HYDRODYNAMICS STUDY OF SUBMARINES DESIGN USING CFD ANALYSIS

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Abstract

This paper discusses the hydrodynamic ratio of the bow and stern of a submarine from a small perspective. Each submarine consists of three parts: the bow, the cylinder and the rear. There are no Corning Towers or other submarines in this test. This paragraph attempts to develop sharp and rigid shapes using CFD methods and flood detection software. What's interesting about this paragraph is the resistance in fully locked mode with no additional unintended consequences. First, important parameters of the internal structure of the bow and all available dimensions of the strong position of the submarine are presented and discussed. Third, CFD analysis should be performed for all other projects. For all models, the speed, area, width and all times (length of nose, length of center and back) are common, and proportions of nose and back are different.

Introduction

Submarines play an important role in military strategy and are essential devices for maritime research. However, the risk of submarine activity was compared to 1975-2005. Compared to the number of incidents from 1946 to 1974, the number of submarine accidents has decreased "three times". This event could facilitate the training and practice of developing underwater structures. There is also an increasing number of new steps to overcome risk assessment challenges. The danger is unavoidable, especially in high-speed sea conditions. Here are some recommendations and ideas for submarines and their placement. The fundamentals and concepts of structural design should be carefully studied. The structure of submarines depends precisely on hydrodynamics, as well as marine vehicles and various ships. When a submarine is submerged, the power available is limited and consequently less drag is essential in the hydrodynamic design of a submarine. There are two main stages in the share of submarine plating. Each submarine consists of four parts: a bow, a cylinder, a stern and a sail. These components play an important role in the hydrodynamics of submarines that can be designed in a variety of conditions. The underwater part is divided into two categories: strong hulls and light hulls. The rugged housing provides a dry environment for atmospheric stress, energy and moisture and other sensitive substances under high pressure of human life. A lightweight outer shell with a waterproof roof provides a hydrodynamically efficient environment and resists sea deer weathering. The purpose of this rarity is to find the best combination of bow design and drag for a submarine. The submarine is based on elements of hydrodynamic sharing, trapezoidal shape and central cylindrical structure. This is a rare solution to this problem. This is because marine submarines and aircraft have an intermediate hull, for example the lobes of a cylinder inside the hull. The power required is less than inside the underground mode. So, in real submarines, it is the country with the lowest power required to operate a submarine. The focus of this section is to withstand complete immersion without free effect as high density occurs at complete immersion. Materials and Methods.

Models Specification

The basic model reviewed here; In this study, only bending and stiffness due to drag should be studied, so it is an axisymmetric torpedo-shaped hull without accessories.

There are 3 predominant assumptions:

1: To test the hydrodynamic effect of the bow, the length of the bow and back did not change from model to model. This will help make the bow and background effect more visible.

2: The middle quotient is constant in all models, and the middle is cylindrical.

3: Overall length, bow, middle and base lengths remain unchanged to ensure the most balanced hydrodynamic conditions. The diameter is the same for all models. So, l/d occurs in all modes. These are flexible frames, resistances to the outside of ploys and baskets and are specific to each model.

This section reviews ten models with different types of bow and stern combinations using a cylindrical mid-hull with no other parts. For all models there could be a constant period of 9 meters and a constant diameter of 2 meters, but that's an exact number. In all models, the length of the bow is 1 m and the length of the stern is 2 m. The central part is a 6-meter-long cylinder. The central part is cylindrical, but the front and back parts are different for each model.

