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THE DEVELOPMENT OF HIGHLY INTEGRATED SOFTWARE TO CALCULATE SHIP PROPULSION QUALITIES

The computerization possibilities of the ship propulsion qualities calculations are analyzed. There is compared traditional calculations method and proposed method using electronic tables processor. Also it is analyzed 3D-modeling tools to visualize designed propeller screw.

Keywords – calculations computerization, propulsion qualities, electronic table processor, propeller screw, 3-D modeling tools.

1. Introduction

The computer technologies are becoming an obligatory everyday tool of an engineer. Above all it concerns calculations automation. Really if an engineer does a computation "on the paper" he must do all the operations again for new similar object. On the contrary if the computations were computerized, engineer may simply change input data to get new adequate result. The computerization is reasonable if some complex computations are made often or just many times.

The ship design is such complex engineer problem that needs much mechanical computations so it is logic to use computer to automate it (for example see [1]). There are many different ship design phases that are learned by ship theory, ship hull structure and ship structural mechanics. The analyzing of ship propulsion qualities is the difficult and important stage of work and may be done some times. That is why it must be computerized to lighten the engineer's work.

2. Calculations Automation

Ship propulsion qualities calculation consists of:

- ship towing resistance and power rating calculation;
- selection of main screw geometric elements;
- calculations of optimal screw geometric elements with the given speed;
- selection of propulsion engine (by calculated power rating and motor speed);
- cavity testing;
- strength calculations.

All of these stages are recommended to make out with standard paper calculations [2]. Author tried out to automate it using such software as electronic tables processor (such as Microsoft Excel or Spread). Overview of the created file is shown on Fig.1.

In the left top corner there are input data for the project: ship's geometric characteristics and projecting speed. Lower there is towing resistance calculation that uses cells with input data. The result is the towing resistance and corresponding power rating values for various ship speeds.

In the center top region there is the main screw computation for given ship speed. It uses previously calculated towing resistance values and allows to select main screw size and other characteristics.

As you see there is the transparent data transfer that is very handy: you have not to input results of the previous calculation to computer again to get next one results. It gives really new possibilities to automate engineer's work: it is sufficiently to enter only input data and most of work processor makes instead of you. Of course there are some actions that must be done by a human, for example he has to select the propulsion engine (maybe by economic or accessibility reasons). But the main aim of the computer using (to exclude routine monotonous operations) is completely reached. Probably with using macros we can teach computer to make whole the calculations but there is no such need (because of small amount of manual work presented).

One more automation advantage is the graph construction. There are some graphs to analyze ship's propulsion qualities such as propulsion diagram (left bottom region of the window on Fig.1). This graph is automatically built by the program and changes due to cell's data changing.

3. 3-D Visualization of Designed Mechanism

The end result of the designing process are not only calculated numerical results, but also propeller screw drawing. It must be done by special labour-intensive technique. It has three views (all with one propeller blade): front view, side view and special view named expanded blade outline. The last one is build by the standard sections that are zoomed to appropriate size and properly positioned. Then using this expanded blade outline engineer must build two other projections. He has to carry over points to those projections using inaccurate lath method. It gives sizeable errors but there are no more accurate methods in hand-drawing.

Automation of a drawing may have some stages. The first one is making of an electronic drawing (see Fig.2) and it already gives great advantage: you can carry over points using handy witness lines and get no inaccuracy (of course you can also copy it, edit, print many times etc). Also to draw front view manually you must lay off given distance on the curve using flexible lathes that gives inaccuracy near millimetres. If you make out electronic drawing you can use such possibility as the creation of a point on a curve at a given distance.

The next automation level is making of a three-dimensional model of an object. Then the program automatically generates required drawings and an engineer must only improve the drawing (usually it needs dimensioning). The author has created three dimensional model of a propeller blade having appropriate characteristics that were calculated.

