THE OBTAINMENT OF COMPLEX CONTOURS FOR AEROSPACE INDUSTRY IN SOLIDWORKS SYSTEM

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Abstract. In the focus of the present article are parameterization and establishment of the bottom of the light seaplane in a geometric modeling system. The consummated approach allows to create a relatively smooth surface of the bottom of a hydroplane and to prepare it for engineering analysis.

Keywords. Modeling, SolidWorks, seaplane.

1 Introduction

The choice of the external contours of the bottom of the seaplane is one of the most important tasks that engineers come across in the process of its designing. Such important parameters as displacement, hydrodynamic quality and speed of the exit of the plane to redan depend of the number of redans, their relative position and angle of deadrise boats. When designing a seaplane by means of old methods constructors face many challenges. If you change the specification of the impressive work you have to redo that spends extra resources.

1.1 Topicality of the work

The proposed method allows creating parameterized models in the software environment Solid Works. These models are reconstructed quickly when changing input parameters.

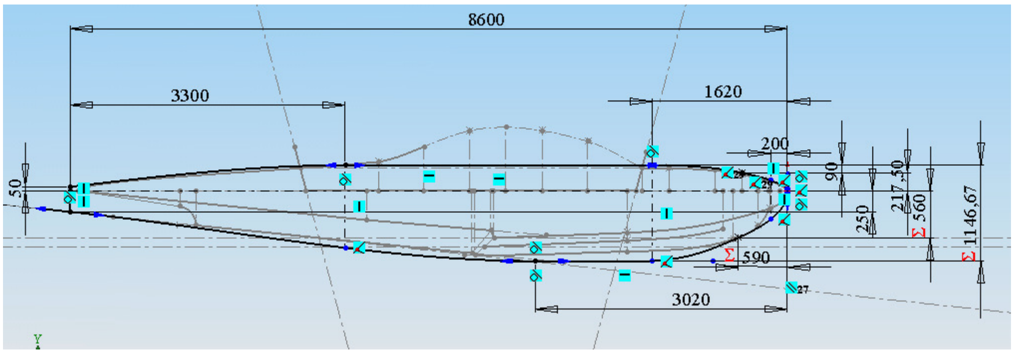


Figure 1

The most valuable part of this method is the principle of construction of the body. The resulting body has complex geometric shape, however, rather simple when using the tool combination of simple bodies.
This method of designing of external contours simplifies the designer's work by breaking a complex task into a number of simple ones. Another indisputable advantage of the method is cost-effective expenditure of system resources. The bodies of simple geometry, that are described mathematically easier and respectively, system calculates faster than bodies of complex geometric shapes. It solves the problem of a number of systemic errors that the user faces when constructing complicated bodies.

