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# An Analysis the Accident Between M/V Ocean Asia and M/V SITC Qingdao in Hanam Canal (Haiphong Port)

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ABSTRACT: The paper presents a special case of the ships accident. The accident was happened without any contact between ships. The cause of the accident is the hydrodynamic interaction between ship in a shallow canal and the analysis is consulted to determine the percent of fault of the accident.

## 1 SUMMARY OF THE ACCIDENT

On the 23rd September 2008, the M/V OCEAN ASIA with engine-trouble is towed through the Ha Nam canal into the port of Haiphong at the speed of 3 knots. At buoy No. 21, the pilot of M/V OCEAN ASIA saw three vessels intended to overtake him so he required the other three vessels stop these actions because of narrow area. But they are continued overtaking M/V Ocean Asia. First one, a tanker overtaken M/V Ocean Asia at buoy No. 21; then M/V Far East Cheer had overtaken M/V Ocean Asia on the portside. The last one, M/V SITC Qingdao proceeded to overtake M/V Ocean Asia.

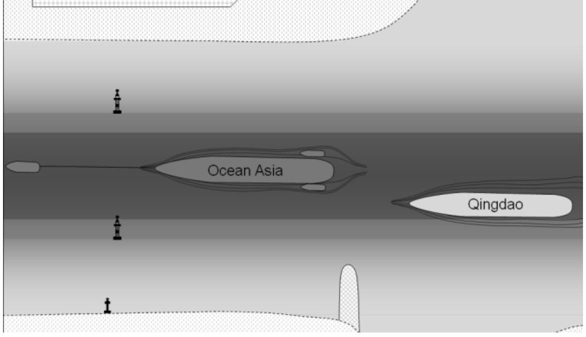


Figure 1. The scene of the accident

At this moment, M/V Ocean Asia was in the center line of the canal. The M/V SITC Qingdao sailed at the speed of 12.7knots. When the distance between two vessels is 0.5 NM, M/V SITC Qingdao reduced her speed and her speed is 9 knots when she was passing M/V Ocean Asia. The distance between side to side of the vessels is 10 – 15m when they were passing.

At the moment, when the stern of the M/V SITC Qingdao had passed the bow of M/V Ocean Asia, the M/V Ocean Asia quickly crashed into the shore, stranded on the right bank of the canal.

The particulars of these vessels are as follow:

- M/V Ocean Asia:
  - Call sign: 3EMN4
  - Flag: Panama
  - IMO number: 7712353
  - L.O.A: 158.85 m
  - Breadth: 23 m
  - Air draft: 41.8 m
  - Draft F/M/A: 6.3 m /6.4 m /6.6 m
  - GT 10835
  - DWT: 13992 MT
  - Cargo: 345 containers equal 5738 MT
- M/V SITC Qingdao:
  - Call sign: V2BO3

- Flag: Antigua & Barbuda
- IMO number: 9207560
- L.O.A: 144.83 m
- Breadth: 22.4 m
- Air draft: 41.5 m
- Draft F/A: 7.0 m /7.2 m
- GT 9413
- DWT: 12649 MT
- Cargo: 5900 MT

The canal's depth and breadth are 8 m and 80 m respectively. It is one way canal and taking over is prohibited here. The M/V Ocean Asia was towed by three tugboats: M/V Da Tuong towed at the bow by towing line 150 m in length; M/V Transvina and M/V Marina 18 supported at the stern (Fig. 1). At the moment of the accident, there was not current in the canal; water is still.

In this accident, there was no contacting between vessels so there was no evidence on the hulls. To blame on M/V SITC Qingdao, it is necessary to improve that the M/V Ocean Asia came aground due to the influence by overtaking of M/V SITC Qingdao.

## 2 RESEARCH BY SCALED MODELS

To research by scaled models, it is necessary to have condition of the experiment as same as real situation. The formula of the relation between a real vessel speeds and a scaled model vessel is as follows:

$$V_{model} = V_{realvessel} \times \sqrt{k} \quad (1)$$

where, k is the dimensional ratio of real vessel and model.

In 2003, a research about "Hydrodynamic Interaction between Moving and Stationary Ship in a Shallow Canal" were carried out by Stefan Kyulevcheliev, Svetlozar Georgiev, Ship and Industrial Hydrodynamics Department, Bulgarian Ship Hydrodynamics Centre, Varna, Bulgaria and Ivan Ivanov Shipbuilding Department, Technical University of Varna, Bulgaria. They use two scaled models with the parameters are show in the Table 1.

