behavior is complicated by number of external and internal causes, since it allows them to remove aggression, cope with isolation and passivity. At the same time, the school teacher often faces another problem - when an auspicious and generally successful student, believing that success is guaranteed by previous merit, stops making efforts in school, lets everything take its course. In this case, the situation of success, created by the teacher, takes the form of a kind of puff pie, where between the layers of the test (between two situations of success) the filling is located (the situation of failure).

Computer technologies help to qualitatively change the content, methods and organizational forms of training and under certain conditions can contribute to the disclosure, preservation and development of the individual abilities of the students, their personal qualities; the formation of cognitive abilities; the intention for self-improvement. Multimedia computer technologies allows to replace almost all the traditional technical training means. In many cases, such a replacement turns out to be more effectively, allows the teacher to operatively combine various means that contribute to a deeper and more conscious mastering of the material being studied, saves lesson time, fills it with information. Therefore, it is completely natural to introduce these means into the modern educational process. Multimedia means allow to provide the best, in comparison with other technical teaching means, the realization of the principle of visibility, which plays a leading role in the educational technologies of primary school. In addition, multimedia is given the task of providing effective support for game forms of the lesson, active “student-computer” dialogue, and all this contributes to success in the educational process.

Thus, success as a process and a psychological-pedagogical concept is necessary for a modern teacher, parent and junior student, the result of which is self-realization of the pupil and feeling of satisfaction from the work done.

REFERENCES

1.Slastenin V.A. Pedagogica. –M.:Akademia, 2003. – 576 p.(in Russion)

2.Kulyatkin Yu., Tarasov S. Educational environment and personal development.// Novie znanie. – 2001. – № 1.(in Russion)

3.Andreeva Yu.V. Teaching practice. Primary and basic general education. Optimistic strategy of creating a situation of success in the educational activities of adolescents. –Ufa: East University, 2000. – 128 p.

METHODOLOGY DETERMINING DISPLACEMENT AND MAJOR DIMENSIONS OF UNMANNED UNDERWATER VEHICLES IN THE EARLY STAGES OF DESIGN

Pyshniev S.N.
Ph.D.(Technical Sciences),
associate Professor of Admiral Makarov National University of Shipbuilding ,
Nikolayev, Ukraine.
Changli Yu
Ph.D, .(Technical Sciences),
associate Professor of Harbin Institute of Technology,
Weihai, P.R. China.

Abstract. The article is devoted to the description of the new method for determining of displacement and the main dimensions of the remotely operated underwater vehicles. The method is based on polynomial approximation of data array, the parameters received by results of mathematical modeling the teithed survey, inspection and universal working vehicles. The method is based on the calculation of payload mass. The ROV weight load includes the possibility to use modular elements. As an example, the calculation of the main dimensions of the real vehicle builed in Nikolayev in 1993-94 is given.

Keywords: unmanned underwater vehicle, displacement calculation, main dimensions calculation, weight load calculation, payload.

Defining the basic parameters of the object being developed has always been and remains the most important task for the designer. The efficiency of the solution method is the higher the more accurate the calculations can be made at the first steps of the project task.

The most important dependencies used to determine of the displacement and dimensions of the vehicles are balance equations, or the equations of the existence of the vehicles, such as the equation of masses, volumes, energy margin, and information exchange.

Setting the task: correct determination of displacement and main dimensions of unmanned underwater vehicles (ROV) presents a difficult task for the designer, especially if there is no close prototype. [9]. The designer often has face to face a situation where he, apart from the terms of reference, does not have the necessary information for the future of the project.

The object of the study is tied uninhabited underwater vehicles.

The main tasks, which were solved during the study - development and justification of methods of calculation of displacement and main dimensions of underwater vehicles according to the data of the technical assignment.

Research methods - approximation of artificial data array, the calculated for the searching, inspection and working vehicles.

It is known that the mass equation analytically represents the fact that the displacement of the vehicle is the functional sum of the masses constituting the load [3],

$$m_o = \sum m_i(m_o, r) + m_{inv}, \quad (1)$$

Where m_{inv} - invariant, independent of mass displacement, determined before the beginning of dimensions calculation, based on the technical assignment for design, for example, manipulator, TV camera, depth sensors, ROVs positions, etc.

m_i (mo, r) are masses that make up the remaining load items and depend both on the total mass of the future apparatus and on its tactical and technical characteristics (TTC). In fact, the mass of the light body, electric cables, propulsions and other equipment of the vehicles depends in one way or another on its size, and therefore, form the total mass of the object. At the same time, some load items are linear, and others do not change linearly with the growth of the total mass of the vehicles [4].