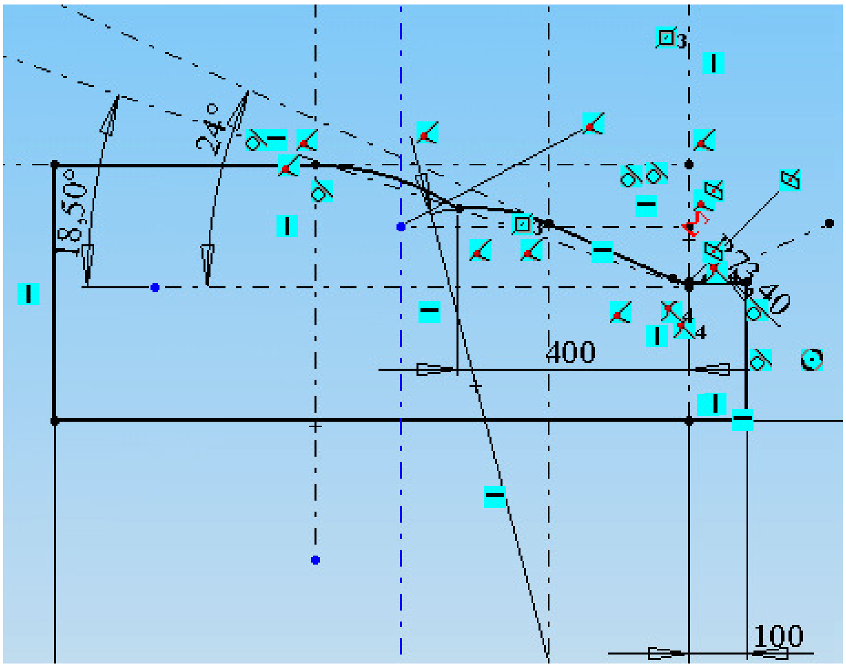


Figure 2

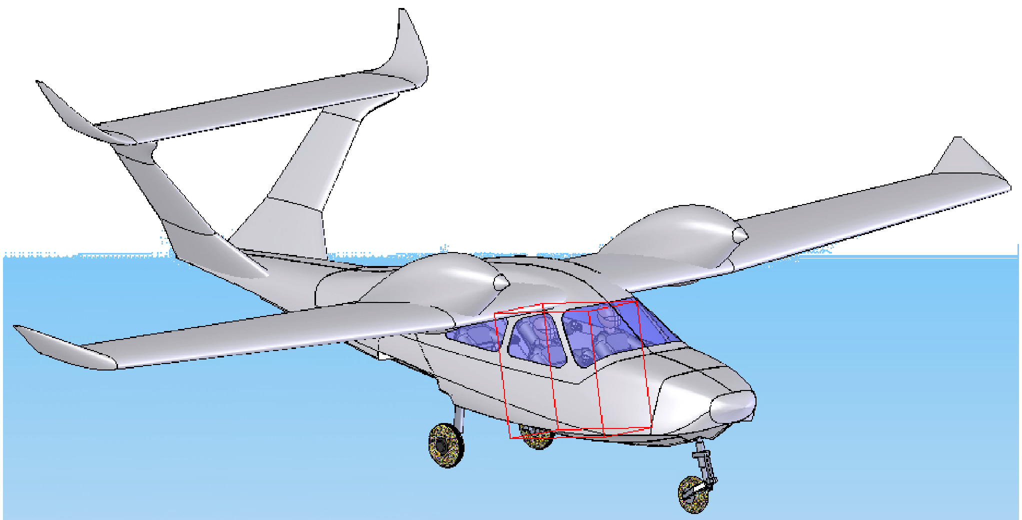


Figure 3

Following the work of a number of conclusions: a method that simplifies the construction of bodies of complex geometric shapes. with a set of recommendations for the parameterization and nomenclature content sections wasdeveloped. The problem of saving system resources and time to design.
Using these techniques the project of the seaplane was developed. Amphibious aircraft designed for 4 people, cabin Superior with the possibility of rapid conversion to 6 persons. As a prototype amphibian L42, La4, La6, La8 is used.

