

# A Study on the Improvement of Marine Traffic System in the Ulsan Approaching Waters

\* Jae-Yong Jeong\* · Dae-Gwun Yoon\*\*† · Cheol-Seung Kim\*\*

\*, \*\* Division of Maritime Transportation System, Mokpo National Maritime University, Mokpo, 530-729, Korea

## 울산항 접근수역의 항로지정에 관한 연구

정재용\* · 윤대근\*\*† · 김철승\*\*

\*, \*\* 목포해양대학교 해상운송시스템학부

**Abstract :** This study examined environmental condition, marine accidental data, marine traffic capacity and traffic flow, and fisheries zone status near Ulsan approaching water area. A questionnaire survey of marine traffic system was conducted on experts and users, and new plan was proposed. On the basis of the responses of experts and users to questionnaire, the essential factor of navigation danger and the essential factor of collision risk as well as the improvement plans were proposed. More efficient navigational fairway was set up through this study.

**Key Words :** Marine accident data, Marine traffic survey, Traffic flow, Questionnaire survey, Navigational fairway

**요 약 :** 본 연구에서는 울산항 인근해역에 대한 자연환경, 해양사고, 해상교통량 및 해상교통흐름 관측, 어업현황 등을 조사·분석하고, 전문가 및 이용자에 대한 설문조사를 실시하여 개선안을 도출하였다. 본 연구는 전문가 및 사용자의 설문조사 실행을 통한 항해위험 필수요소, 개선계획 및 충돌위험 필수요소를 제시하였다. 본 연구의 결과로서 보다 효율적인 항로를 도출하였다.

**핵심용어 :** 해양사고자료, 해상교통조사, 교통흐름, 설문조사, 항로

### 1. Introduction

Ulsan harbor is an important economical harbor in our country. It is responsible for carrying out 37% of the national cargo every year with 81% of that accounting for hazardous goods. Because large, middle or small size oil tankers come and leave the harbor frequently, Ulsan port is a place where there is a high risk of crude oil pollution.

Marine traffics near Ulsan approaching waters are crossing and converging at the diversion points of No. 1 fairway~No. 2 fairway, No. 1 fairway~No. 3 fairway as well as the area approaching No. 1 fairway abeam the headland of cape Gawnjeol. By the year 2011, minor modifications are expected for the water utilities due to additional developments, the number of berths will increase from 49 to 78.

This study examined environmental conditions, marine accident data, marine traffic capacity, traffic flow survey and fisheries zone status near Ulsan approaching water area. Finally a questionnaire survey was carried out for experts and users to propose a new plan.

### 2. The assessment of marine traffic environment

#### 2.1 The assessment of marine traffic environment

Around the Ulsan port area where the tide phenomenon is extremely weak, the highest tidal range is 48.2 centimeters, average tidal range is 32.6 centimeters, the lowest tidal range is 17.0 centimeters, and therefore this is not a big factor when it comes to navigating and approaching it's shores(Korea Meteorological Administration, 2000~2004).

The strongest rising flood current occurs in the south west direction. It takes 2.5~3.0 hours to reach the highest tidal range, with speed of about 0.5~1.8 knots. The strongest ebb current occurs in the northeast. It takes 1.0~3.0 hours

\* First Author : jyjong@mmu.ac.kr, 061-240-7308

† Corresponding Author : dyoon@mmu.ac.kr, 061-240-7179

to reach the lowest tidal range, with speed of about 1.1~2.0 knots. Nearby the Mipo harbor, from north~northeast direction, ocean current speed is about 0.5 knots. There is a warm current from the north around the bay, so the speed of concurrent flow is about 0.3 knots. In front of the newly developing harbor, the speed of the strongest rising tide current is 2.1 knots, the lowest is 1.2 knots.

The natural environment characteristic is that Kurusio current is flowing along Korea by the east coast, therefore when Kurusio current superposes the rising tide, the ocean current increases the speed to 4 knots. When ships navigate either inside or outside of the line connecting Ulgi lighthouse and Gwanjeol cape area, their speed will have a very big difference due to meteorological factors. Moreover eastern and southern parts are open towards the ocean, therefore the wind speed and ocean waves from this direction will influence ships navigation, but influences with regards to fog occurrence, tide level difference and tidal current in the breakwater; are not significantly big.

## 2.2 Marine casualties investigation

Maritime casualties investigation was carried out from 2000 to 2004 year. This was based according to the result of the query of Korea maritime tribunal concerning the area along Ulsan approach on positions (Lat. 35° 20' ~Lat. 35° 40', Long. 129° 20' ~Long. 129° 35') (2000 year~2004 year) (Korea Meteorological Administration, 2000~2004).