Table 1. Parameter of the models

| | Moving hull | Stationary hull |
|---|---|---|
| Length between perpendiculars [m] | 4.000 | 4.400 |
| Length at waterline [m] | 3.881 | 4.400 |
| Beam [m] | 0.456 | 0.456 |
| Draft [m] | 0.080 | 0.080 |
| Block coefficient | 0.928 | 0.870 |
| Displacement [$m^3$] | 0.131 | 0.139 |

The experimental set-up with the accepted coordinate system for the forces and moments are shown schematically in Figure 3 below. The relative position of the two models has been determined by detecting a marker at the bow of the moving model with a laser fitted at the stationary model.

a) Moving hull

b) Stationary hull

Figure 2. The models were used in the experiments

Both the models have been free to sink and trim, but fixed in all other degrees of freedom. The moving model has run along the centerline of the tank with a width of 2.6 m.

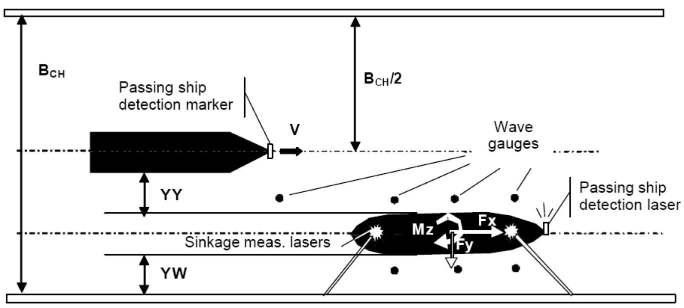


Figure 3. Experimental set-up

The measuring unit, mounted on the stationary hull, has comprised two strain gauges for the longitudinal force, allowing in this way deduction of the yawing moment, and one strain gauge for the lateral force. Two lasers detecting the distance to fixed horizontal plane attached to the canal wall have measured the sinkage of the hull.

Experiment was carried out with the sets of canal depth, model speed, and distance between two vessels when overtaking others (Stefan 2001). In this paper, the results of experiments which have conditions similar to conditions of the accident of the M/V Qingdao and M/V Ocean Asia will be presented.

The Figure 4 and Figure 5 show the experimental results when the moving model was overtaking stationary model at the speed of 0.875 m/s and ratio of canal depth and draft (H/T), respectively, 1.5, 2 and 2.5.

The length between perpendiculars of SITC Qingdao LBP is 134m. The length of the moving model in experiment is 4m. So the speed of 9 knots of the M/V SITC Qingdao equivalent to the model speed as follows (Cohen 1983):

$$V_{model} = 9 \times \sqrt{\frac{4}{134}} = 1.56 \ (knots) \ = 0.800 (m/s) \quad (2)$$

The speed of moving model in the experiment was 0.875m/s, so it can be considered as same as the speed of SITC Qingdao when she was overtaking M/V Ocean Asia.

About the depth of the canal, the rate of draft and depth of both vessels draft SITC Qingdao and Ocean Asia were only about H/T = 1.1 ÷ 1.14. From Figure 3 to Figure 5, forces and torque acts on the stationery are depended in inversely proportional to the value of H/T. This leads to the amplitude of forces, moment acts on the M/V Ocean Asia will be greater than the value represented on a graph of the case H/T = 1.5.

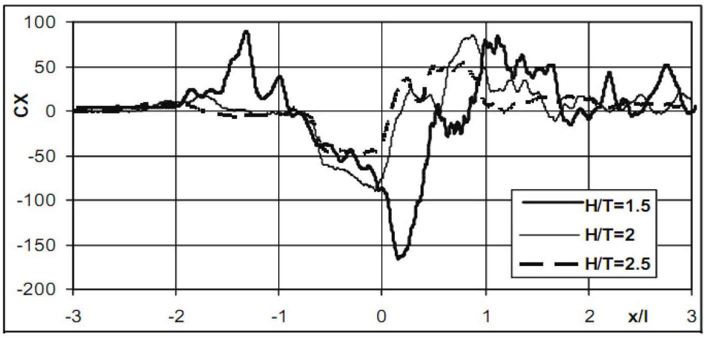

Figure 4. Hydrodynamic load CX at equal speed and different water depths

On the Figure 4, when the distance from SITC Qingdao to the Ocean Asia was about two lengths of a vessel (x/l=-1.5) the M/V Ocean Asia was pushed a bit forward. Since bow SITC Qingdao access to the stern of M/V Ocean Asia (x/l = -1), the M/V Ocean Asia was pulled back until the stern of M/V SITC Quingdao is passed the bow of M/V Ocean Asia (x/l = 1). During this period, the force got the maximum value as the bow of M/V SITC Qingdao passing the bow of M/V Ocean Asia.

The transverse force acting on the hull M/V Ocean Asia was variable as follows: When the distance of two vessels is half of vessel's length (x/l = -0.5, Fig. 5), the M/V Ocean Asia was pushed toward the shore. Then, from x/l=0 to x/l=1, M/V Ocean Asia was pulled to M/V SITC Quingdao. This pulling force was maximum value at the position A on the Figure 5.

