructions, with which machines will produce this part.

In fairly advanced systems, it is possible to take into account the structural properties of materials. When using these values in mathematical modeling of a structure, it is possible to get an estimate of certain moments of its behavior even before it leaves the pantograph system drawing device. This function allows you to evaluate the consequences of certain changes in the behavior of the part.

Creating innovation is the primary task of engineers. Modern computer-aided design systems create the best ground for the process of implementing the designer's ideas, reducing the design time and being at the top of the market when implementing the product.

### 1.2 What is the CAM system

In turn, computer aided manufacturing systems are a system of technological pre-production, the purpose of which is to manufacture complex profiled parts on numerical control machines, in the process using 3D models obtained in computer aided design systems. Successful functioning of modern enterprises that produce

complex technical products has become impossible without the widespread use of CAM systems. Manufacturing parts using computer technology is the application of software systems to control mechanized tools. Using this technology, you can make certain shapes from materials to create structures and fixtures from them. These mechanisms translate objects previously designed in computer systems into reality, by transmitting commands to controlled mechanized systems.

### 1.3 The use of CAD/CAM technology in the trends of modern realities

CAD/CAM technologies were widely used in the market in the 80's. At the same time, the transition of systems from mainframes to personal computers was made a reality, which in turn had an impact on increasing the spread of this technology, as PCs were more accessible and convenient to use.

Over time, many programs have been developed that use these technologies for design. Due to its availability and wide distribution, there are currently leaders in this industry. Such platforms as SolidWorks, AutoCAD, and Compass-3D have become leaders in the use of Our market at the present time. Currently, an enterprise that wants to reach a high level of production and become competitive in this field can not do without producing a product of good quality and at an affordable price. Thanks to the use of high speed and memory of computers, it is possible to significantly reduce the time and money spent on production. Computer-aided design, computer-aided manufacturing, and computer-aided design or construction technologies translate these processes into reality.

Modern medicine has also not spared this technological breakthrough and the main Department in use has become dentistry. If earlier dentistry was limited to a certain range of available technologies for setting fillings, in our time the use of CAD/CAM systems, with a new method of controlling the shape of the object, gives a wide choice of materials.

In addition to the large-scale use of these programs in production, each of them has available training versions that train future specialists in higher education institutions. And many of them are available for free use for non-commercial purposes, for personal training of people who have an interest in this area.

Integrated systems have been widely developed and become an integral part of production, and therefore there was a need to divide into levels. It is common to divide CAD/CAM systems into three levels which are shown in Table 1.

The rapid development of technology has led to a very high variety of mechanisms. Levels have been developed to simplify the work process and easily determine the complexity of the work. So the creation of complex science-intensive products, such as space technology or missiles, is impossible without high-tech integrated systems in order to prevent technical problems in the system that can lead to large consequences. For training and familiarization with CAD/CAM systems, or designing simple parts of mechanisms, low-level programs were developed that did not require high technological characteristics of the computer and were more easily accessible.

Table 1 - The levels of CAD/CAM systems

| System level | Example of system |
|---|---|
| High | Pro/Engineer, NX, CATIA, EUCLID, I-DEAS, etc. |
| Medium | SolidWorks, SolidEdge, Pro/Desktop, Mechanical Desktop, Autodesk Inventor, etc. |
| Low | AutoCAD, TrueCAD, Medusa, КОМПАС-3D, БАЗИС, etc. |

## 2 Overview of unnamed aerial vehicles

Inasmuch as the main task of each state and government is to protect its population, all advanced technologies are primarily directed to the military-industrial complex. Many inventions become easy to use and gradually become popular in everyday life. These developments include a computer, the Internet, and even a microwave oven. Now people do not know how to find the right address without a phone with navigation, which was also created primarily for military needs. Drones are no exception in this case. Currently, the use of remotely controlled drones in various spheres of public activity is widespread. They are more common in activities related to shooting, that is, quadrocopters. Images captured from a bird's-eye view do not leave many people indifferent and are very popular. But mobile, remote-controlled devices with cameras are not only used for shooting video, they also serve as excellent assistants in search and rescue operations. Due to the advanced Bluetooth and Wi-Fi technology, drones can climb to a great height to explore difficult places accessible to human begins. The use of unmanned aerial vehicles in the rescue service helps save more lives. This shows that drones can be used in different areas, for example in the United States, according to BI Intelligence analysts, they are used in more than ten areas, as shown in figure 1.