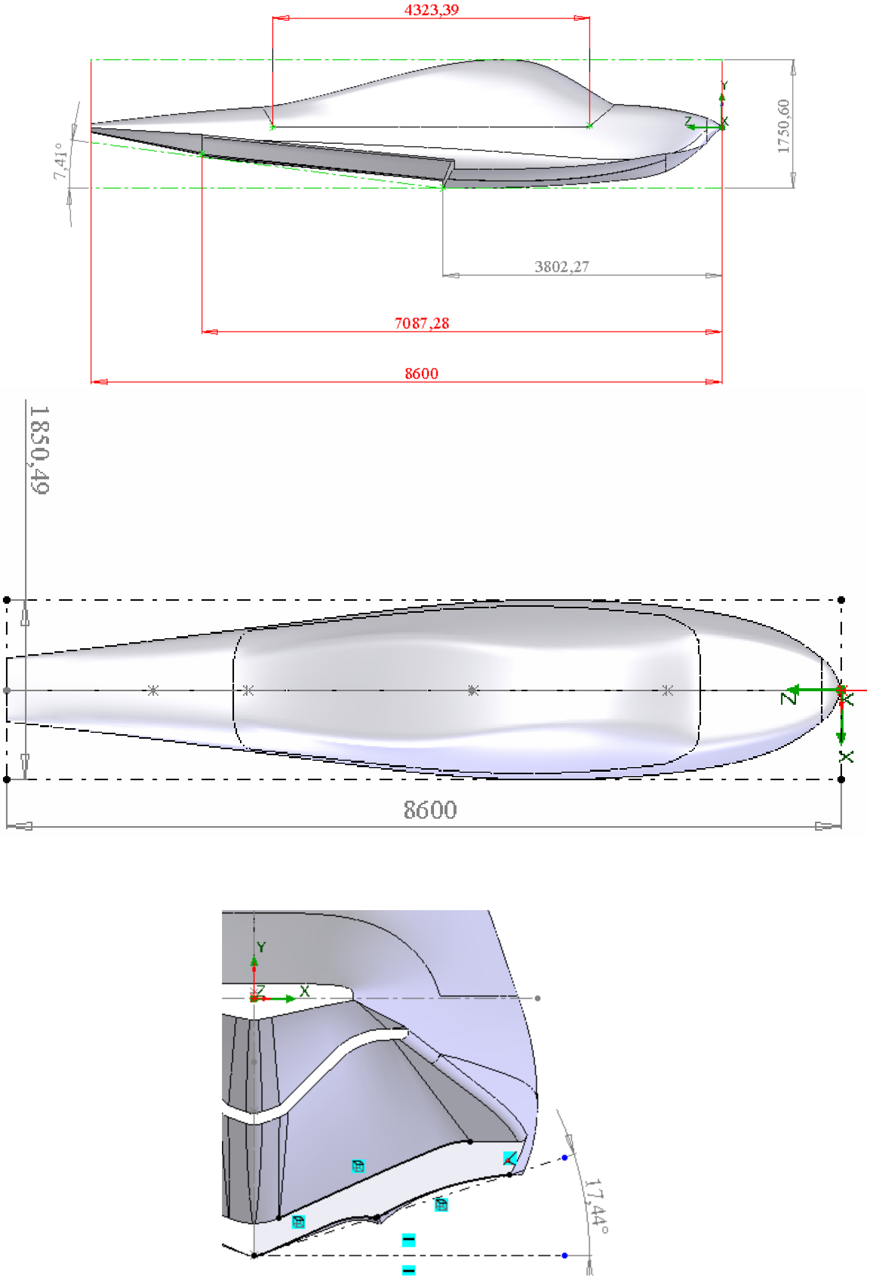
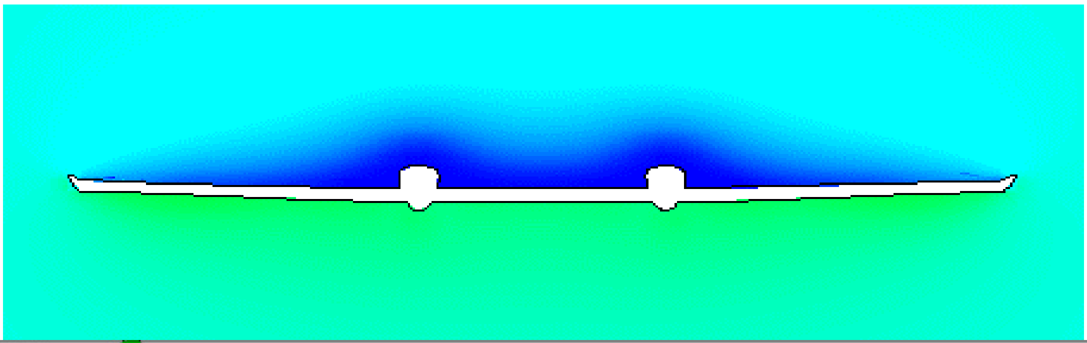