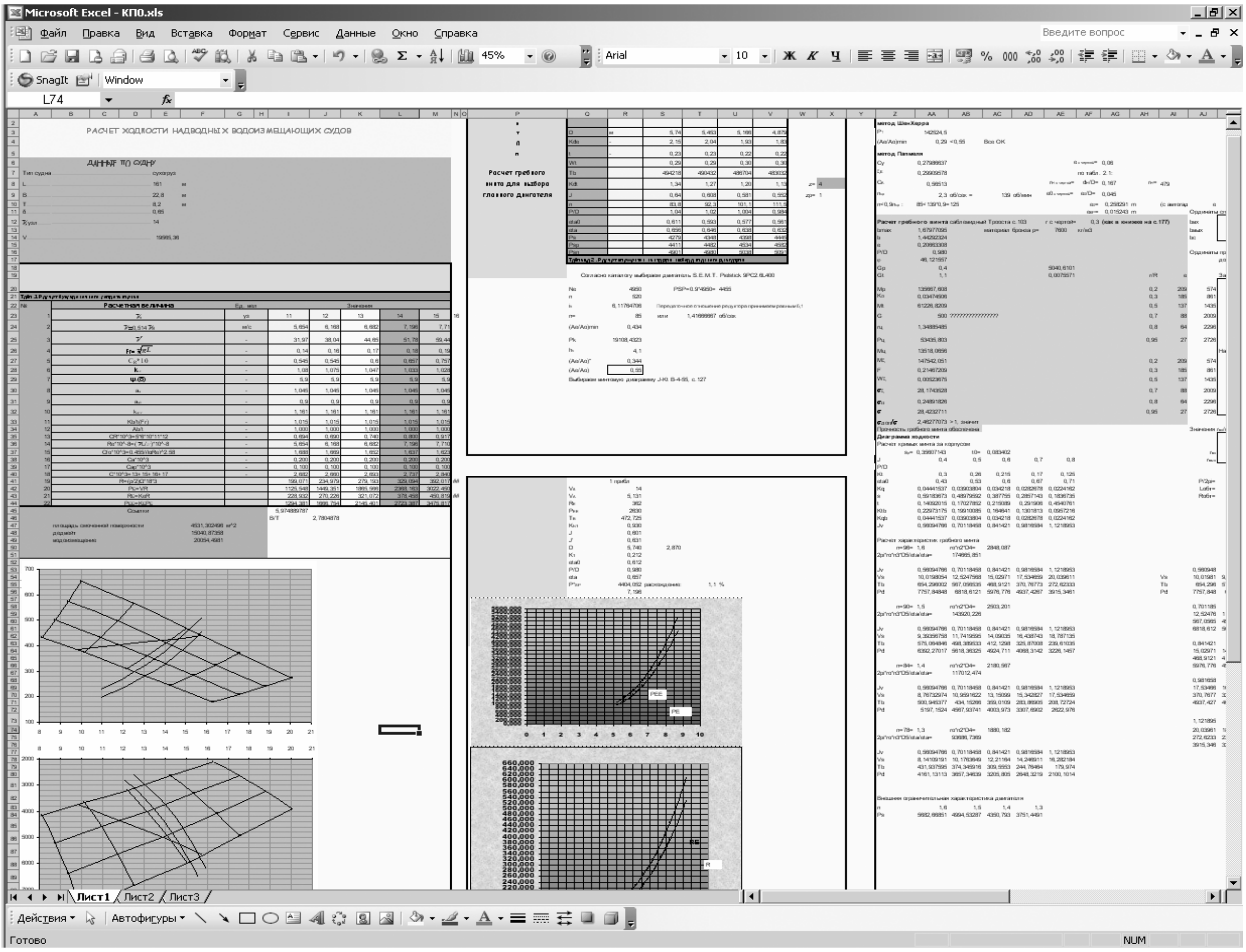

Fig.1 Developed product overview.

The next automation level is the creation of a parameterized model that can change in order to correspond input data. So an engineer inputs to the 3-D editor calculated measurements and gets ready drawing which needs some improvements. The author works at this problem.

The best automation gives highly integrated software product that just gets input data about the ship and gives out complete calculation results and ready propeller screw drawing.

4. Conclusion

Engineer’s work includes many routine and monotonous calculations. Of course it must be automated using personal computers. The greatest advantages give highly integrated products that get all input data and as less as possible asking human and produce ready output result. Such software is also developed for shipbuilding branch in National University of Shipbuilding both for educational purposes and for shipyards.

