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A STUDY ON THE OPTIMIZATION OF HIGHLY STABLED SHIPS BY USING ROLL STABILIZATION TANKS

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Abstract - *Ship stability deals with branch of naval architecture and Ship Design. It shows that how a ship behaves at sea both in still water and in waves whether intact or damaged. Several methods including roll stabilization tanks, active control fins, rudder roll stabilization systems, and bilge keels are commonly used for roll stabilization purposes and each one of them has its own advantages and disadvantages. The potential for the use of roll stabilization tanks on this paper is to identify an effective roll stabilization system for use on Research Vessel.*

Key Words: Ship Stability, Roll Stabilization, Passive Systems, Tank Stabilizers, Naval Architecture, Ship Design.

1. INTRODUCTION

A ship is subjected to rolling and pitching not only during the time it is moving in the sea, but also when it is standing stationary at one position. Stabilizers in ships are mainly of two types – fin stabilizers and tank stabilizers. Fin stabilizers are used to balance and keep a ship safe during rough weather from excessive rolling and pitching whereas tank stabilizers are used when the ship is not moving, for e.g. at anchorage. The working of ship's fins stabilizers depends on the speed of the ship. This means that if the ship is not moving the stabilizers cannot be used to oppose the rolling motion of the ship, generated by the force of the waves. However, in tank stabilizers it's totally a different game. Tank stabilizers are used to ensure the equilibrium of the ship when it is stationary and without any motion.

As the name suggests, tank stabilizers are made up of tanks which are located in the extreme transverse region of the ship. Tank stabilizers provide a righting or an anti-rolling motion when the ship is not moving. The anti-rolling force takes place as a result of delayed flow of fluid in a suitably positioned transverse tank. The working of this type of ship stabilizer as a ship stability apparatus is independent of the ship's speed.

2. ARRANGEMENT OF TANK STABILIZERS

These partially filled tanks consist of two wing tanks connected at the bottom by a substantial crossover duct. The air columns above the liquid in the two tanks are also connected by a duct. As in the free surface tanks, as the ship begins to roll the fluid flows from wing tank to wing tank causing a time varying roll moment to the ship and with careful design this roll moment is of correct phasing to reduce the roll motion of the ship. They do not restrict fore and aft passage as space above and below the water-crossover duct is available for other purposes.