Provisions of CFD Analysis

This analysis is performed on ANSYS software based on the CFD system. Typically, the legitimacy of the results of this software program is completed with the help of a few test scenarios and in recent times this software program has become a tradition of Attentive and reliable CFD simulations software. To simulate this situation, this article uses the finite volume method. A support grid with cubic mobile devices was used to mark the strip across the submarine. Selected cells near objects get smaller and smaller while testing other local features to model boundary layers near solid surfaces. Kersilon is the turbulence model, and y+ is supposed to be 50. The float is assumed to be a compressed liquid (pure) at a temperature of 20 degrees Celsius. Input (in the same flow), there is a free queue to select the desired number of cells. In some cases, the number of matches selected after 0.42 million matches and the results compared to the results are nearly identical

The results are almost comparable to the results. It demonstrates that the results are not affected by meshing (Fig 1). In all models, regardless of the grid, cell counts are considered up to 1m, and every iteration is stored as 1 million out of 1 million or more depending on the number of matches. Based on this, symmetry (between the 4 sides of the stadium) and walls

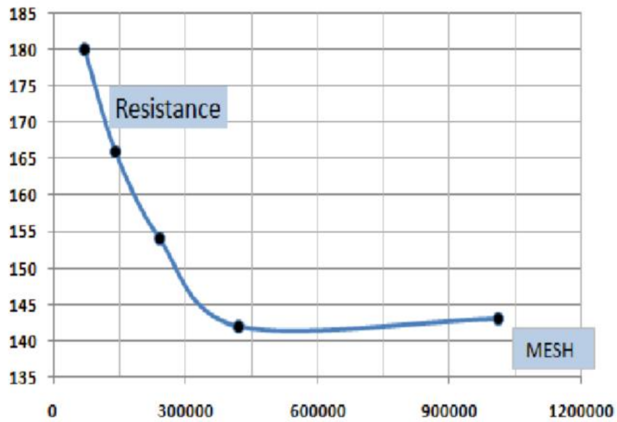

Fig.1- Mesh Independency Relation

(Underwater frame). Block size 1/2 ca, 50m long (corresponding to 5l), 4m purlin (part of the purlin is 4p) and 8m high (corresponding to 8p).

Because of the axially asymmetric lobes, it is possible to model half an arm or a part of the body. In the medium term, research shows that a semi-beam option like the 4r may be appropriate. The older version is grounded and after the 3L range of the typical 5L range (Figure 2). Shows 8 differences and errors. 9% can refer to numerical methods.

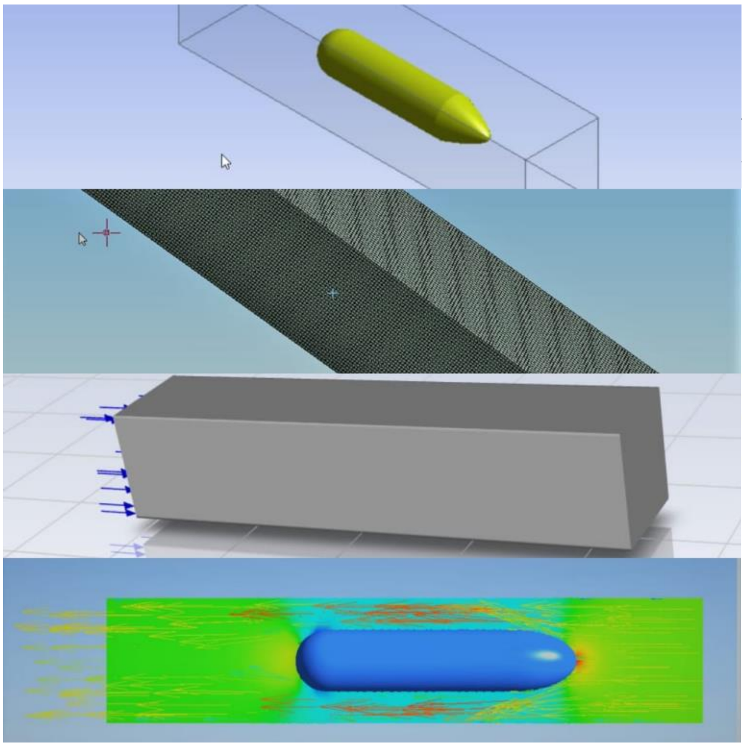

Fig.2 - Modelling of Domain, structured meshes and model of submarines

Different speed models are chosen depending on the Reynolds range. ref.25 ensures that the drag coefficient after 5 million Reynolds remains relatively stable. As a result, speed is determined by three factors, up to a maximum of 5 million. The velocities in m/s are 3,6,9,15 and 17.