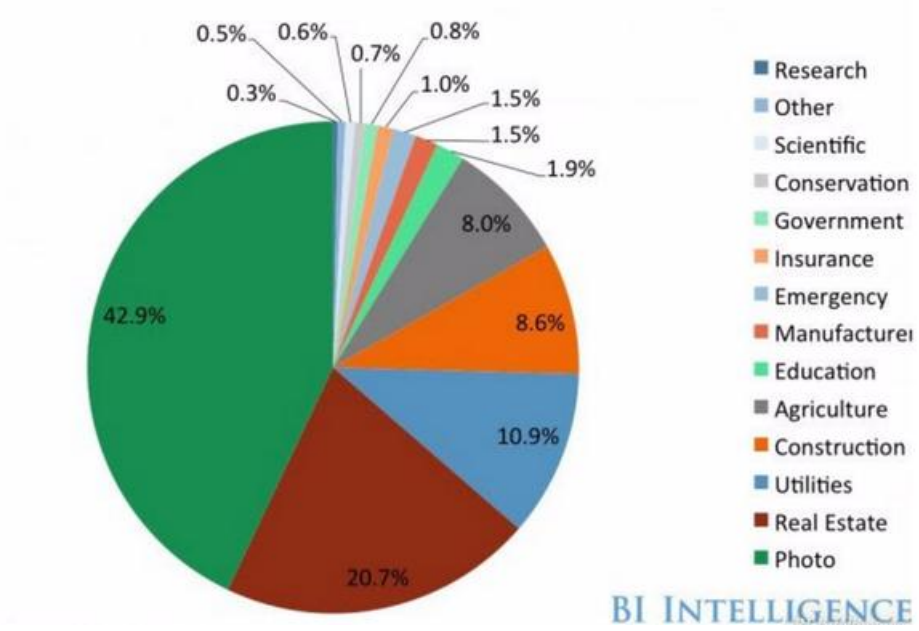



Figure 1. Drone usage statistics from BI Intelligence analysts

### 2.1 Classification and types of drones

Due to the wide range of capabilities, abundance of components and configurations, unmanned aerial vehicles are divided into many different categories by size, range, possible load, basic mechanism or purpose. It is very difficult to remember the full range of features of this device, since the functionality is practically unlimited.

For better visualization, drones can be divided into four groups, which are

presented in table 2.

Table 2 - Types of unmanned aerial vehicles

| Type of drone | Description |
|---|---|
| Micro | Approximate weight of 10 kilograms, battery charge duration of 60 minutes, maximum flight range of 1 kilometer |
| Mini | The approximate weight is 50 kilograms, the battery charge duration is about 5 hours, and the maximum flight range is 5 kilometers |
| Middle | Approximate weight of 1 ton, designed for 15 hours of flight, maximum range of 10 kilometers |
| Heavy | The approximate weight is more than a 1 ton, the battery charge lasts for more than a day, and the possible movement at an altitude of about 20 kilometers |

### 2.2 Scope of application of the designed drone

The purpose of this unmanned aerial vehicle is to extinguish the main sources of fire during a fire. In the event of a fire in a particular area or building, the first priority is to save a person's life if they are caught in the fire, and to prevent a fire. Each fire has its main sources where the fire starts. In order to stop the spread of fire to a large area, you need to extinguish these foci. Since the spread of fire is a very rapid process, often the main sources of fire are located in difficult to reach places, in the very center of the fire. In this regard, it is not possible to get to it, or it is dangerous to the lives of people fighting the fire. During a fire, remote-controlled drones with fire extinguishing equipment will be used to reduce the risk of fire-fighting workers.

### 2.3 Components of a firefighting drone

The performance of the drone directly depends on the components, in our case, these are control mechanisms such as the motor, receiver and battery inside the drone, as well as the remote control. Since the designed drone is small in size the Turnigy 2900kv motors on the edge of each blade will be enough to send the cargo to the place we need. With a weight of only 19 grams, this type of motor shows high efficiency.

The cargo in this case is a fire extinguisher grenade Lifeguard-01 or otherwise it is called SAT119, an example of which is shown in figure 2. High efficiency and ease of use influenced the choice of this particular tool for the drone. The process will be to get to the hearth and throw a grenade with a fire extinguishing agent into it. The grenade is represented as a flask with water and chemicals that instantly neutralize the fire. As soon as the tank breaks in the center of the fire, the water that was inside will reduce the temperature, and chemicals will neutralize the oxygen. Due to this outcome, the fire will not be able to continue burning because there will be no oxygen, and the impact of chemicals on a large area will help to extinguish the fire

around.

Battery selection is a very important process for the drone to work properly. A suitable option is the Battery Turnigy 2200 mAh Lipo pack. A small volume gives us an advantage in light weight. The fast charging process allows you to quickly enter the built-in device.


Figure 2. Fire extinguisher SAT 119

## 3 The design process of the drone

In the process of creating the drone model, the computer-aided design system KOMPAS-3D was used. The methods of using this system were available during the training program of the University.

KOMPAS-3D is a universal system for two-dimensional and three-dimensional design, which has gained popularity in production due to the ease of development and wide functionality of solid-state, direct and surface modeling. The main goal of the program is to prepare a complete package of drawing documentation and implement the idea in the form of a three-dimensional projection. For the interpretation in a heterogeneous environment KOMPAS-3D has the capability to import and export files in the formats STEP, IGES, ASIC, STL, DXF, PARASOLID, etc. In addition to 3D-design capabilities, the KOMPAS-Graph set of functions includes an automated system for the development and registration of design and project documentation, designed to support the standards of the unified system of design documentation, systems of design documentation for construction or standards of a specific enterprise. Compass also includes the ability to link with CAM systems to prepare the designed product for production.