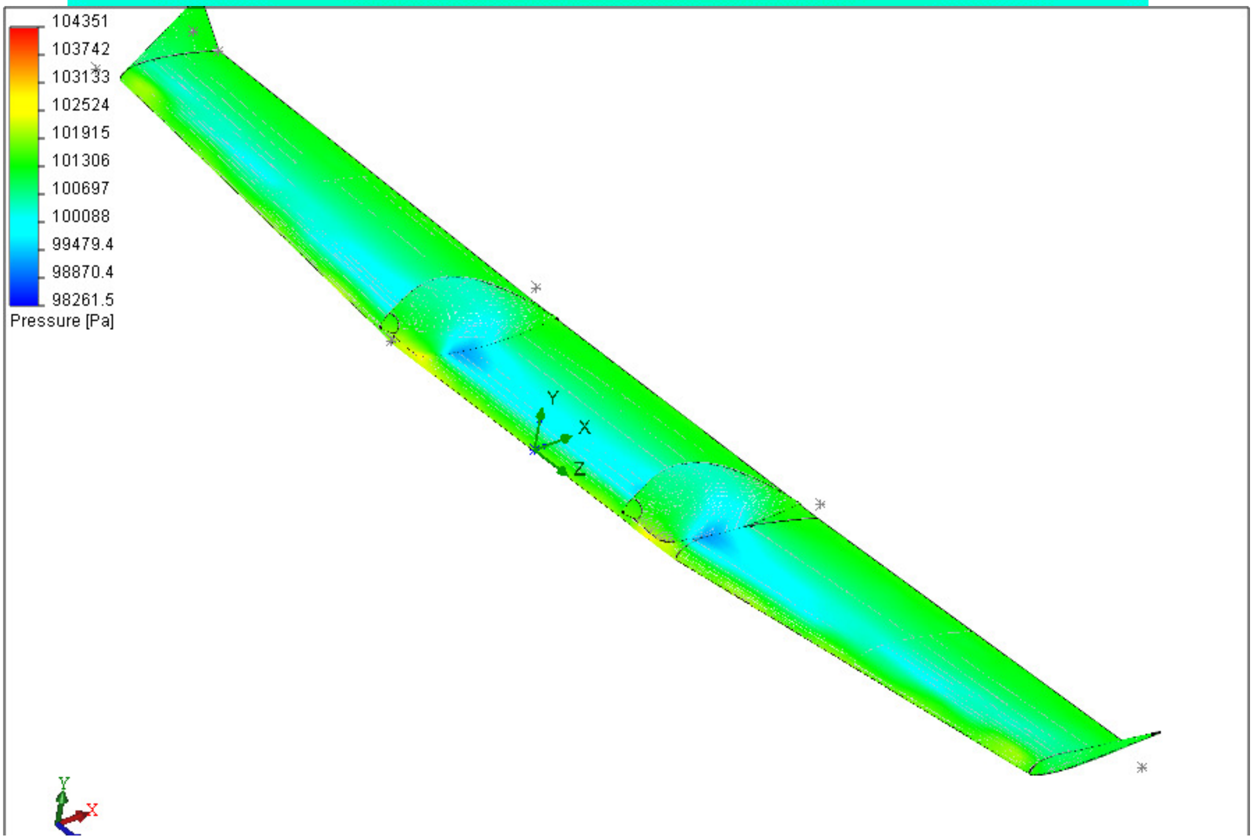
Figure 4

The research of aerodynamic characteristics of the isolated fuselage at a speed of 55 m/s, showed resistance to 32 kgs.

1.2 Wing

Airfoil: NACA 23015. The wing has neither geometric, no aerodynamic twist. At the detachable part of the wing are hovering ailerons, with a constant chord of 23%. Fauer flap with a chord of 35% is located in the center wing section, engines with propellers in flight variable pitch and feathering system with a diameter up to 2 meters can be found here as well.





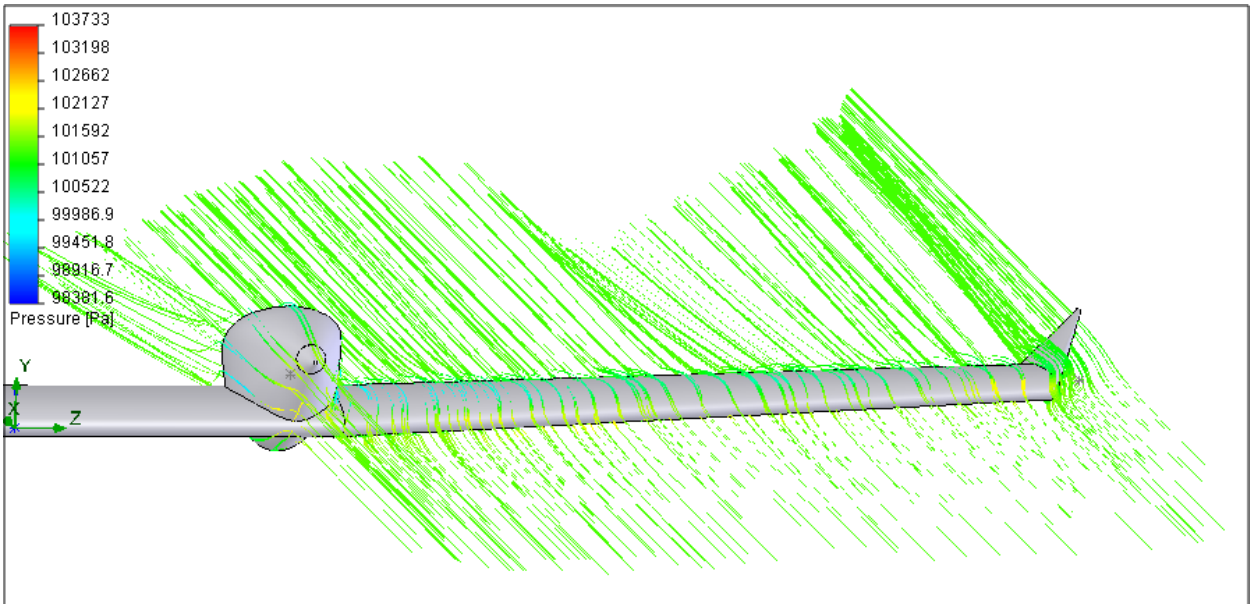


Figure 6: Flow works research

1.3 Empennage

Empennage consists of two keels for the collapse, the angle of 40 degrees and adjustable stabilizer.