Results

Total resistance is equal to friction resistance plus resistance. Ansys workbench software shows impedance and pressure resistance. Friction resistance is the total resistance minus the pressure resistance. Equivalent to this coefficient-based topic for 6 models, plots of total resistance versus Reynolds number are shown in Fig 3. All drag coefficients are based on a cross section of π square meters. Based on the result through ANSYS we observed the 3rd model is having the highest total resistance and 5th being the lowest However, the disparities across the models are substantial. The reasoning underlying the variances can be discovered by paying attention to these differences submarine's geometric design

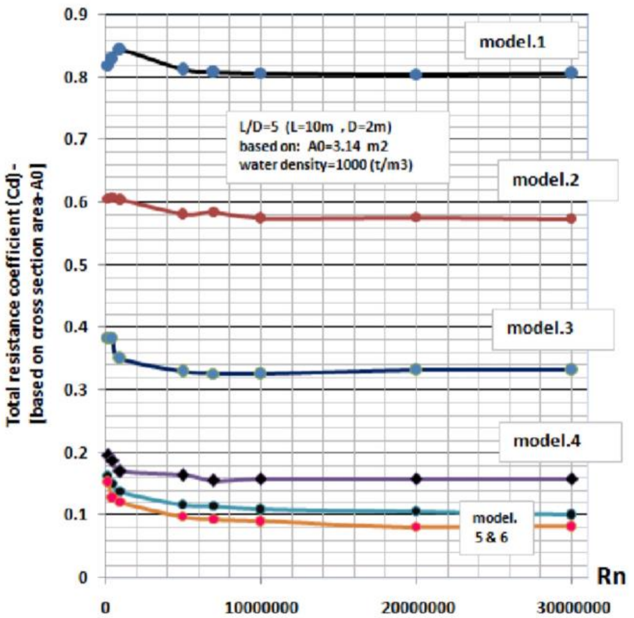

Fig. 3 - Total resistance coefficients for six models

You can now answer questions in these areas. Example: Why can't I use a boom share for a submarine? Why should feed be weighed? Why do you need to bend the arch? Why is a curved feed better than a simple curved feed? Etc.

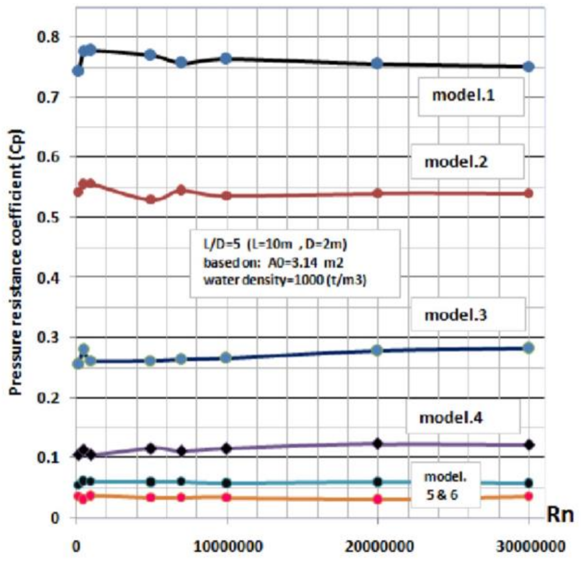

Fig. 4 - Pressure resistance coefficients for six models

In this diagram, the pressure resistance coefficient is calculated using Reynolds numbers. Fig.4. The form of an object determines its resistance to pressure (submarine) Hence the name "resistance suit". It is assumed here that the liquid is impermeable. The effect of viscosity is known as frictional resistance. As mentioned earlier, all odds after 5.2 million Reynolds are diamonds.

