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Analysis of Wave Damage Accident in Jinshan Water Area

Zhichao Sun

Merchant Marine College, Shanghai Maritime University, shanghai 201306, China.

Abstract

A wave damage accident was caused when the shipping ship was traveling from north to south through the east side of Jinshan Zhangjing River terminal of Shanghai Weihao Storage and Transportation, which resulted in the sinking of a small attached boat inside the terminal. One of the crew members was killed and another seriously injured. This paper analyzes the law of ship traveling waves produced by ships on the sea, analyzes the process of the wave damage accident, and puts forward some suggestions for ship handling in narrow inland waters.

Keywords

Wave Damage Accident; Ship Wave; Ship Maneuvering.

1. Introduction

The waters of the Zhangjing River in Jinshan are 50 meters wide on average. Four vessels were involved in the accident, Wanhanshanhu0961, Tonggang 118, Wanjiangshun 338 and an iron attached small boat. At the time of the accident, the other three ships were parked side by side at the wharf except the moving ships. The sailing wave generated by the sailing ships drove the outer ship, and the outer ship hit the inner ship. In addition, a second collision was formed, resulting in the sinking of the auxiliary boats and casualties. In inland waterways, narrow waterways and inlet and outlet waters, due to the increase in the traffic density of ships, Marine accidents happen from time to time, causing heavy loss of life and property. In particular, the navigation waves of this time, especially large ships and some high-speed government ships of Marine police and Marine surveillance departments, are easy to cause relatively large ship traveling waves in their driving areas. The traveling waves of each ship interfere with each other and superimpose each other, which is undoubtedly a potential safety hazard for ships operating in these areas. Therefore, it is the basic method to prevent the occurrence of average accidents to carefully analyze the causes, find out the deficiency of safety work and take targeted preventive measures. Through the analysis of this accident, we can draw lessons from it, avoid or reduce unnecessary mistakes, and achieve safe navigation.

2. Fundamentals of Ship Traveling Wave Theory

2.1 Wave mode analysis

The so-called ship traveling wave means that when a ship sails in a narrow inland waterway or artificial canal, the ship's bow and stern form bow wave system and stern wave system respectively due to the pressure generated by the ship's hull on the water surface. Both the bow and stern waves are composed of two distinct groups of diffused waves and transversal waves, which are confined to the fan-shaped area behind the ship. Diffusion wave has spread direction with an Angle of wave propagation Angle theta shipping routes, ship line wave peak point is called the peak point, the peak point form the peak point of attachment, the center of the scattered wave peak connection between the ship and the Angle phi values, 19 ° 28 in the deep-water circumstance (kelvin), does not change with speed, and under the condition of shallow water, The Angle of φ, the wavelength and the sailing state of the ship all change in different degrees. The size and direction of the dispersion wave are

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related to the ship type and speed, etc. The movement direction of the dispersion wave system is always perpendicular to the peak line of the dispersion wave, and it propagates to the shore on both sides at a certain speed.

The peak line of transverse wave system is perpendicular to the direction of shore line, and its wave height is much smaller than that of scattered wave system. However, after interference with scattered wave system, the combined wave height at the divergence point (the intersection point of transverse wave and scattered wave peak) will be increased, thus affecting the wave action

2.2 The influence of ship travelling wave on the sailing ship

When a ship is moored at a wharf near a fairway, if the ship in the fairway travels at a fast speed and the distance between the ship and the moored ship is relatively close, the ship traveling wave will cause the intense rocking movement of the moored ship. In serious cases, the ship's hull may be damaged or its cable may be snapped, resulting in a major safety accident.

Many foreign experts have done a lot of theoretical research and model tests on the mechanism of ship traveling wave acting on the mooring ship, summed up some practical and simple estimation methods, and listed ship traveling wave as ship load in the design code for the analysis and calculation of ship mooring force. In recent years, many large berths in China's ports are built along the approach channel, and the front edge of the wharf is very close to the edge line of the channel. Ships moored in such berths are easily affected by ship traveling waves. Although the relevant documents of China's maritime authorities and shipping companies all warn that the ship traveling wave has adverse effects on the safety of the mooring ship, the port engineering design departments in China have not paid enough attention to it, and there is no relevant regulation that includes the ship traveling wave as the load calculated by ship mooring force in the current port engineering design codes.

3. Computational model of sailing wave

When the ship moves on the water surface, the velocity and pressure around the ship change. When the pressure increases, the water surface rises, and when the pressure decreases, the water surface drops, thus forming a series of ship traveling waves moving along with the ship. Ship wave theory to study where there is a lot of incomplete, in actual engineering application, in addition to the theoretical difficulties, because of the complexity of the hull surface, channel depth and width of the irregularity, the influence of such factors as difficult to get a more appropriate, accurate and clear physical meanings of the mathematical model and the corresponding analysis and calculation method, It is very difficult to solve the velocity, height and attenuation range of ship traveling wave theoretically.