### 3.1 The design of the component parts of the drone

The designed unmanned aerial vehicle consists of two parts of the base, upper and lower, the cover of the body and six claws, presented in Supplements A, B, C and D. The reason for the greater number of claws in the designed drone than in standard drones is its purpose for firefighting. In our case, in addition to the camera, the drone will have the task of lifting a load in the form of a fire grenade. Six motors on the edge of each wing provide a safe and easily controlled flight without overloading. In the process of creating a model of the drone body, suitable propellers with high aerodynamic characteristics were selected to improve the quality of flight.

### 3.2 Hardware for creating a real model of drone

To create a real full-fledged model of the projected drone on a 3D printer, need to choose the appropriate material for printing. The material in this case will be PEEK intended for desktop 3D printers. This material is suitable not only for the characteristic of high strength, but also for impressive properties of heat resistance and chemical influences. The high mechanical strength of the structure makes it possible to avoid rapid wear and light damage due to hard contact. Impressive indicators of resistance to thermal effects more than two hundred degrees Celsius provides an opportunity to get closer to the source of fire for more chances of elimination.

Since the material used for production is quite heat-resistant and its melting point reaches 332℃, need a printer with a high maximum temperature of the extruder. The CreatBot F160-PEEK 3D printer is suitable for printing heat-resistant plastic with a maximum extruder temperature of 420℃. The print area is 160 x 160 x 200 mm and

is suitable for creating parts. The printer's technical specifications are shown in table 3.

Table 3 – Technical characteristics

| Type of characteristic | Description |
|---|---|
| Printing technology | FDM |
| Print area | 160x160x200 mm |
| Height of the layer | From 0.04 (from 40 microns) |
| Positioning accuracy | Z axis – 0.00125 mm, XY axis – 0.00125 mm |
| Maximum printing speed | 200 mm/sec |
| Recommended printing speed | 60 mm / sec |
| Maximum print head speed | 200 mm/sec |
| Diameter of the loaded plastic | 1.75 mm |
| Support for models from programs | Autocad, Solidworks, Kompas, 3Dmax, Archicad, Zbruch, Cinema4D, Scatchup, etc. The model is exported from the program in STL format |
| Program for preparing the model for printing | Cura, Replicator G, FlashPrint, etc. |
| Number of extruders | 1 |
| Maximum extruder temperature | 420°C |
| Type of extruder | Directly Drive |
| Diameter of the extruder nozzle | 0.4 mm (can be replaced with other sizes) |
| Platform temperature | up to 150 °C (set in the print settings) |
| Stepper motors | 1.8° angle step with 1/16 microstep |
| Control | ATmega 2560 |
| Touch sensitive display | Yes (4. inch) |
| Interface language | English |
| Card support | USB |
| Consumables | PLA, ABS, Carbon Fiber, Wood, Nylon, PC, PTEG, HIPS, PP, Flexible, TPU, PVA, PEEK, etc. (thickness 1.75 mm) |
| Supported file type | .stl, .obj .amf |
| Operating systems | Windows XP, Win Vista, Win7, Win8, Win10, Linux, MacOS |
| Input voltage | 100-240 V, 50-60 Hz |
| Power | 300W |
| Printer size | 370 x 320 x 490 mm |

| | |
|---|---|
| Printer weight | 20 kg |

FlashPrint platform is selected for producing 3D printing. The purpose of the program is to convert the finished 3D model into a programming language available for the printer. The computer itself must be connected to the printer at this time. The program is built in an accessible format with a minimalistic interface that includes a field for the object and the main function panels. The interface is shown in Figure 3.

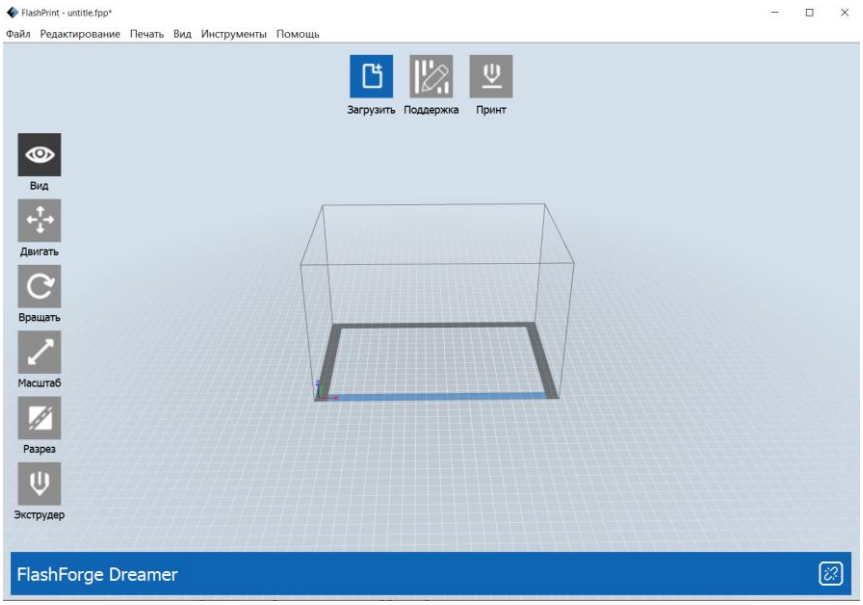



Figure 3. The FlashPrint program interface

Objects in the 3D printing process are produced in a vertical position, this is necessary for applying more layers in process of creating, which makes the part more durable. Support is added to each part to ensure that the part is kept smooth and there are no errors during the manufacturing process. Support is created with minimal cost in a thin layer, since the main task is to hold the part during production. The support parameters are shown in table 4. After the production process, the support is removed, and the remaining seams on the surface are removed using sandpaper or other means.