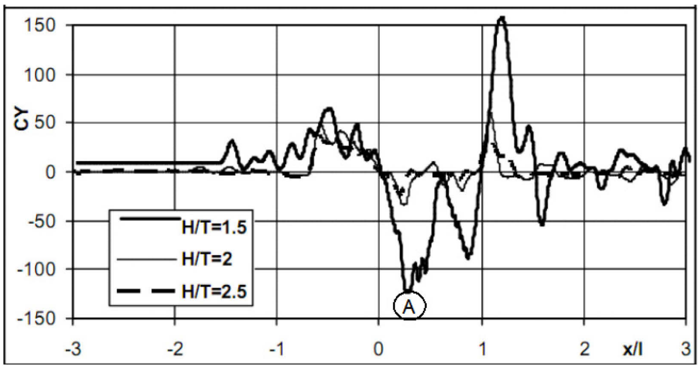

Figure 5. Hydrodynamic load CY at equal speed and different water depths

At the moment, when the stern of M/V Quingdao passing the bow of M/V Ocean Asia (x/l=1), the transverse force was change the direction quickly and the M/V Ocean Asia was pushed strongly to the shore.

The Figure 6 shows the moment effects on the hull of M/V Ocean Asia. Before x/l=0, the moment changed the direction frequently. It courses the swaying to the M/V Ocean Asia. When the bow of SITC Qingdao was passing the bow of Ocean Asia, the moment rises quickly (point B in Fig. 6). It turns the bow of Ocean Asia strongly toward to the right canal.

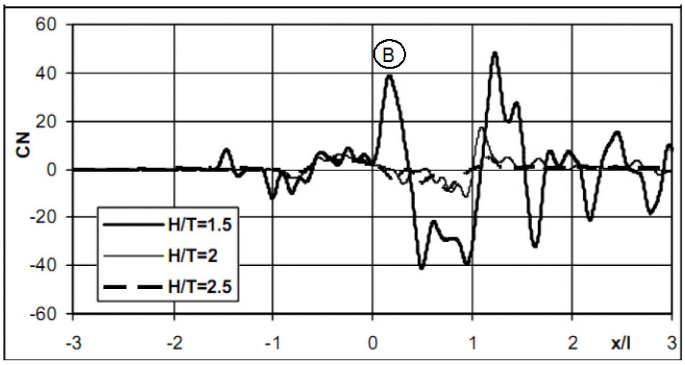

Figure 6. Hydrodynamic load CN at equal speed and different water depths

The transverse force and moment acting on the M/V Ocean Asia peaked almost at the same time as the bow of SITC Qingdao passing the bow of Ocean Asia (points A and B in Figure 5 and Figure 6). Under the influence of pulling force and moment, the M/V Ocean Asia changed her course toward the right bank of the canal.

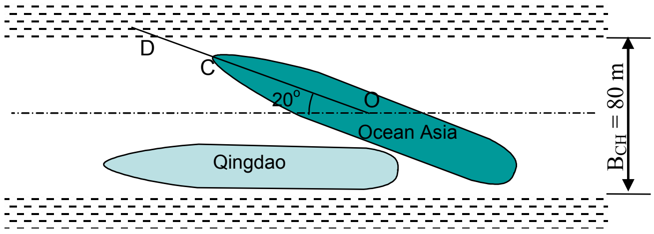


Figure 7 The distance from Ocean Asia to the shore

According to accident document, at the position M/V Ocean Asia run on ground, its heading was about from $40^o$ to 45° compared to axial canal. Assume that when SITC Qingdao passed M/V Ocean Asia, the heading of Ocean Asia was deflected away from the direction of canal $20^o$ (Fig. 7). The distance to shore from the bow of Ocean Asia is:

$$CD = OD - OC \tag{3}$$

where:

$$OD = \frac{B_{CH}/2}{\sin 20^o} = \frac{40}{\sin 20^o} = 117\,(m) \tag{4}$$

$$OC = \frac{1}{2} \times LOA_{Ocean\ Asia} = \frac{1}{2} \times 158 = 79\,(m) \tag{5}$$

The distance from Ocean Asia to the shore is:

$$CD = 117 - 79 = 38\,(m) \tag{6}$$

The M/V Ocean Asia is towed at speed of 3 knots. It takes 24.6 seconds to pass over the distance CD = 38 meters. This is a very short period of time, it not allows the M/V Ocean Asia and tugs to have any actions to against this effect.

Moreover, the tugboat M/V Da Tuong towed by the towing line 150 m in length, so it is not available to adjust the course of M/V Ocean Asia. Two other tugboats at the stern of the M/V Ocean Asia also could not reduce the changing course suddenly of M/V Ocean Asia because the M/V SITC Qingdao was passing too close to M/V Ocean Asia, there was no room for tugboat maneuvering. In additional, these two tugboats were at the stern of M/V Ocean Asia while the hydrodynamic force acted on the vessel's bow. That's why in this situation, the three tugboats could not against the changing course of M/V Ocean Asia which caused the accident.

