FIELD OF STUDY AND RESEARCH PLAN

UNDERGRADUATE MAJOR: MARINE TECHNOLOGY

(2013-2018)

Research Topic: Ship design and hull optimization from the premise of CFD

In this research, an existing ship hull was optimized and the model of the optimized hull was built and tested in the marine towing tank and in a street pond. An existing craft was re modeled using CAESES friendship system after which it was optimized with respect to parameters including the beam, bow. The region from the bow to stern was optimized simultaneously with analysis system in conjunction with the CAESES friendship system.

During the course of the research work, it was made clearer that the performance of a ship is dependent on variables including the hull-form and that the hull-form plays a crucial role in enhancing the stability of vessels. Hence the need to examine the stability of high speed crafts and how the stability can affect the design and vise versa.

(1) Research theme

Research Topic: Stability assessment of High Speed Craft

The research "stability assessment of High Speed Craft" as the name implies would emphasize on the Transverse and longitudinal stability of a HSC. This would be researched from the premise of ship designing process to enhance the development of more stable craft in steady and highly turbulent sea.

The Research Advantages includes the following:

- The research would enhance the knowledge base of the shipbuilding industry, increasing the efficiency of craft produced.
- The research would tend to boost the economy of nations including Indian and Nigeria by reducing marine perils.
- It would serve to strengthen the relationship between Japan and Nigeria as ship builders in

Nigeria who wish to adapt to the new trend may seek advice and affiliations from Indian where necessary.

(2) Research plan

Research Background

History holds that Marine perils have always been recorded. There is usually huge loses accompanied by the perils which involves loss of cargo, vessel or part of vessel or even crews have been lost .This occurs because the vessel in a way looses it stability-transverse, longitudinal or otherwise. A high speed craft is not left out in perils. A high speed craft as it implies moves at a very high speed compared to other vessels and thus a high chance off stability loss.

A high speed craft HSC can also be also called a speed craft or fast ferry.

In accordance with **SOLAS Chapter 10 Reg. 1.3**, high-speed craft are craft capable of a maximum speed, in meters per second **(m/s)**, equal to or exceeding:

$$\mathbf{3.7 \times \nabla^{0.1667}}$$

Where ∇ is the Volume of displacement in cubic meters corresponding to the design waterline, excluding craft of which the hull is supported clear above the water surface in non-displacement mode by aerodynamic forces generated by ground effect. **(Imo.org 2019)**

Stability of craft is a very critical part of vessel designing. The stability of any vessel design has to be analyzed to confirm that such vessel can be stable in standard conditions. The stability of a high speed craft lays on the basic principles propounded by Sir Isaac Newton. The forces acting at every point on the vessel can be examined and a consensus in the working conditions (maximum speed, tonnage capacity).If not there should be design reconsideration.

The purpose of the research would be narrowed down to Carter for the application of stability in the design process of a high speed craft. Propounding models for easy understanding of stability of the craft in adverse conditions.

Research Purpose and Significance

The main purpose of Research is to understand why high speed craft becomes unstable and to recommend design to breach the gap.

Other purpose of research includes the following:

- To propound Models to easily asses the stability of a High speed Craft in extreme conditions.
- To validate the mathematical model via model testing of a scaled High service Craft.
- To evaluate the impact of turbulence on stability of HSC

Literature Review

Advances have been made in analyzing the stability of high speed craft. It is already known that Transverse stability significantly decreases at high Froude number**.(Ikeda & Katayam 2018)**.The decreased stability can be noticed in the large heel and even listing of the craft where the tendency to restore stability may be low. The degree of ship motion plays a vital role in the stability analysis of a high speed craft.

katayma have explained some unstable motions which can be experienced by high speed craft which includes

- stability loss at high speed
- Unstable rolling induced by pitch motion
- Unstable pitch and heave coupling motion
- Roll and heave damping created by vertical lift force

A stable ship ones damaged losses its stability. Unstable Conditions can follow suit -the ship never stop listing, and trimming and goes down within minutes or stops heeling after which go aground. **(Fas.org 2019)**.This assertion depicts extreme Conditions at which a high speed craft can loss stability after being damaged.

It have also been spelt out that a high speed craft has different motion characteristics**(Ikeda &**

katayama 2018).A high speed craft can capsize by broaching, parametric rolling or stability reduction by waves .

In the course of research small alterations would be made on relevant part of the vessel to assert its stability.

Froude number concept has been used fully in research peculiar to stability and its relations. The concept of Froude number would therefore be briefly reviewed.

Froude Number

Froude number is a coefficient, a non dimensional number which can be applied to any size of vessel. It is the ratio of the vessel speed to the root of the product of acceleration due to gravity and the length on water line. **(boatinternational 2018).**

Different range of Froude number has different effect on the motion of ship and hence the stability. It was posited that Froude number of 0.4 is a good yardstick-a unique number for stability measurement. When Froude number is 0.3 humps are experienced. It is the point where the hull length equals two wavelengths. For Froude number 0.5 hull lengths equals 1 wave length. For Froude number between 0.5 and 1, a semi displacement hull emerges**. (boatinternational ,2018)**

Research Methods

In the research a specific HSC would be examined. Different Stability test would be carried out on her. The stability result would be presented for different alterations of factors including the trim, list, full load condition and a mathematical relationship would be produced amongst them where possible. After which a scaled model would be built and tested in the Marine lab to physically examine the relationship posited.

REFERENCES

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