Table 4 - Supports parameters

| | |
|---|---|
| Type of support | woody |
| Overhang limit | 55° |
| Diameter of the column | 3.0 mm |
| Diameter of the base | 6.0 mm |
| Height of the base | 6.0 mm |

Automatically designed supports for parts that are manufactured in operation are shown in Figure 4 and Figure 5.

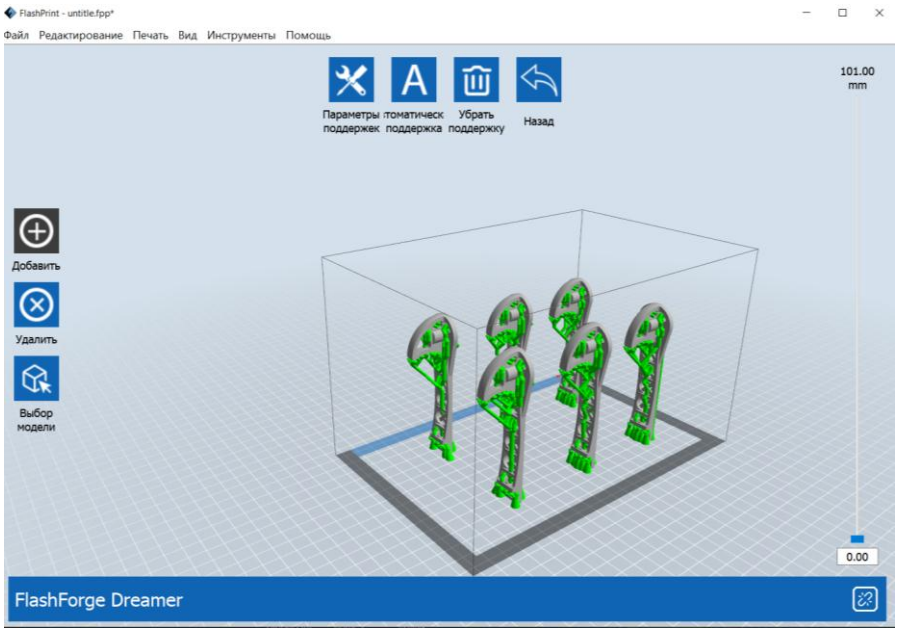



Figure 4. Support model for claws

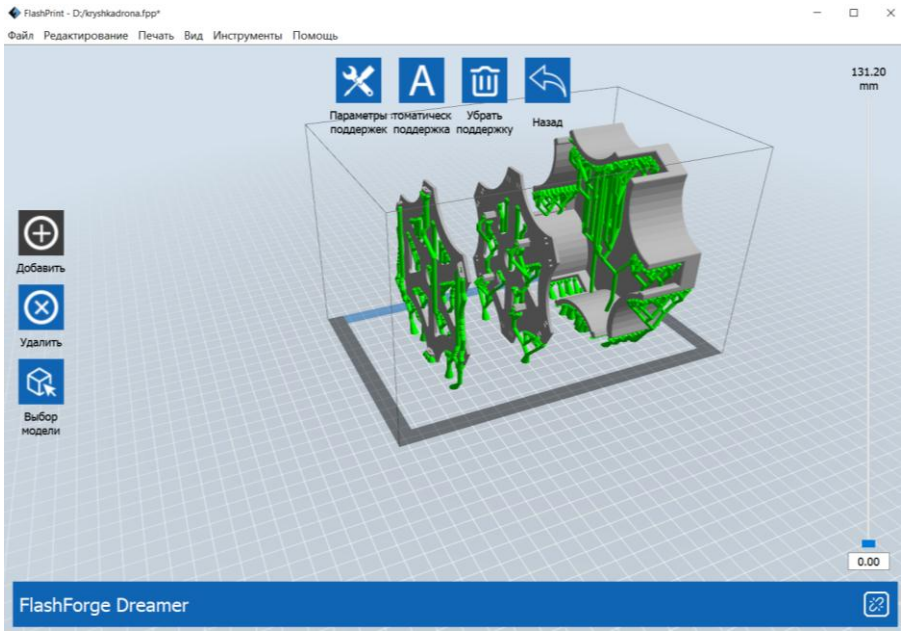



Figure 5. Support model for main parts of the corpus

The last stage of production before printing is the simulation of the printing process. This report gives us information about the print duration, estimated weight, and applied number of layer. Before you start printing, you must configure the print settings. The first step is to select the material and print resolution. The material used is PEEK, the resolution must be high for greater strength. Before starting to print you need to add the raft function which allows you to create a thin layer on the printing table that eliminates possible damage to the base of the part and is removed as easily as the support. You also need to select the height of the layers, the degree of filling, the speed and temperature of the printing process. The parameters of the printing process are shown in table 5.