Fig. 1 shows the result of marine casualties in Ulsan port.

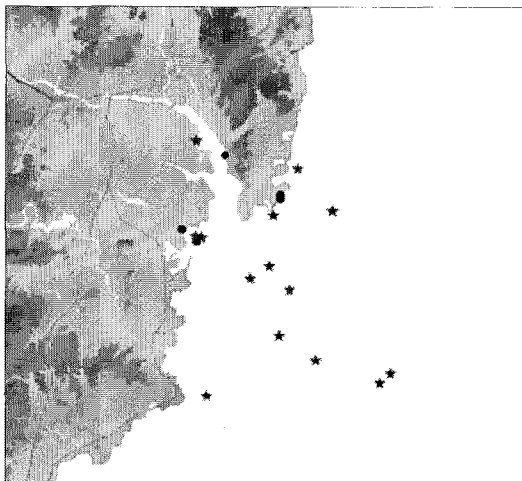


Fig. 1. Locations of accidents.

Collisions occur in crossing situations on the No. 1 fairway and the anchorage(M1~M7), which is used by small ships, as well as around dolphin wharf and the

diversion point towards No. 2 fairway where the traffic flow inbound and outbound.

The area of the East anchorage is where the traffic flow usually overlap. The ships whose fairways overlap in this area are the ships navigating from Pohang port to Ulsan and Onsan ports via East anchorage, tug boats carrying shipbuilding materials from Woobong, Ijin and Cheoyong towards Hyundai Mipo Shipyard and Hyundai Heavy Industry as well as ships navigating from Pohang to Busan ports that use the area as a shortcut. This Overlapping of fairways is mainly caused by the East anchorage protruding outside the outer sea area.

Another area where the danger of collision is high in the sea area east of the cape of Gwanjeol where Large ships as well as small tugs change their normal fairway to opt for a short fairway towards the left side of the No. 1 fairway Passing the SPM area or pass around the right side of the No. 1 Fairway. Other ships heading from Pohang to Busan and vice-versa tend to pass this area also, taking their fairway dangerously close to the entrance of the fairway before passing the east anchorage. This change from their expected fairway causes unexpected alterations whereby increasing the danger of collision.

Stranding accidents occur in the entrance of shelter port, in the M anchorage zone and nearby the entrance of the Onsan port.

Altogether 6 oil tanker accidents happened therefore there is more than 1 accident in an average year.

## 2.3 Marine traffic survey

Ulsan port marine volume of traffic(year 2000~2004) within the past 5 years taken from Ulsan Regional Maritime Affairs & Fisheries Office Port-MIS raw data of their computer center. The data from the VTS center used for the analysis was based on the highest traffic volume recorded within 3 days(72 hours)(Ulsan Regional Maritime Affairs & Port Office, 2005).

Below are the results of their analysis:

The M 1 to 7 anchoring zone is used by ship's of 1,000 GRT and it is being used at an average of 5,500 times yearly, which averages about 15 times a day, and that is twice higher than normal use. The maximum use is about 20 to 30 times, therefore it now in a saturated condition. The M9 to 10 anchoring zones used by ship's of 6000~7000 GRT and it is being used at an average of 1,530 times yearly, which averages about 4.19 times a day. M11 to 12 is used by ship's of 800~1200 GRT and it is being

used at an average of 315 times yearly, which averages about 8.6 times a day. But now M 11 to 12 anchorages were removed due to port development which caused a shortage of anchorage area. E1 anchorage is being used by ship's of 3,200 GRT and it is being used at an average of 5,720 times yearly, which averages about 15.7 times a day. E2 anchorage is being used by ship's of 1,400 GRT and it is being used at an average of 1940 times yearly, which averages about 5.31 times a day. E3 anchorage is being used by ship's of 17,000 GRT and above, and it is being used at an average of 975 times yearly, which averages about 2.7 times a day. Compared to E2 and E3 anchorages, E1 anchorage is more protected against severe weather conditions due to location, therefore it is usually used by small ships congesting the area creating a dangerous area for ship's navigating from Pohang to Ulsan.

Fig. 2 shows the dangerous characteristics of the tracks followed by ship's leaving and entrance Ulsan port.