Referring to the division of all masses of the vehicles into two categories by the nature of the dependence on the total mass, equation (1) will be written as:

$$m_O = (q_{ЛК} + q_{АКК} + q_{ДРК} + q_{ПЛ})m_O^{2/3} + (a_{УР} + a_{КДС} + a_{ЗВ})m_O + m_{INV}, \quad (2)$$

where m_O - mass of fully loaded apparatus;

q_I - mass meters proportional to $m^{O2/3}$;

a_I[are the proportional coefficients of the masses proportional to the m_O.

In this equation, the non-linear dependence (degree 2/3) is accepted for the weight of the light body, accumulators, propulsion-steering complex, float, and the linear dependence for the equalizing, roll-trimming systems and the buoyancy margin of the apparatus. Solving this cubic relative to mo1/3 equation, we find the normal displacement of the apparatus.

There are three canonical methods of determining the displacement of ROV [6], which have passed from the theory of surface vessel design. One of which, as shown above, is based on the solution of the algebraic equation, the second on the differential recount of the vehicles load articles, and the third uses Newton 's graph-analytic method, successively approaching the solution with the reclusive formula

$$m_{i+1} = m_1 - F(m_1)/F'(m_1) \quad (3)$$

This process is described in more detail in [5].

All of the above methods have certain disadvantages. First of all, it is a great dependence on the accuracy of the original data. Most often it is information about the articles of load of a close prototype, which is often erroneous. It is essential that for surface vessels it is much easier to find such information than for underwater vehicle equipment [8]. To date, statistical material on ROVs is extremely limited.

Description of the method - the author tried to change the approach to solving this problem, and will focus on the "independent" components of the load of the apparatus. There are two good reasons. First, these "independent" load elements typically constitute a payload that enables the apparatus to perform the main task. Second, the technical data for these load elements are the most reliable. They are specified in the specification or in the documentation.

In order to start calculation of characteristics, we need to know the following conditions: ROV assignment; search area, m^2; Depth and hydrology in the area of work; Design speed of ROV, m/s;. In addition, will be assumed that the architectural and structural type of ROV is defined.

The author 's method of determining the main characteristics of ROV is proposed. The method is based on the statistical material received by data processing of hypothetical prototypes of two types calculated on mathematical models of the ROV - the searching and inspection and universal workers. In the future, the obtained data are clarified through the project load table and for 2-3 iterations lead us to the completed result. The technique is quite versatile and produces reliable results for a wide range of underwater vehicle designs. One of the key issues in determining the displacement and main dimensions of the ROV is the correct determination of the value of the GWP payload corresponding to the nature of the work performed. By payload we will understand all equipment and devices that provide the solution of the task. The list of this equipment belongs to the category of so-called "independent" variables, the modification of the list of which changes the characteristics of the entire set.

For selection of main dimensions of ROV and determination of its displacement in the first approximation, consider the example of inspection ROV "Diaf 600," the sckim of which is shown in Fig.1.

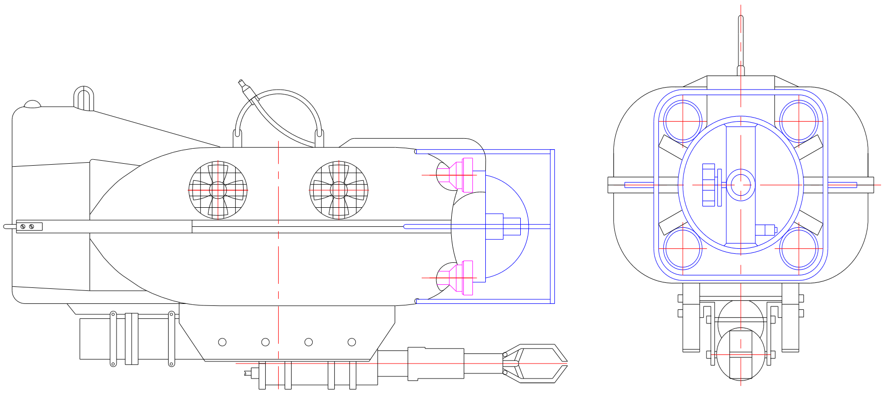

Fig.1. Skim of inspection ROV "Diaf 600."