Table 5 – Parameters of the printing

| Parameter | Descripton |
|---|---|
| Type of the printer | |
| Manufacturing material | PEEK |
| Resolution | high |
| Layer height | 0.1 mm |
| Thickness of the first layer | 0.2 mm |
| Filling degree | 50° |
| Filling structure | hexagon |
| Printing speed | 60 mm/sec |
| Speed of the extruder | 100 mm/sec |
| Extruder temperature | 350 °C |
| Platform temperature | 130 °C |

An example of the final result is shown in Figure 6 and Figure 7. In the application window on the left, you can see the scale of detail layers, which allows you to see the step-by-step construction of the model.

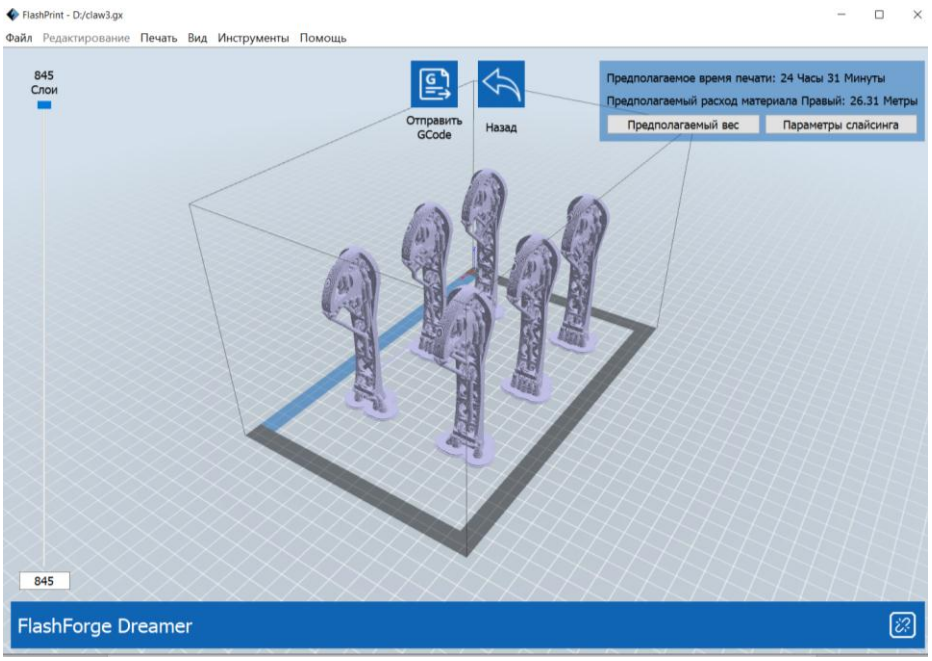



Figure 6. Claws print projection

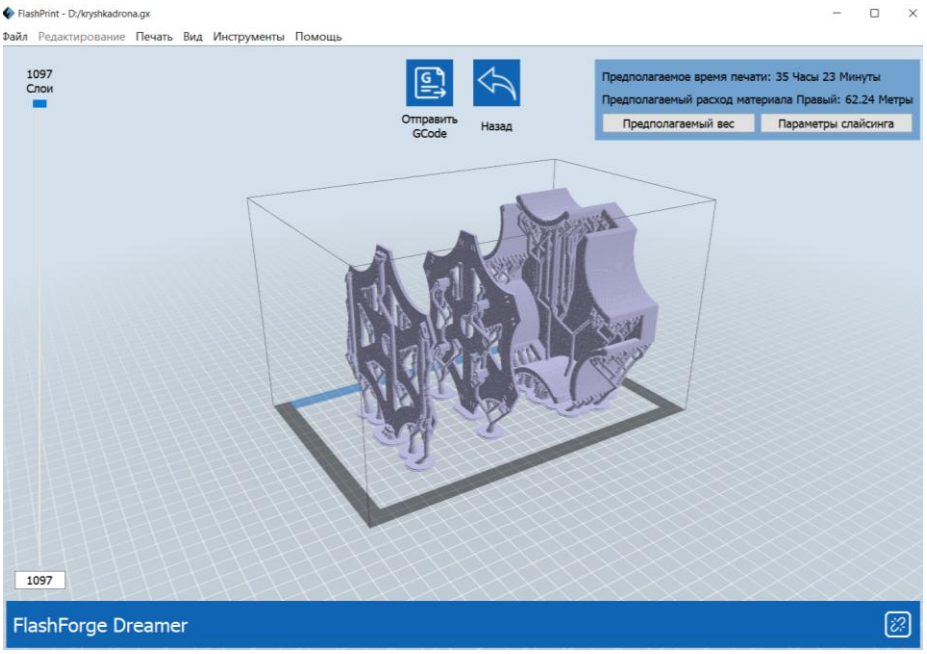



Figure 7. Corpus parts print projection

Parts are produced together to save time spent on printing, as this process takes a significantly long time. If you have a single printer, it will take 60 hours to produce these parts.

# CONCLUSION

The diploma project considered one of the possible ways to use an unmanned aerial vehicle in order to fight fires. In the theoretical part, the design systems were described and the general concept of the drone. The process of operation of this aircraft in the fight against fire was described and the most suitable accessories were selected.