At the beginning of the 20th century, based on the theory of Kelvin, Havelock derived the estimation formula for the relative wave height of ship traveling waves under deep water conditions, as shown in Formula (1):

$$H_c = \alpha H \left(\frac{S}{H}\right)^{-0.33} \left(\frac{v}{\sqrt{gh}}\right)^{2.67} \tag{1}$$

Where, H is the height of the ship's traveling wave at the foot of the bank slope (m); α is the coefficient related to ship type; S is the distance between the foot of the bank slope and the ship's rail (m); H is channel depth (m); V is ship speed (m/s); G is the acceleration of gravity (m/s2). The formula is mainly based on the formula put forward by DELFT Institute of Hydraulic Engineering in the Handbook of Waterway Engineering, and combined with the field test data of ship traveling wave carried out in Jiangsu and Zhejiang in the 1990s, it is proposed that the range of correction coefficient α should be 0.35~0.42, and 0.42 is suggested. Ship speed is the most important determinant of ship travelling wave. The wave height of ship travelling wave increases with the increase of ship speed and decreases with the increase of distance from ship.

According to the channel water level of Zhangjing River in Jinshan is 2.6 meters, the two vessels berthed side by side have silted shallow on the shore. The sailing vessels have been appraised, and the speed was 5 kilometers per hour when passing the two berthing vessels at that time. When a ship

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navigates in restricted waters, the action of ship traveling waves has adverse effects on the surrounding ships. The factors of the ship traveling waves at different distances and their influence on the target ship are analyzed quantitatively. As shown in Fig.1, the determination of the safe area of the target ship is the theoretical basis for determining the ship's safe speed. The influence of the ship's traveling wave on the target ship is analyzed and explained.

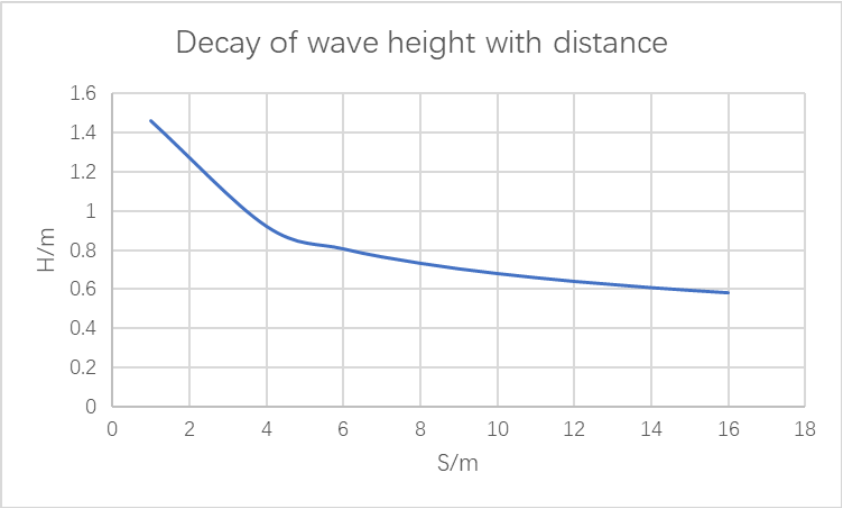

Fig. 1 Decay of ship wave height with distance

4. Conclusion

According to the related literature, the common formula for calculating the wave height of ship traveling wave is summarized, which is used to judge the distribution of ship traveling wave generated by ship traveling wave in water area. However, since ships are berthed side by side, it is complicated to calculate the impact of the sailing wave generated by moving ships on the berthing ships. The calculation of the sailing wave is complicated, with many influencing factors and many unknown parameters, and the estimated result may have a greater impact. In the further study, it can be assumed that if there is no berthing ship with outer gear, The influence of the sailing wave generated by the sailing ship on the berthing ship of the inner gear is compared.

References

[1] M.Q.Zhuo, J.S.Xu,Z.X.Zhu. Numerical Simulation of Ship Traveling Waves in Shallow Water Channel [J]. Journal of Hydrodynamics (Series A),2019,34(01):63-68

[2] S.Y. Zhang, L.H. Huang. Influence of Ship Traveling Wave on Port [J]. Water Transportation Engineering, 2018(06):150-153.

[3] Z.S.Li, W.Wu, H.Chen, H. Liu. Numerical simulation of ship traveling wave climbing on bank slope in inland waterway [J]. Journal of Hydrodynamics Research and Progress (Series A),2016,31(05):556-566.

[4] Z.H. Wang, H. Song. Influence Analysis of Ship Traveling Wave on Mooring Ship [J]. Water Transportation Engineering, 2015(09):28-34.

[5] W.Z.Luo, Q.R.Zheng, T.C.Wu. Numerical Simulation of Ship Travelling Waves in Narrow and Shallow Channel [J]. Ship Engineering,2014,36(04):88-91.

[6] C.Y. He, L.H.Ju, W.B. Feng. Field observation and physical model test of ship traveling wave in South Jiangsu Canal [J]. Water Transportation Engineering,2012(08):130-135.

[7] J. L.Du, K.Gou, H.Jian. Journal of Dalian Maritime University,2005(02):4-6+14. (in Chinese).