Payload of ROV "Diaf -600" includes two TV cameras, four lamps, multi-beam sonar, depth sensors, radioactivity, magnetometer, manipulator-grip, navigation system and control system. In total, more than 10.0 kg. of payload. Flight speed of ROV is 2.5 m/s. The calculation is performed in the following sequence [4]: The expected value of ROV displacement in the first approximation is determined by the formula:

$$\Delta_{ПА} = \frac{P_{ГР}}{\eta_{ГР}}$$

where $\acute{\eta}_{ГР}$ the coefficient of utilization of displacement counted on the following dependence:

$$\eta_{ГР} = (A - B \cdot H_P \cdot 10^{-3} + \Delta\eta) \cdot 10^{-2} + 0{,}045; \qquad \text{where}$$

$$A = 10{,}8 + 0{,}024P_{ГР} + 9{,}2 \cdot 10^{-6} {P_{ГР}}^2;$$

$$B = 1{,}18 + 0{,}003P_{ГР};$$

$$\Delta\eta = 1{,}55 - 1{,}33v_{ПА}.$$

In this case, it is considered that the residual buoyancy of the payload $P_{ГР}$ = 10 kg; H_P =600 m; $V_{ПА}$ = 2.5 m/s. At these numerical values:

$$A = 10{,}8 + 0{,}024 \cdot 10 + 9{,}2 \cdot 10^{-6} \cdot 100 = 11{,}118;$$

$$B = 1{,}18 + 0{,}030 = 1{,}21;$$

$$\Delta\eta = 1{,}55 - 1{,}33 \cdot 2{,}5 = -1{,}78.$$

$$\eta_{ГР} = (11{,}118 - 1{,}0 \cdot 1{,}21 - 1{,}78) \cdot 10^{-2} + 0{,}045 = 0{,}126.$$

ROV displacement in the first approximation will be equal to:

$$\Delta_{ПА} = \frac{10}{0{,}126} = 79{,}36кg.$$

In calculations we accept $\Delta_{ПА}$ 80.0 kg. This $\Delta_{ПА}$ value is indicative and will be refined on subsequent iterations.

Data on foreign prototypes ROV "ECA H800" and "Predator 300" [11] give $\Delta_{ПА}$ values in the range of 96 - 67 kg with a payload value of 34 and 11 kg.

The main dimensions of the Diaf 600 vehicles in the first approximation are determined by the formulas:

$$L_{ПА} = \left(0{,}085 \cdot \sqrt{D_{ПА}} + 0{,}22{v_{ПА}}^{1{,}2}\right) - 0{,}1;$$

$$B_{ПА} = 0{,}08 \cdot \sqrt[3]{(D_{ПА} + 2)} - 0{,}06;$$

$$H_{ПА} = 0{,}092 \cdot \sqrt[3]{(D_{ПА} + 3{,}5)} - 0{,}09;$$

If the ROV architecture represents a "frame" layout without a streamlined light hull, the overall completeness factor can be calculated using the formula; $\boldsymbol{\delta = 1 - (0,09v)}$ in our case, δ = 0.78.

According to the calculation results in the first approximation the **dimensions of ROV "Diaf - 600" will be: L = 1.27 m, B = 0.64 m, H = 0.72 m.** Then it is possible to go to estimation of masses and volumes of components of weight load of the vehicle.

The frame

Frame is based on sandwich panels include fibreglass-sintaktik-fibreglass. The weight of these elements can be estimated using the factors of total ROV completeness of the and filling the volume of the surface housing $k_{v.}$ Works [4. 6] estimate the range of k_v, which for this type of ROV under consideration will be about 0.48. The integral mass density of these structural elements at the density of the syntactic of 500 kg/m^3 [6] will be 700 kg/m^3.

$$m_{НР} = 1{,}03 \cdot (LBH) \cdot \delta \cdot k_{ЗП} \cdot \rho_{СФ};$$

$$m_{НР} = 1{,}03 \cdot (1{,}08 \cdot 0{,}65 \cdot 0{,}6) \cdot 0{,}585 \cdot 0{,}18 \cdot 700 = 32кг.$$