The COMPASS-3D system was used to design the part, which made it possible to fully create a model of the body parts. The capabilities of 3D printers nowadays simplify the creation of such parts, as the process of manufacturing from plastic becomes much easier, and the part less weight. Such types of plastics as polyether ether ketone can compete for strength with metals. Therefore, the production of the drone in reality is quite possible.

Possible chances to reduce the level of fire danger is the main task. The use of such unique technologies for the benefit of people is an important aspect.

## LIST OF REFERENCES

1 Volsov D.G. DESIGN OF MODERN AIRCRAFT BASED ON INFORMATION TECHNOLOGIES AND COOPERATION; Вестник УлГТУ 3/2015

2 Shcheverov, A. N. Design of unmanned aerial vehiclest / A. N. Shcheverov. - M.: Машиностроение, 1978.

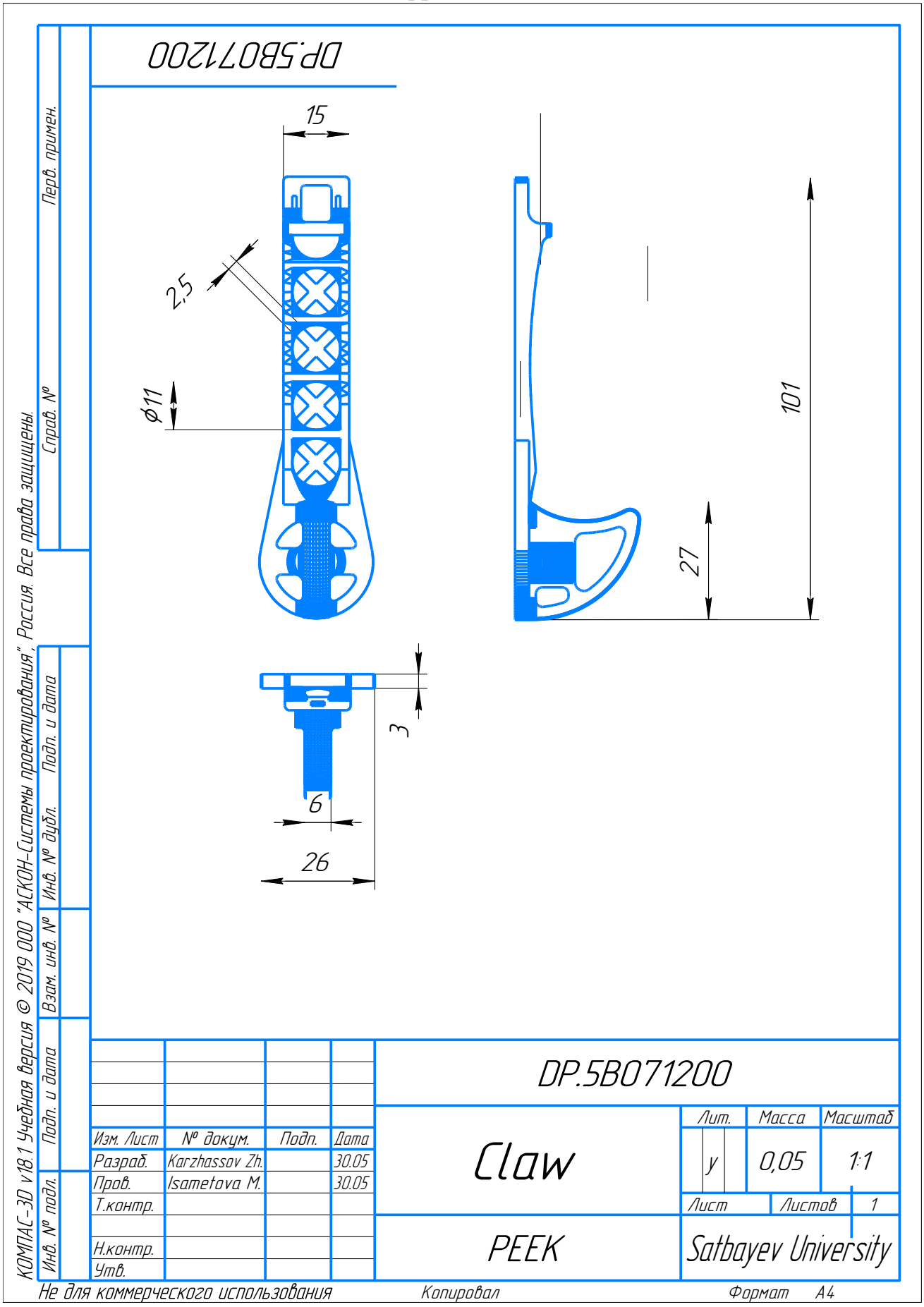
3 Tarasov, E. V., Methods of designing aircraft. E. V. Tarasov, V. M. Balyk. - Moscow: Издательство МАИ, 2000.

4 Itskovich G. M. et al. Course design of machine parts. 6th edition., revised. M., "mechanical engineering", 197015 Ivanov B. C. 'Fatigue destruction of metals. - Moscow: Ме-таллзфгиздат, 1963. - 272 с.