1.4 Cabin Interior Layout

Cabin is merged with the cockpit. In main configuration there is a layout of two rows of two seats. The distance of 350 mm between the seats makes it possible to pass between the them. The right front seat folds to install ladders for the snoot enter and exit. To avoid contamination of the instrument panel on the side of the right pilot, the panel is closed.
In a special configuration the aircraft can take on board up to 6 people. Extra seats are set: the fifth – in the second-row seats, the sixth behind the second row.

1.5 Undercarriage

Undercarriage of the light hydroplane is designed by three core schemes, with the bow of the auxiliary support. The geometrical parameters of the chassis are represented in the table 1:

Parameter	Value
Diameter of main wheel bearing	476 mm
Wheel diameter bow supports,	400 mm

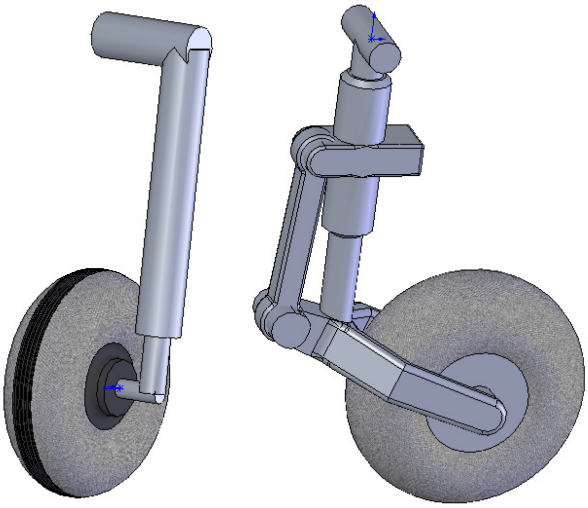


Figure 7: Landing gear

1.6 Engine

The propulsion of the product consists of two engines, the takeoff power of 100 hp (75 kW). The project is completed with engines Rotax912 USL.

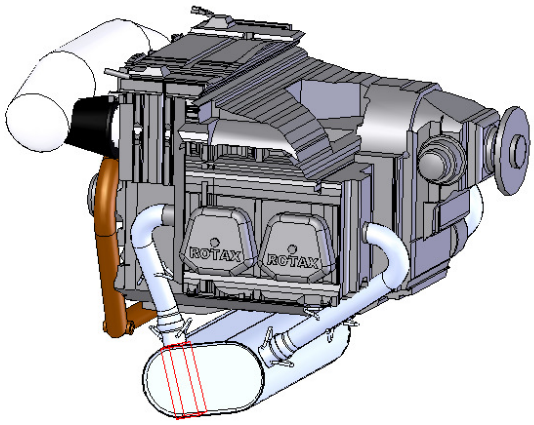


Figure 8: Engine Rotax912 USL

1.7 Fuel system

Fuel can be found in three tanks. Two tanks are located in the center section, an additional tank located in the central part of the fuselage. The output of fuel begins from lower tank by pumping it in the top one. The fuel system is equipped with an emergency discharge.
The total capacity of tanks is 400 liters.

1.8 Weight summary of the aircraft

Weight summary of the aircraft is based on preliminary research prototypes, as well as seaplanes RDC and the experimental data on modern composite materials based on structural fiberglass and epoxy resin curing cold and transition.

Weight summary	Elements	Weight elements	Summary	1503,85	
Фюзеляж			183,85		**12,23%**
	Shell of the fuselage	119			7,91%
	Constriction set	17,85			1,19%
	glass cover	18			1,20%
	Implement	19			1,26%
	Avionics	10			0,66%
wing			140		**9,31%**
	wing	140			9,31%
empennage			30		1,99%
	Vertical keel 1	9			0,60%
	Vertical keel 2	9			0,60%
	Tail-plane	12			0,80%
undercarriage			66		**4,39%**
	main	18			1,20%
	secondary	48			3,19%
load			400		**26,60%**
	Целевая (2 чел.)	200			13,30%
	Служебная (2 чел)	200			13,30%
Power system			438		**29,13%**
	Rotax912USL	190			12,63%
	propellers	24			1,60%
	mount	24			1,60%
Foil system			220		**14,63%**
	foil	200			13,30%
	Foil tank	16			1,06%
	Foil tube	4			0,27%
Control system			26		**1,73%**
	gear	18			1,20%
	Controls gear	8			0,53%

Table 1: Weight summary parameters .

To calculate the weight of the shell the weight of 1 square meter of the surface is taken, made of 4 layers of fabric T10 from the outside sheathing, and 2 layers of fabric T10 from the inside one. Increase or decrease of the weight of the fuselage, that is possible, is not taken into account, because of the lack of technical study of the project at an early stage of design.