## 3 EFFECT OF NARROW CANAL

In the above experiments, the overtaken vessel was near the shore. In the case of the accident, the M/V Ocean Asia was towed at the center line of the canal and the M/V SITC Qingdao ran very near the shore so the forces and moment effect on M/V Ocean Asia are not only as the analysis above, there are additional impacts.

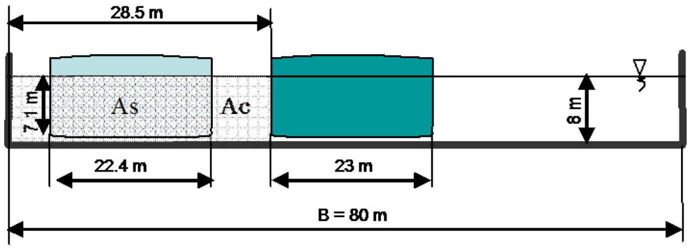


Figure 8 Cross section of the canal when the M/V SITC Qingdao was over taking M/V Ocean Asia

At the cross section describing on the Figure 8, the maximum allowed speed of the SITC Quindao is just 1.7 knots while it ran at the speed of 9 knots. At this speed, it creates much of chaos water flow and has lost control.

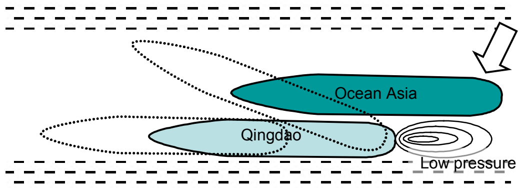


Figure 9 Effect due to narrow canal

When M/V SITC Qingdao passing M/V Ocean Asia, the flow of water between vessels was strong chaotic. A big volume of water at the bow of SITC Qingdao could not transfer to the stern because of narrow canal. It creates a low pressure area behind the M/V SITC Qingdao. To fill up the water to this low pressure area, large volume water on the starboard stern of M/V Ocean Asia had moved and it causes the heading of M/V Ocean Asia changes suddenly toward to the shore (Fig. 8).

## 4 CONCLUSIONS

Thus, when the M/V SITC Qingdao overtook M/V Ocean Asia, they simultaneously affected by:

- Forces and moment as analysis in the section 2, and
- Low pressure area behind M/V SITC Qingdao due to narrow canal as analysis in the section 3.

Both of effects have peak at the same time so they create powerful effect, making the M/V Ocean Asia sudden shift to the right bank of the canal.

According the above analysis, the cause of the accident between M/V SITC Qingdao and M/V Ocean Asia are as follows:

- M/V SITC Qingdao had violated regulations on safety, running at large speed and overtaking at the narrow area, where it is prohibited by the Port Authority.

- The pilots on the vessels did not have the necessary coordination of their work. The pilot on the M/V SITC Qingdao was not obeyed the rule and regulation of the canal which prohibits overtaking and limits the speed at this section of the canal. If M/V SITC Qingdao sailed at lower speed and M/V Ocean Asia kept out of the way of the M/V SITC Qingdao, they accident could not happen.
- M/V Ocean Asia did not be applied any safety measures. The anchor of the vessel did not use as it should be. M/V Ocean Asia is towed vessel but it not means that M/V Ocean Asia has no responsibilities in this case.
- M/V Ocean Asia was towed so the ability to maneuver is limited, especially the ability to use a rudder to keep track. This makes the risk of incidents such as when she is overtaken by others.

M/V Ocean Asia ran aground due to these above reasons. According to the analysis, it can be said that the accident of M/V Ocean Asia was caused by the overtaking of M/V SITC Qingdao.

## NOMENCLATURE

| | |
|---|---|
| B | Beam of ship(s) |
| $B_{CH}$ | Canal width |
| CN | $= 1000\ Mz / (0.5\ \rho\ \square VM^2\ L_S^2\ T)$ |
| CX | $= 1000\ Fx / (0.5\ \rho\ VM^2\ L_S\ T)$ |
| CY | $= 1000\ Fy / (0.5\ \rho\ VM^2\ LS\ T)$ |
| FH | Froude number (based on water depth) |
| Fx | Longitudinal force |
| Fy | Lateral force |
| H | Water depth |
| hw | Wave elevation |
| $L_M$ | Length of moving ship |
| $L_S$ | Length of stationary ship |
| l | $= 0.5\ (L_M + L_S)$ |
| Mz | Yawing moment |
| T | Draft of ship(s) |
| $V_M$ | Speed of moving model |
| x/l | Non-dimensional stagger between the middle sections of the ships |
| YW | Spacing between stationary ship side and canal wall |
| YY | Spacing between ship sides |
| ρ | Mass density of water |

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