5 Sukhanova, A. We have a unique methodology for top-down design: interview with A. N. Filatov, it Director of the Federal state unitary enterprise " ЦСКБ-Прогресс" / / CAD/CAM/CAE Observer. - 2010. no. 5. - Pp. 10-23.

6 Golubev I. S., Samarin A.V. «Design of aircraft structures»- M.: Машиностроение, 1991

Supplement A



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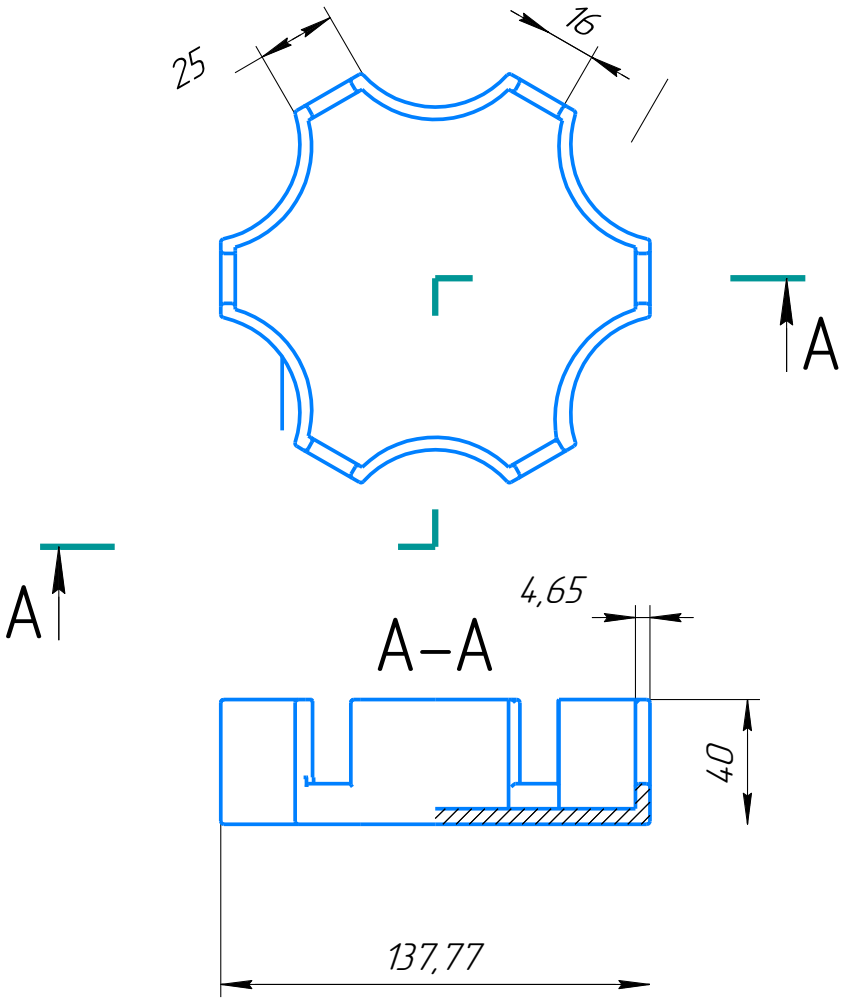