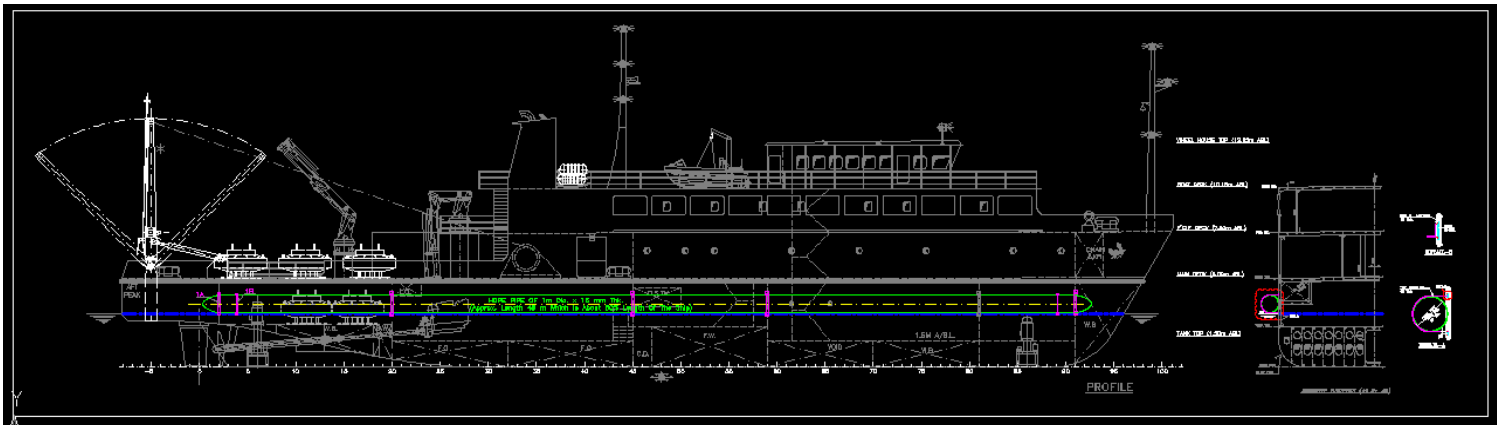

Fig - 1: Vessel with Side hollow pipe Option 1

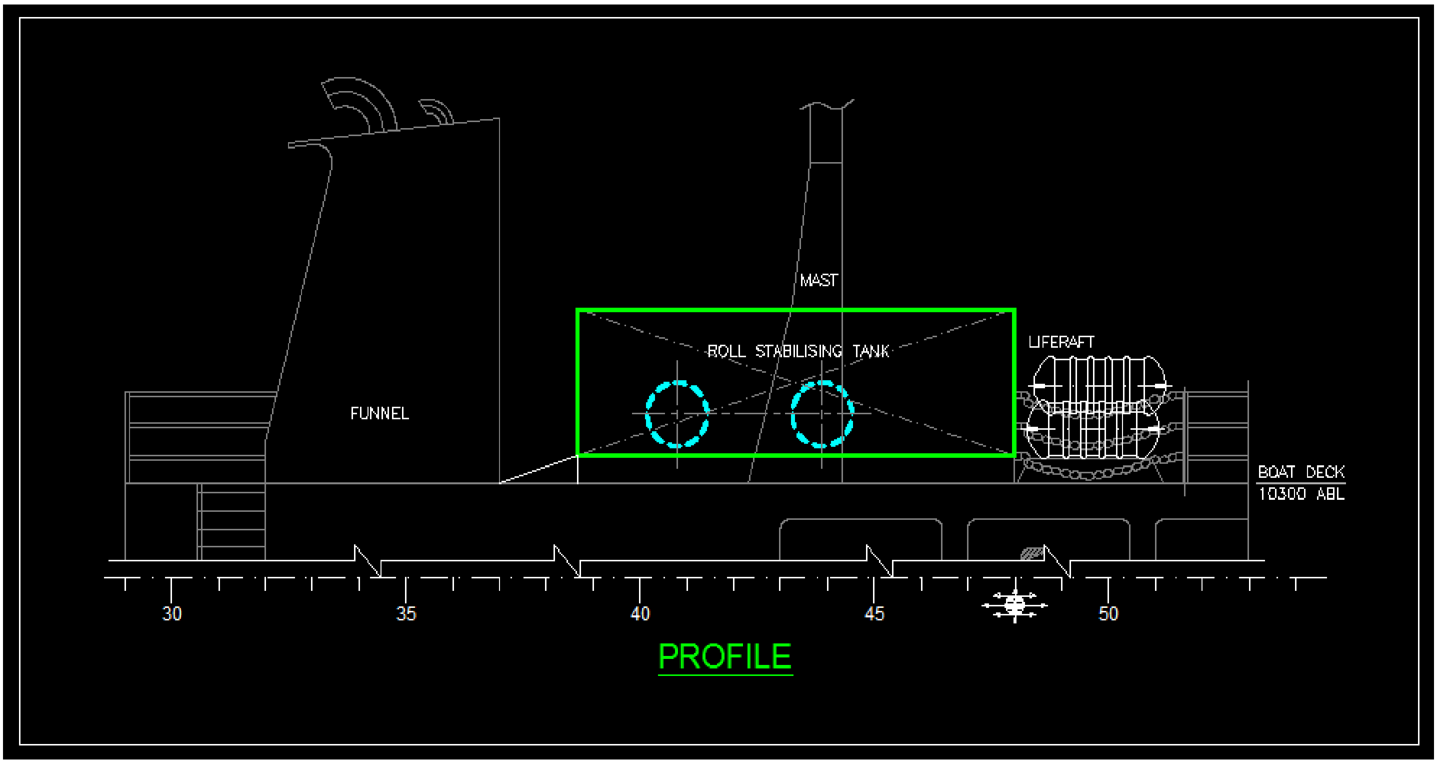

Fig – 2: Vessel with Roll Stabilization Tank on deck Option 2

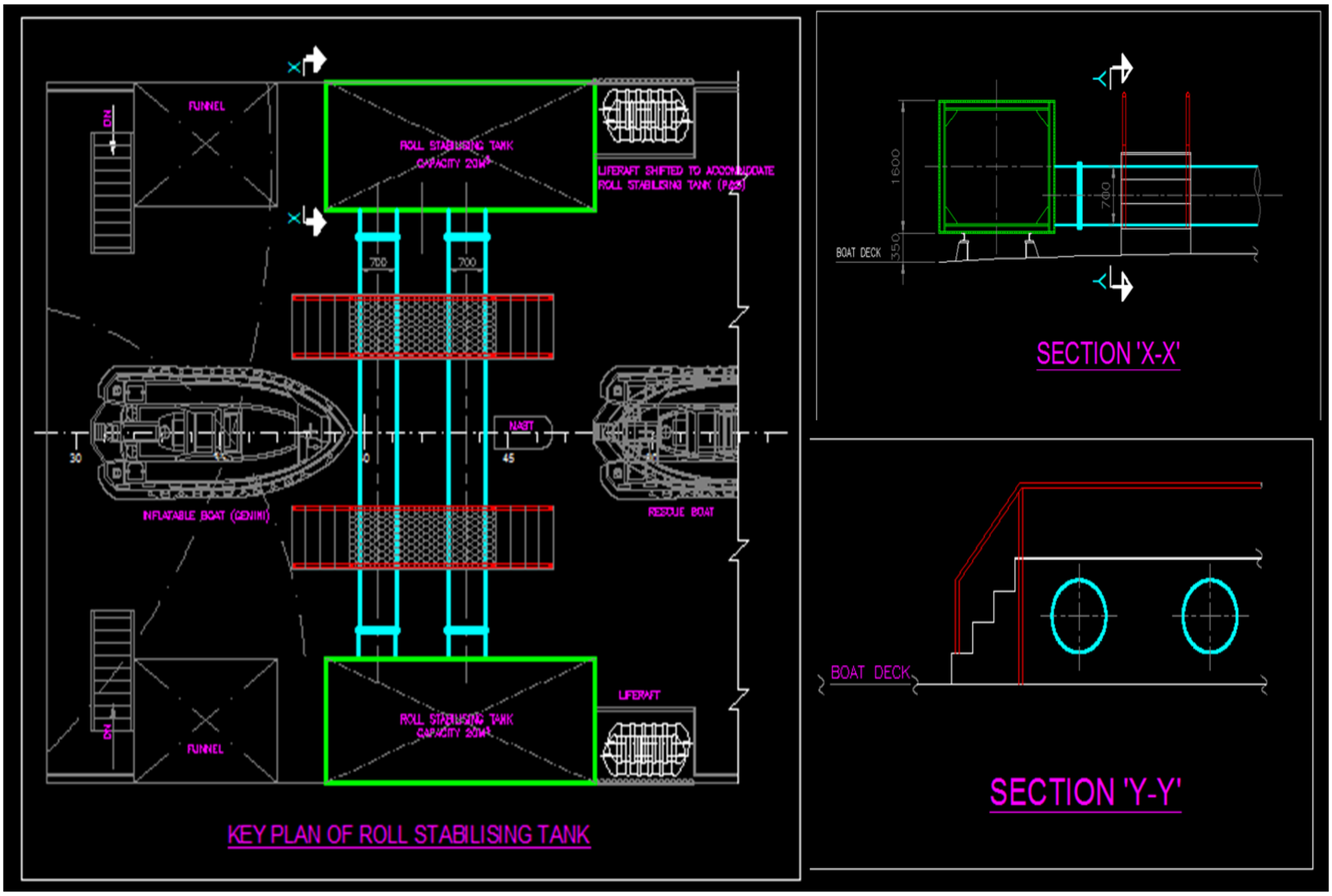

Fig – 3: Key Plan of Roll Stabilizing Tank

3. OPERATION OF TANK STABILIZERS

When the ship is stationary there is no movement in the water inside the tank. However, as the ship rolls the water inside the tank gains momentum after a certain period of time. This means that when the ship is finishing its roll and is about to turn, the movement of water inside the tank, which initiates at a later stage, opposes the rolling motion of the ship from inside and thus balances the ship. The similar process is repeated when the ship rolls on the other side. In this way stabilization of the ships takes place with the help of tank stabilizers. The main reason this operation is known as a passive operation, is that it uses water flow which is activated by gravitational force.

However, accommodating tank stabilizers into a ship's design might turn out dangerous to its own stability. For this reason, the tanks should be carefully and specifically designed for a particular ship using data from the model tests. The level of water inside the tanks should also be adjusted according to the ship's loading condition and limit. Efforts should also be made to reduce the free surface effect that results from the moving water, which eventually disturbs the stability of the ship..

4. CONCLUSION

By considering the aspects like Ship type and Mission, the stabilizers are considered. The large number of existing stabilizers makes it possible to find a stabilizer for virtually every conceivable mission, be it low speed trawling to high speed pursuit. The question of whether or not to have a stabilizer depends not upon the availability of stabilizers, but rather on whether or not a particular stabilizer will be useful. This can be determined by finding the increase in operability relative to some motion criterion. It would seem that in a changing environment in which is carried out the roll stabilization finds wide application the adaptive control. For some vessels of varying over a wide range dynamic, it may be desirable to adapt the controller to the new natural frequency of the ship. This requires the identification, which under the influence of disturbances can cause significant number of difficulties. Researchers in the works devoted to the synthesis of stochastic stabilization systems despite the characters of the dominant disturbances rarely come across a probabilistic approach control. It appears that the use for example of minimum variance strategy, which the objective is to minimize the steady-state output variances, would be justified. The adaptive minimum variance control can be used in predictive form too.

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