The floating volume of these structural elements will be:

$$V_{HP} = \frac{32}{700} = 0{,}0457 м^3.$$

Propulsion complex

The required power for ROV movement in three planes is determined by the method [2, 7]

$N_x = R_x v_x$; или $N_x = 0{,}5(\rho v_x^3) C_x S_x$;

$N_y = R_y v_y$; или $N_y = 0{,}5(\rho v_y^3) C_y S_y$;

$N_z = R_z v_z$; или $N_z = 0{,}5(\rho v_z^3) C_z S_z$

In our case V_x = 2.5m/s; V_y = 1.2 m/s; V_z = 0.8 m/s; Cx=0,32; Cy=0,72; Cz=0,82; S_x=HBψ =0,33м^2;. S_y=LHσ = 0,53м^2 ; S_z=LBα =0,58м^2;

N_x= 0,5 1020 $(2{,}5)^3$0,32 0,33 = 842 *Вт*

N_y= 0,5 1020 $(1{,}2)^3$0,53 0,72 = 336 *Вт*;

N_z= 0,5 1020 $(0{,}8)^3$0,82 0,58 = 123 *Вт*;

For design reasons we choose asynchronous 400 Hz motors with a powerfull of 200 W for steering devices and 900 W for cruise motor

The weight and volume of electric drives are determined by the method [8]:

$$m_{ПР} = 0{,}9 \cdot \left(6{,}05 N_{ЭЛ}{}^{0{,}667} - \frac{N_{ЭЛ}}{4_{ЭЛ}}\right),$$ где NЭЛ=0,2 кВт.

$$m_{ПР} = ,0{,}9\left(6{,}05 \cdot 0,2^{0{,}667} - \frac{0{,}2}{4}\right) = 2{,}0 кг$$

$$V_{ПР} = \frac{m_{ПР}}{3300} = \frac{2{,}199}{3300} = 0{,}66 \cdot 10^{-3} м^3.$$

Considering that 3 steering drives are installed on the ROV, their total weight will be 6.0 kg, and the volume, respectively, 1, 98 x 10-3 m^3.

$$m_{ПР} = 0{,}59\left(6{,}05 \cdot 0,9^{0{,}667} - \frac{0{,}2}{4}\right) = 3{,}33 кг$$

$$V_{ПР} = \frac{m_{ПР}}{3300} = \frac{3{,}33}{3300} = 1{,}04 \cdot 10^{-3} м^3.$$

The weight and volumes of the propellers will be accepted according to the prototype data.

$$m_{ГВ} = 4 \cdot 0{,}23 = 0{,}92 кг;$$

$$V_{ГВ} = \frac{0{,}92}{1730} = 0{,}53 \cdot 10^{-3} м^3.$$

Pressure hulls (PH) of the ROVs control system.

Weight of electronic units of the ROV monitoring and control system is determined by statistical dependence:

$$m_{СУ} = 0{,}503 \cdot \sqrt{Duv};$$

$$m_{СУ} = 0{,}503 \cdot \sqrt{91{,}5} = 4{,}81 кг$$

.

Based on the condition of electronic control boards placement in the PH, the diameter of micro PC format is assigned structurally dVH = 0.12 m. Given that the density of installation of the elector units is mo = 350-450 gr/dm3, in calculations we accept mo = 400 gr/dm3, the internal volume of the PH should be not less than The length of the cylindrical insert of the PH will be determinate

$$l_Ц = \frac{4V_{ПК}}{\pi \cdot d_{ВН}{}^2};$$

$$l_Ц = \frac{4 \cdot 0{,}0132}{3{,}14 \cdot (0{,}12)^2} = 1{,}168 м.$$

It is structurally defined that the number of the pressure hulls is equal 4 with a length of cylindrical insert of 0.32 m. Covers of the personal computer have the hemispherical form with a m R=0.15 radius. Predesign of durability of a structure of cylindrical buildings is carried out by a technique [1, 10], the Cylindrical part of the personal computer is made of the thermo strengthened aluminum alloy of B 95 type with [σ] = 420 MPs. Wall thickness of the cylindrical part of the hull

$$t = \frac{PpD}{[\sigma] - Pp};$$

t = 14 0,12/ (420 -14) = 0,0042 м

Structurally accept the wall thickness of the cylindrical part 6 mm. Covers are 10 mm thick and are made of aluminum alloy of 6061-T6 type. The strength test calculation confirms the selected PH thicknesses in terms of the strength and stability of the shell for a working depth of 600 m with a safety factor of 1.45.