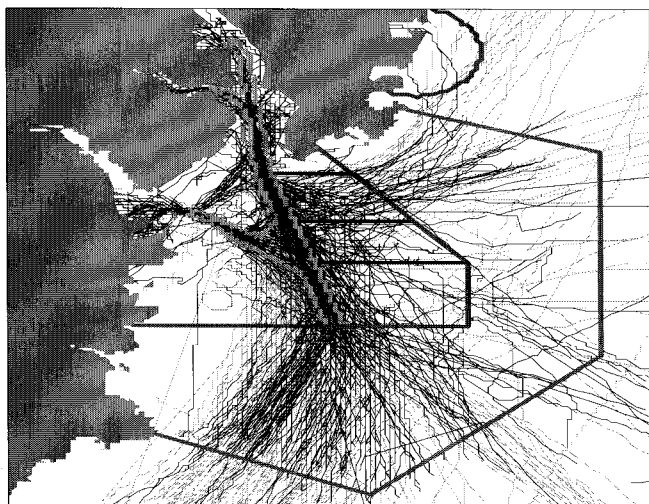


Fig. 2. Ship's tracks around Ulsan waters.

No. 1 dangerous characteristic is that near cape Gwangeol. We can observe that the tracks are widely scattered which makes crossing and overtaking the only dangerous concerns. But this tracks are the same pattern used by ships leaving Ulsan port which makes the area very dangerous area for navigation. Moreover the traffic congestion makes it hard for the VTS operator to monitor safe navigation.

Next is the characteristics of tracks along the area from the entrance of No. 1 fairway up to the area above M1 anchorage considering the situation of No. 1 characteristic where the same pattern is used by ships coming in and out, this is aggravated by the narrowing fairway of the area covered by the tracks and the absence of buoys to

guide ships passing the area. Ships tend to pass inside or outside the fairway at will making navigation for ships unpredictable.

Thirdly, there are also some ships enter or leave port through the sea area nearby the Hwaamchu/east seawall. Fourthly, because the ships enter Onsan port from M anchorage it increased the volume of traffic. Because ships navigate in the M1~7 anchorage, in the dolphin wharf and on narrow and small water, it increased the risk of collision.

#### 2.4 Fishery existing circumstances

The security of sailing ships, the navigation law and the fairway construction~adjustment around the Ulsan, the investigation related to fishery distribution situation near the sea area, the result is that there is no fishery.

#### 2.5 The survey for experts and users

Near the Ulsan port sea area, we take the user and the pilot association, the marine association as the object, collect the information about Onsan port fairway and the aids to navigation ,and the opinion about the anchorage. In the Onsan port the problems of ships entering or leaving port to be as follows.

Firstly, nearby No. 1 fairway, the sea area fairway is narrow and small, the fairways which entering or leaving port ships are crossed and concentrated, the fairways of ships which entering or leaving port, the ships and the harbor crossed and concentrated. The fairways of ships entering or leaving port through 1 fairway west sea area crossed, fairway the side, therefore it violates 11<sup>th</sup> of law of the opening of a port.

Secondly, already surpassed the M anchoring zone use limit, because ships entering Ulsan port increased , the amount of anchorage use also increases, in fairway crossing and the volume of moving traffic flow increase to cause the certain danger.

Thirdly, breakwater nearby sea area navigational water is narrow and small, ships enter or leaves port to enter the anchorage fairway ships entering port from Pohang port cross and centralize nearby the narrow sea area of breakwater, fairway invasion and nearby break water entrance, ships have great angle change direction, these contains the risk.

Fourthly, about the aids to navigation, as a result of No. 1 fairway entrance goal absence, leaves the ships which ships enter port not to observe the standard but freely

navigate happen frequently, therefore it needs to establish LANBY to distinguish the Ulsan port fairway. Seacoast lighthouses hold the post of the related Seuldo island lighthouse of defense port, as the leading light of Ulsan port east of the end of west of water break, it plays the extremely vital role, because of lighthouse altitude, light intensity and behind light, north Onsan port water break lighthouse recognition difficulty. In order to improve this situation, therefore the lamp is high/lighthouse diameter, racon. The illumination lamp and so on the establishment is extremely essential. Moreover regarding Onsan port buoy, because behind light disturbance, on fairway buoy recognition also very difficult, therefore the LED establishment extremely is also similarly essential(Korea port and harbour association, 2000).

### 3. The proposal of marine traffic system

Nearby the Ulsan port sea area, communication system likes Fig. 3. The Main item is as follows.

#### 3.1 From No. 1 fairway entering or leaving port and approaching waters

Table 1 shows the position of fairway.