1.9 Basic design performance characteristics

As reference values flight characteristics, taken reasonable power plant based on the Rotax 912 engine USL, with a maximum take-off power at the level of 100-115 hp. While assessing the aerodynamic characteristics of aircraft were used averaged data prototypes.
Reference values to determine the flight characteristics during take-off are shown in the table 2:

Quality landing	10
Quality cruising	13
Quality takeoff	12
Landing speed	84.76926
Wing Area	20.928
Wing loading	71.85828
Take-off weight	1503.85
Empty detonator	1,303.85
Power SD, total	200
The load on the power	7.51925
Maximum speed of	233.4318
Efficiency screw	0,67
Specific fuel consumption	0,25
Range	1251.029
Total volume of the boat, t	6700
Normal volume of boats	1503.85
Reserve Buoyancy	445%

Table 2: Performance characteristics .

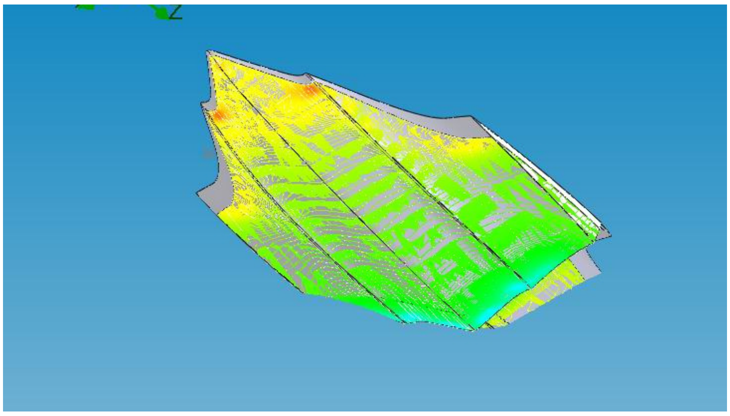


Figure 9:

According to hydrodynamic studies, data obtained for different variants of displacement (table 3, 4):

H	V	X	Y	K	dk/dv	V m/c	q	Ro
950	3900	500	2550	5,1		10	50	1
850	2836	558	3012	5,4		10	50	1
750	1776	299	2312	7,73	-0,0022	10	50	1
650	935	210	1257	5,98	0,002077	10	50	1
550	389	125	743	5,94	7,64E-05	10	50	1

Table 1:

H	Cx*S	dCxS/dV	Cy*S	dCyS/dV
950	10		51	
850	11,15556	-0,00108604845447	60,24	-0,008684211
750	5,98	0,00000000053437	46,24	0,013207547
650	4,2	-0,00000000133753	25,14	0,025089180
550	2,5	-0,00000000354351	14,86	0,018827839

Table 4.

Where:
H - bearing a boat in millimeters;
V - volume of the submerged part of the boat in kgf;
X - hydrodynamic resistance of the boat;
Y - lift (buoyancy), hydrodynamic force;
K - the experimental value of the hydrodynamic qualities (GDK);
dk / dv - derivative GDK by volume displacement;
V m / c - the speed of pulling the boat in the basin;
q - dynamic pressure of fluid in the smuggling in the boat;
Ro - density of the fluid "environment"
Cx * S - characteristic of hydrodynamic resistance
dCxS / dV - derivative of the hydrodynamic resistance in terms of tonnage
Cx * S - characteristic of the hydrodynamic lift
dCxS / dV - derivative of a hydrodynamic lift force in terms of tonnage