The mass-dimensional characteristics of the PH adopted in the first approximation are:

$$m_{ПК} = 4{,}1\left(\frac{\rho_{ПК}{}' l_Ц \pi}{4}\cdot\left({D_1}^2 - {D_2}^2\right) + \frac{1{,}1\pi t_{КР} {D_1}^{\ 2}}{4}\cdot 2700\right);$$

where $l_Ц = 3{,}2дм, t_{КР} = 0{,}14дм, D_1 = 1{,}78дм, D_2 = 1{,}6дм, \rho_{ПК}{}' = 620кг/м^3$.

m_{ph} = 3.1 kg; Volume 5.43dm^3; Total weight of hulls in assembly 12.4 kg; Floating volume = 20.92 dm3.

Television complex

The navigation camera is fixed in the upper part of the bow part of ROV and is a sealed container with an internal diameter of 0.14 meters, length of 0.22 meters, ending in front of a transparent hemispherical window. The strength of the window corresponds to a working depth of 600 meters. The telebox is made in a separate pressure hull and forms a single structure located in the central part of the ROV location. The calculation is carried out in the same way as in the previous subsection. The results of the calculations are presented as a weight load table.

Having the data on the equipment composition, the next step of the design will be a graphical and sketch study of the general arrangement of the vehicle, which gives us the opportunity to determine the real dimensions of the L_2,B_2,H_2 design and to compare them with the initial values of the L_1,B_1,H_1. Correction factor k_L [5] is calculated,

$$k_L = \sqrt[3]{\frac{\Delta 1}{\Delta 0}};\ k_L = (75{,}91/80)^{0{,}33} = 0{,}98$$

The main dimensions of the first iteration of the L_1, B_1, H_1 are multiplied by the obtained k_L factor, and adjustments are made to the weight load table. This operation is continued until the displacement of the set of two adjacent iterations differs by 0.5% [6]. Typically, the number of steps to refine the principal dimensions is 2-3.

Conclusions

1. The proposed method of determining displacement and main dimensions of uninhabited vehicles allows to find with sufficient accuracy the parameters of underwater carrier of equipment according to the technical assignment and to go to the stage of sketch design.

2. The proposed method is quite versatile and can be applied to different types of underwater carriers. The error of the first iteration is 8-10%.

LIST OF REFERENCES

1. Shimansky, Y. I. Handbook of structural mechanics of a ship constructors. State Union Edition of shipbuilding enterprise/ Laningrad, 1958, 528 p.

2. Vashedchenko A. N., Pyshniev S. N., Rodichev A. P. Some estimates in the design of underwater vessels. Uch. POS – Nikolaev: UGNTU, 1997, 66 p.; ill.

3. Vashedchenko A. N. Computeraided design of ships. Uch. POS. - L.: Shipbuilding, 1985. - 164 sec –

4. Vashedchenko, A. N., Pyshniev S. N. Design features of self-propelled underwater vehicles. Uch. POS. - Nikolaev: NKI, 1992-56c.

5. Vashedchenko A. N. The theory of ship design: Proc.benefit. Part I-Nikolayev, 1978. - 42 p.

6. Vashedchenko A. N. The definition of the main elements of the underwater vehicle: Proc.benefit. - Nikolaev: NKI, 1991. - 46 p.

7. Vashedchenko A. N., Pyshniev S. N. The definition of the main elements of underwater vehicles. Textbook. - Nikolaev: NKI, 1991, - 65C.

8. Pyshniev S. N., Neckora B. V., Shovkoplyas, M.N. Determination of the effectiveness of propulsion-rudder complexes underwater vehicles. // Proceedings of the international conference UEES 97. – Alushta, Crimea. - volume 2. - p. 133-137.

9. Shostak V. p. Efficiency of ocean development techniques. Areas of project research. - Kyiv: Naukova Dumka, 2002, - 324c.

10. Shostak, V. P., Underwater vehicles, robots and manipulators. - Moscow: GEOS: 2009, - 114s.

11. Robert D. Christ Robert I. Wernli Sr. The ROV Manual. A User Guide for Remotely Operated Vehicles. Is a imprint of Elsevier 225 Wyman Street, Waltham, MA 02451, USA.