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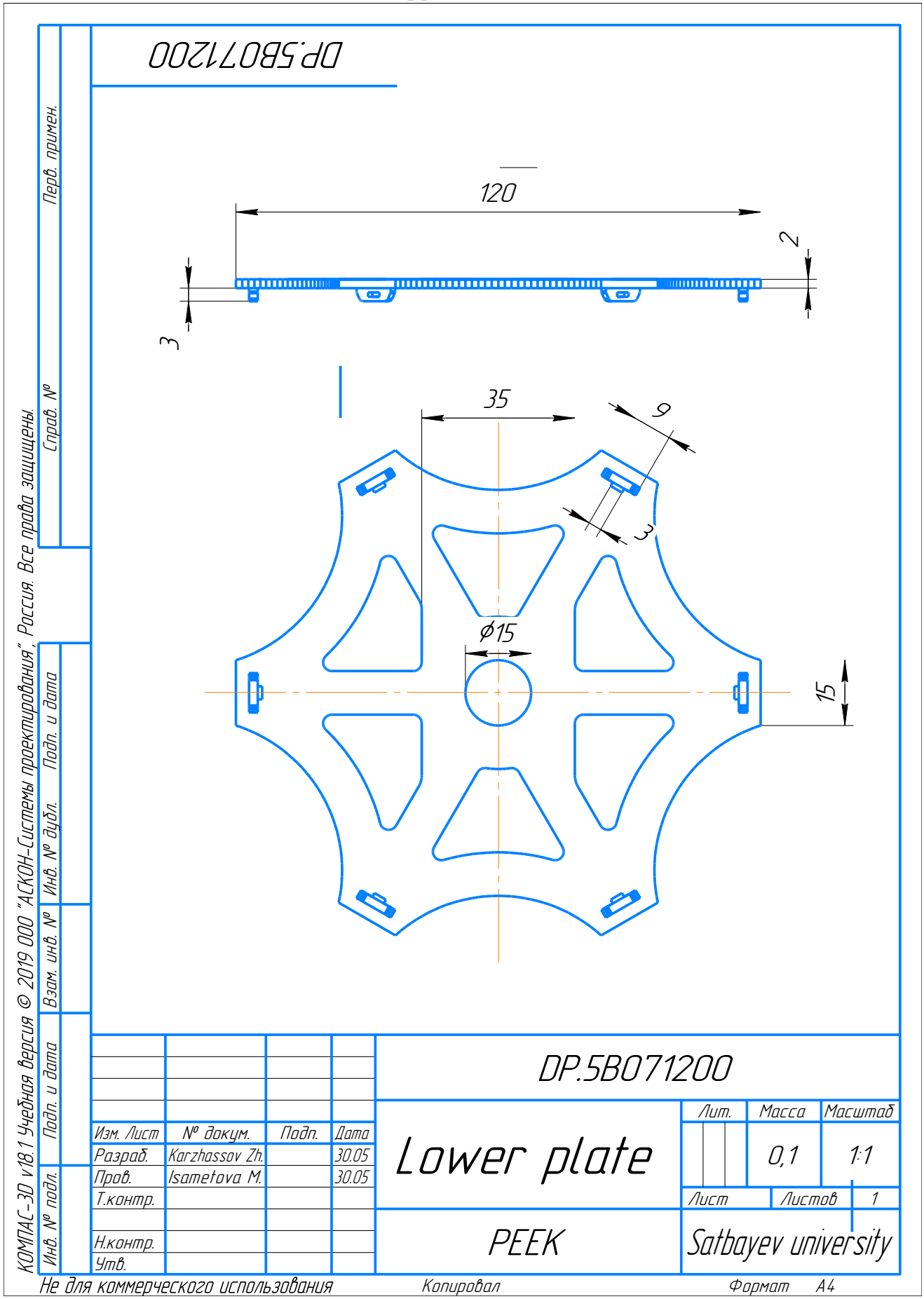
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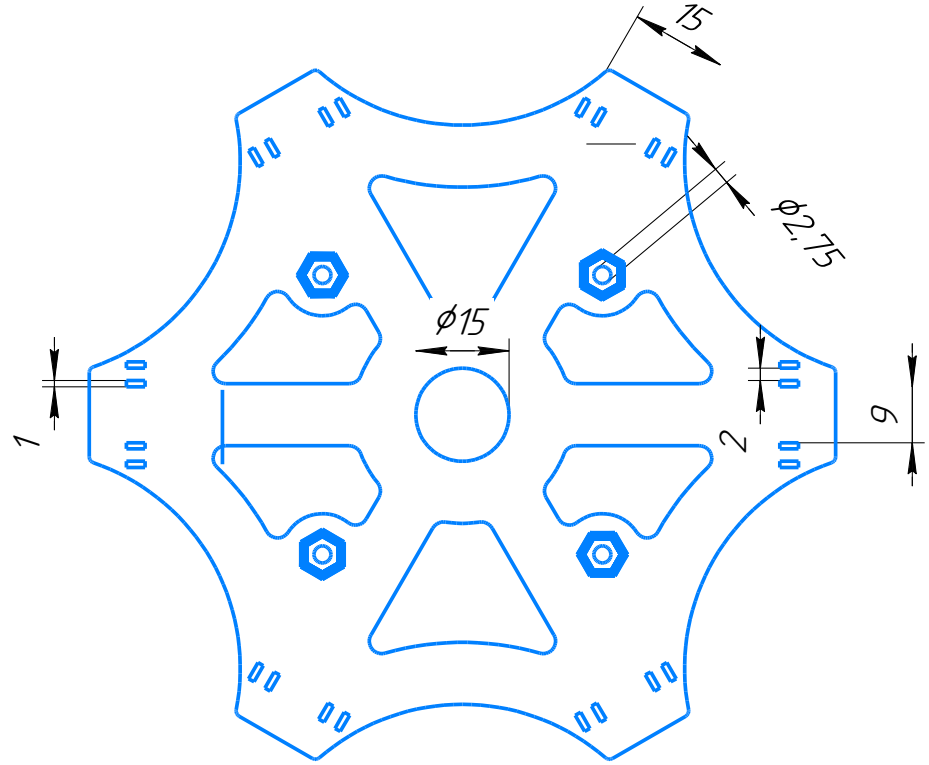


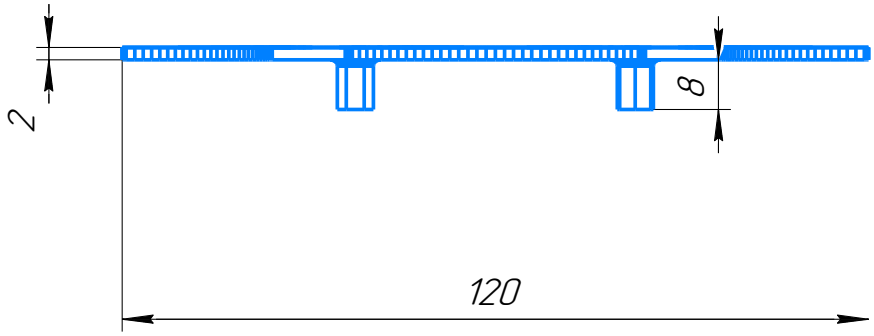


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