Table 1. The position of fairways

Fairway	No.	Lat.	Long.
Limited line of port side	1	35~24~11.0 N	129~24~28.8 E
	2	35~22~22.2 N	129~24~43.2 E
Limited line of starboard side	1	35~24~11.0 N	129~25~27.0 E
	2	35~22~22.2 N	129~26~10.8 E
Traffic separation zone	1	35~24~11.0 N	129~24~58.8 E
	2	35~22~22.0 N	129~25~23.4 E
	3	35~22~22.0 N	129~25~30.6 E
	4	35~24~11.0 N	129~25~01.2 E

The No. 1 fairway turnover port and nearby waters scope is 580 meters, ships does not always navigate along the fairway, not only nearby waters enter port the ships and leave port the ships traffic flow overlapping, repetition, moreover enters or leaves port the ships and the port, the ships also alternately concentrates. Moreover the side waters occurs west No. 1 fairway enters port the ships and leaves port ships overlapping and redundant, violates is open the order method instance and the sea accident also

repeatedly is occurring.

In order to resolve the above problem, reorganizes nearby waters the maritime communication current capacity, does not let into leave port the ships traffic flow overlapping repetition, will leave the scope which will enter port from 150 meters to expand to 600 meters, will enter port front 1.8 nautical miles place establishments LANBY in the turnover, in addition also has established traffic separation zone which will connect enters port.

#### 3.2 Newly established anchorage

M 1~7 anchoring zones amount of use overruns. Because the Ulsan port enters port the ship anchoring zone use, increased 1 fairway marine volume of traffic, the fairway has traversed and in the port moves the volume of traffic. At the same time also increased the risk. Moreover as a result of the Ulsan port project, the M 11~12 anchoring zone is blocked, in order to resolve the anchoring zone to be insufficient, in Woobong neighbor has supposed 8 anchoring zones newly. Table 2 shows the position of anchorage.

Table 2. The position of anchorages

Position	
Lat.	Long.
35~23~09.0 N	129~22~46.2 E
35~23~19.8 N	129~22~18.0 E
35~23~36.0 N	129~23~00.0 E
35~23~42.0 N	129~22~31.2 E
35~23~39.0 N	129~22~00.0 E
35~24~00.0 N	129~23~03.0 E
35~24~04.8 N	129~22~18.6 E
35~24~04.2 N	129~22~12.0 E

#### 3.3 East breakwater~Whaamchu waters

In order to resolve nearby the breakwater navigation waters to be narrow and small, enters or leaves port the ships, nearby the anchoring zone fairway and the ships which enters port from Pohang the direction turnover nearby the water break the volume of traffic centralism overlapping, because the mobility not good tug boat transports the navigation but to cause west and east the water break the entrance nearby as a result of the danger which the great angle change direction but causes, eliminates Geunchiam, Hwaamchun the small ships and tug boat, has east the breakwater distance.

3.4 Aids to navigation

Ulsan port No. 1 fairway difference navigation recognition difficulty, in order to extend the shore long distance lamp and extends the shore lamp's function, for eliminate but creates because of the recognition difficult question which the behind light, proposed resets up and the change likes the Table 1 aids to navigation.

4. The assessment using marine traffic simulation

Fig. 3 is in this research the proposal marine traffic system. May see the separation to be open to navigation proposal and so on region and LANBY establishment has the remarkable good effect compared to ESA value.