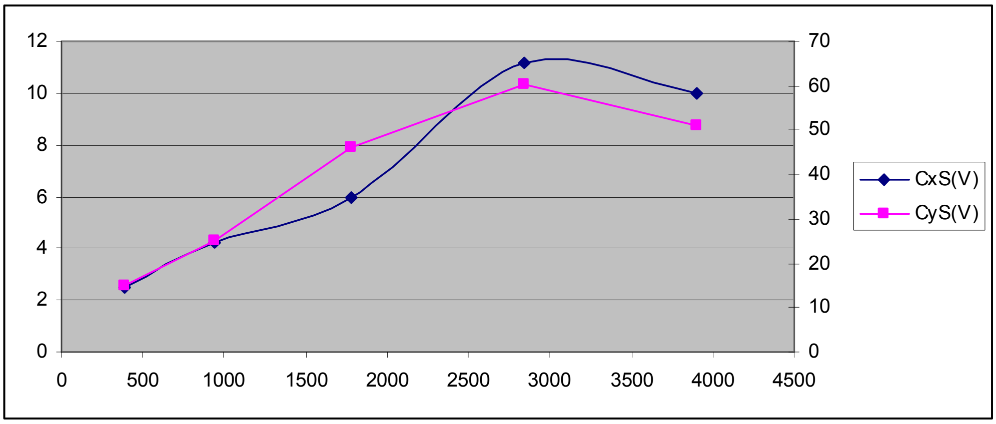


Figure 9

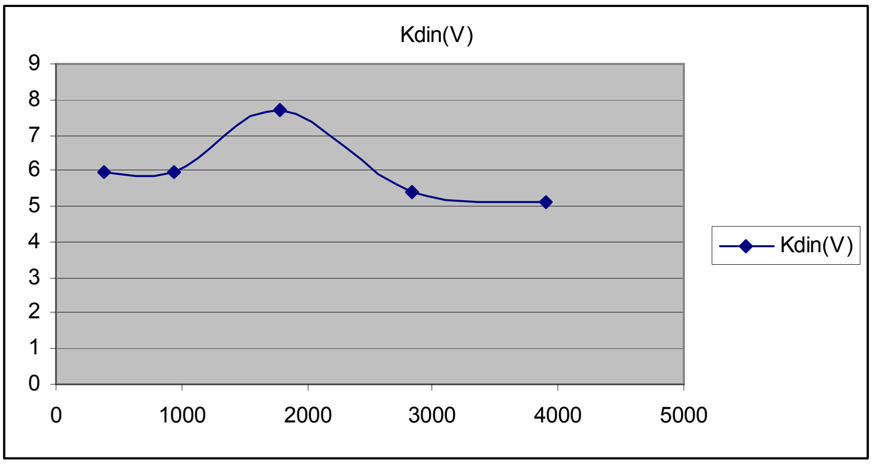


Figure 10

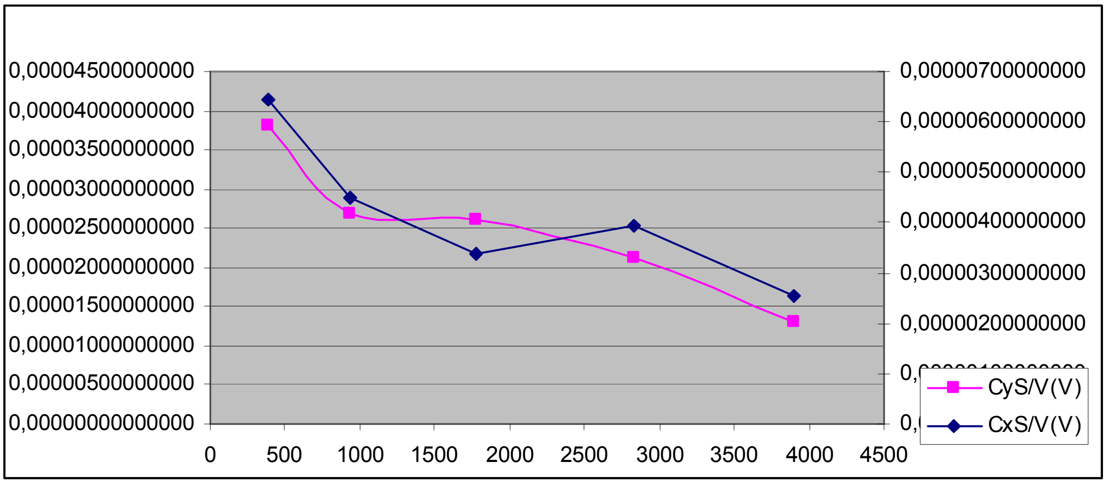


Figure 11

The aggregate estimated dynamic characteristics of the boat shown on the graph:

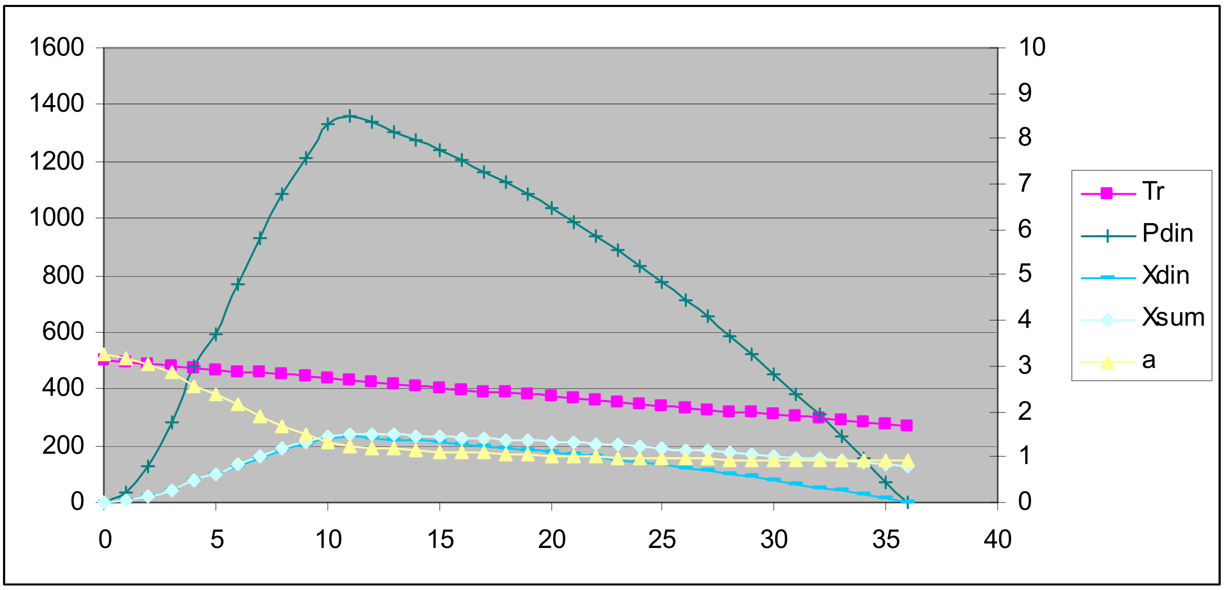


Figure 12

Where:
Tr - available thrust force installation
P din - hydrodynamic component of the lift
X din - component of the hydrodynamic resistance
X sum - the total value of the resistance forces, aerodynamic and hydrodynamic
a - acceleration on the takeoff run at a constant pitch angle boats

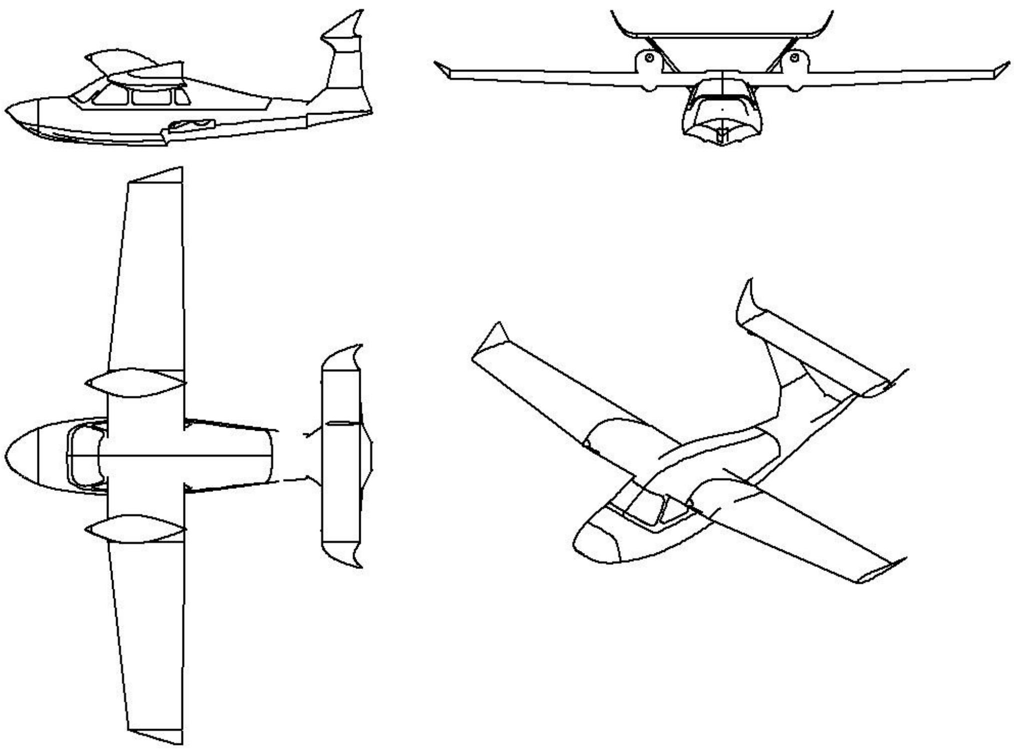


Figure 13

2 Conclusion

The method also aims to make the model more mobile. A number of recommendations for the parameterization of the cross sections follow to end up with a model that can be rebuilt in case of change of specification in the short term. It takes just a few minutes to solve the problem of increasing tonnage, reserve buoyancy, increasing the number of passenger seats, stability. Because of parameterization of the model it is not difficult to change the distance between redans or rebuild the bottom of the profile plane, while the rest of the model will be reconstructed automatically.

One more advantage is the clear presentation. Three-dimensional model can be understood easily by people with different level of proficiency.