Discussion

There is a significant difference in the coefficients for Type 3 and Type 5. The conditional occupancy of today's submarines is similar to the Type 5, which was chosen as the base model. Department. By comparing these results, the general concept of submarine design can be understood. The overall drag coefficient for the six models is shown in the table. All models have the same L, D, and L/D dimensions. It demonstrates that Type 3 has a drag coefficient roughly ten times larger than Type 5. When the calibrated tail is added to Type 2, the drag coefficient is 6.17 times that of Type 5, or 26% less than that of Type 1. According to Type 3, adding a conical arc to Type 2 will reduce the resistance by 75% compared to Type 5. Adding an elliptical arc to a simple cylinder gives a resistance of 56 according to Type 3. % Lower than Model 5. 1. This shows that the arch plays an important role in reducing drag. For an oval with a bevelled tail, like Type 5, the drag is 70% less than Type 3 and 88% less than Model 1. Finally, the Type 5 is a better ride. Body design. The table shows a comparison of the coefficients of resistance to pressure. The magnitude of the change in the coefficient of pressure resistance is greater than the viscosity and impedance.

Table 1 — Total resistance coefficient

V(m/s)	Rn	Type-1	Type-2	Type-3	Type-4	Type-5	Type-6
0.02	200000	0.382	0.605	0.819	0.195	0.153	0.164
0.05	500000	0.382	0.606	0.829	0.188	0.127	0.152
0.1	1000000	0.35	0.606	0.843	0.169	0.21	0.139
0.5	5000000	0.329	0.581	0.813	0.164	0.097	0.119
0.7	7000000	0.326	0.584	0.808	0.155	0.093	0.116
1	10000000	0.326	0.575	0.807	0.158	0.09	0.111
2	20000000	0.331	0.576	0.805	0.158	0.081	0.107
3	30000000	0.332	0.574	0.806	0.159	0.082	0.103

Table 2 — Pressure resistance coefficients

V(m/s)	Rn	Model-1	Model-2	Model-3	Model-4	Model-5	Model-6
0.02	200000	0.227	0.543	0.745	0.107	0.036	0.056
0.05	500000	0.291	0.556	0.777	0.118	0.033	0.063
0.1	1000000	0.262	0.559	0.78	0.108	0.038	0.062
0.5	5000000	0.265	0.533	0.772	0.118	0.035	0.059
0.7	7000000	0.266	0.548	0.758	0.113	0.035	0.06
1	10000000	0.278	0.537	0.767	0.118	0.035	0.058
2	20000000	0.28	0.542	0.758	0.125	0.032	0.059
3	30000000	0.285	0.542	0.756	0.129	0.038	0.058

CONCLUSION

The bow and stern of the submarine must be calibrated (similar to Type 1 and other models). Narrow curved bows are not a good choice, but the blunt should be used as an elliptical bow is recommended (by comparison between Type 4 and Type 6) (some Type 6 and Type 5). A bent tail is better than a tare (by comparison between Type 6 and Type 5). The bow effect on drag is greater than the stern similar to Type 2 and Type 4.

For submarines and submersibles (some Type 10 and others), a shortened bow with a cylindrical bottom (e.g., oval) and a shortened stern (e.g., parabola). Submarines and submersibles having a cylindrical main portion may be recommended by result got between Type 5 and other models.

Nomenclature

- L - overall length of hull
- D - maximum diameter of the outer hull
- R -maximum radius of the outer hull
- V - speed of water in m/s
- A_0 - Cross section area of model= 3.14 m2
- R_n - Reynolds number
- c_t - Total resistance coefficient
- c_p - Pressure resistance coefficient
- c_f - Frictional resistance coefficient
- IHSS - Iranian Hydrodynamic series of Submarines
- CFD - Computational Fluid Dynamics

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