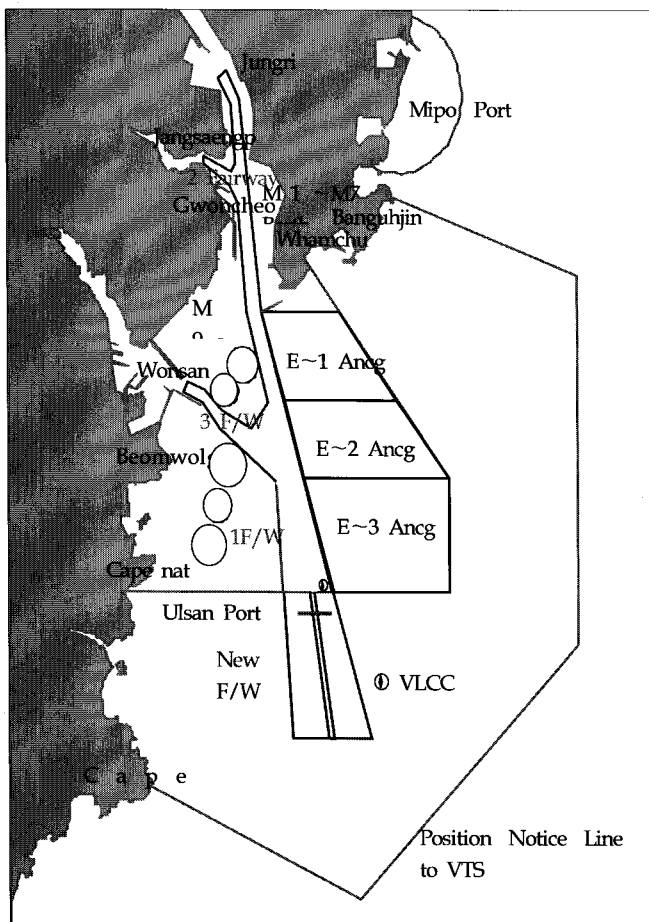


Fig. 3. The improvement of marine traffic system.

This is because the traffic separation scheme construction has the effect regarding marine traffic flow which the rectification ships decreases progressively alternately. Nearby Ulsan port waters ESA value distribution like Fig. 4 and Fig. 5, Fig. 4 is the marine traffic flow simulation test result which in the marine traffic system.

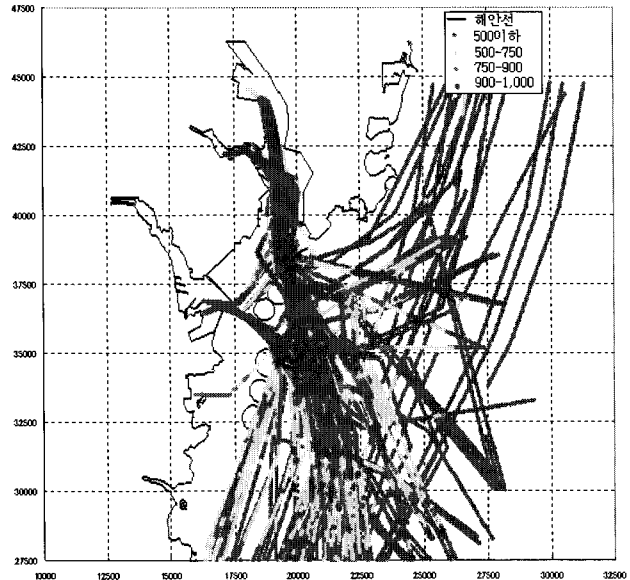


Fig. 4. The result of ESA on the present fairway.

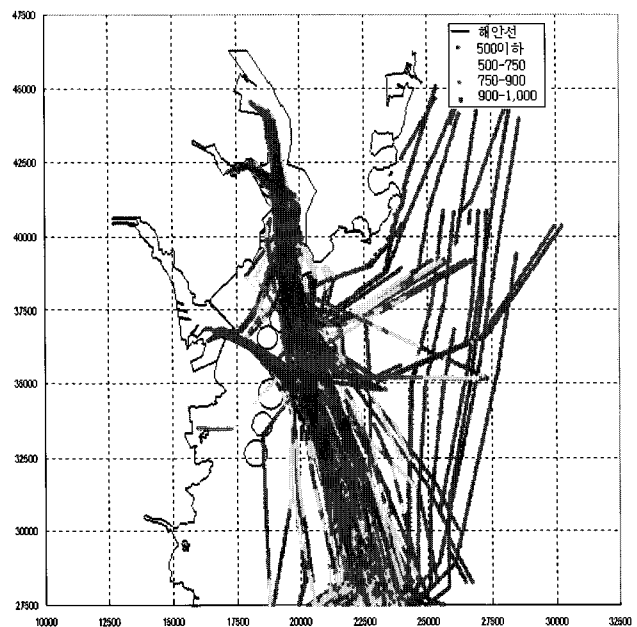


Fig. 5. The result of ESA on the proposed fairway.

5. Conclusion

In this research through enters the waters natural environment, the sea accident, the marine volume of traffic to the Ulsan port, and the maritime communication tense, the fishery present situation, carries on the diagnosis, proposed the navigation dangerous essential factor. And implements to the expert machine and user's questionnaire survey, the collection dangerous essential factor as well as the improvement plan. Use traffic characteristics which obtains in the maritime communication tense investigation,

implementation maritime communication simulation test, appraises the Ulsan port the environment stress value. Through the analysis related specific sea area many kinds of projects maritime communication appraisal result as well as expert opinion's and so on, proposes the navigation fairway. Has implemented the maritime communication simulation test to this research proposal navigation fairway. The result obtained the proposal navigation fairway. Has this better effect the conclusion.

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