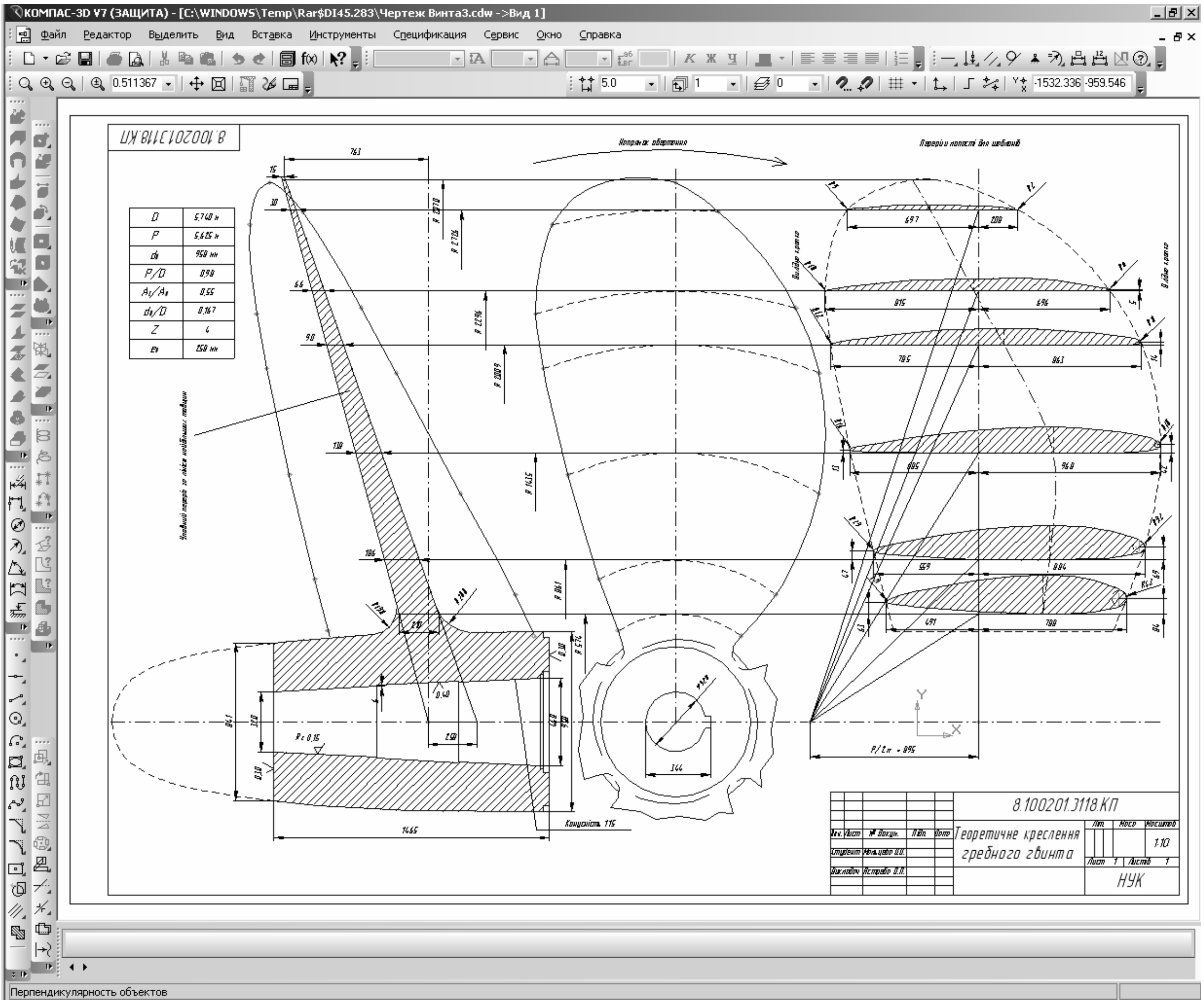

Fig.2. Propeller screw drawing.

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