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A Study on Comparison between Center of Lateral Resistance and Pivot Point being Used in Handling Ships at the Present Time

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ABSTRACT : *The traditional theory regarding the pivot point of a ship during maneuvering, so called apparent pivot point, is located nearly at 1/3 ship's length from the bow when the ship is moving ahead, and between 1/4 ship's length from the stern and the rudder post when going astern. The pivot point is sometimes considered to be the centre of leverage for forces acting on the ship. However, the pivot point is located out of ship due to strong lateral force, such as current and it is very inconvenient to use during maneuvering a ship. In this paper firstly, pivot points due to ship's condition are investigated carefully. And then the center of lateral resistance used at the present are determined. While a new lateral force is added, we can compare the pivot point with the center of lateral forces. Finally, we will suggest the center of all lateral forces for maneuvering instead of pivot point. Especially, it will be very helpful for pilots to handle ships in simulation.*

KEY WORDS : *Pivot point, ship handling, lateral forces, center of leverage, center of lateral forces*

1. Introduction

The traditional 'pivot point' is well known to ship handlers such as pilot, shipmasters, and other navigators. However, the pivot point is not real, but apparent. So we call it 'apparent pivot point' and it is considered that there is no transverse speed at the point.

According to the traditional theory regarding the pivot point of a ship during maneuvering is located nearly at 1/3 ship's length from the bow when the ship is moving ahead, and between 1/4 ship's length from the stern and the rudder post when going astern. Therefore, the pivot point is sometimes considered to be the centre of leverage for forces acting on the ship even if it is not actually.

However, the pivot point is located out of ship due to strong lateral force, such as current and it is very inconvenient to use during maneuvering a ship.

In this paper firstly, apparent pivot points due to ship's condition are investigated carefully. And then the center of all lateral forces used at the present are determined. While a new lateral force is added, we can compare the pivot point with the center of lateral forces. Finally, we will suggest the center of all lateral forces for maneuvering instead of pivot point. Especially, it will be very helpful for pilots to handle ships in simulation.

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2. Concept of Traditional (or Apparent) Pivot Point

Let's suppose that you have a bar shape body floating on a friction free surface and you apply a lateral force on it at one end. The resulting motion can be decomposed in two parts: First, a moment of rotation about the centre of gravity. Secondly, a sideways bodily motion. These two results when combined will cause a change of position of the body as per the right of Fig.1 after the force has been applied for a period of time. We realize that the part of the bar that has not changed position in space, the "apparent pivot point", is not located at the centre of gravity but some distance off it, away from the end on which a force is applied.

This theory applies to ships. It is the main reason why a ship turning has its P.P. at 1/3 ship's length from the bow, since that ship is submitted to the

lateral component of the rudder force.

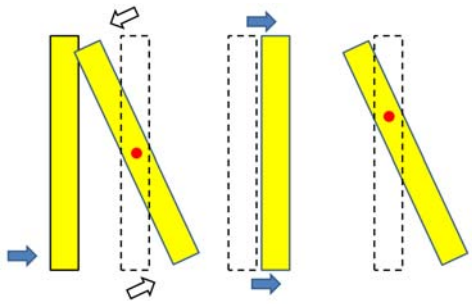

Fig. 1 Apparent pivot point

The combined effect of the lateral motion and rotation have for consequence a “P.P.” away from the acting lateral force. That point that has no sideways movement, having for reference the surface of the water is the “Apparent Pivot Point”. It has no other importance physically speaking. The pivot point is considered to be the centre of leverage for forces acting on the ship. Once again the Apparent Pivot Point is not the centre of leverage of anything.

3. Concept of the center of lateral resistance

At a given moment, the center of lateral resistance (hereinafter CoLaRe) of a vessel is that point where, if you apply an “effective” lateral force, no rotation (if the vessel has a steady heading) will occur. Acting on this point, a lateral force has no arm lever, therefore no turning moment, it only pushes the vessel sideways. A force acting ahead of the CoLARe will rotate the ship in a different direction than the same force acting astern of the CoLaRe would do. The lateral resistance can also be called hydraulic lift.

The position of the CoLaRe depends on:

- the centre of gravity
- the centre of the underwater surface area (hull shape and trim)
- the pressure fields around the hull

The CoLaRe is the leaning point for arm levers. It is not! the apparent pivot point. Actually these two points almost never coincide.

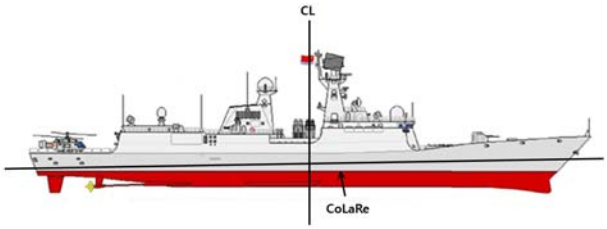

Fig.2. Center of lateral resistance

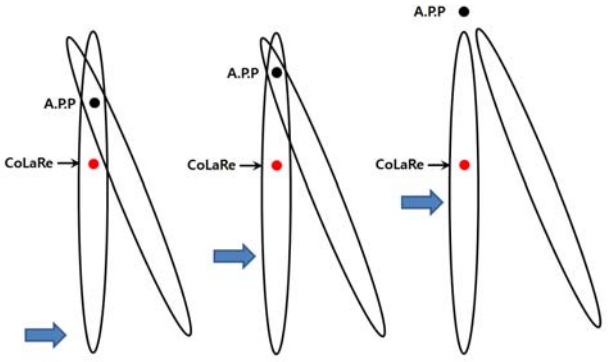

Fig.3. Comparison of CoLaRe and A.P.P.

As shown in Fig.3, apparent pivot point is moved according to side pressure such as tug.

4. Conclusions

This paper was to deal with the center of lateral resistance as a real pivot point. Apparent pivot point is not to determine a lervage in maneuvering. Therefore we suggest a real pivot point as the center of lateral resistance.

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