

CHAPTER 185

Feasibility Study of Deep Water Port of Taiwan District, R.O.C.

H.-S. HOU

Institute of Transportation, Ministry of
Communications, Republic of China

ABSTRACT

Taiwan is now served by five international ports, two of which were newly opened since 1970. They have been under continuous expansion in recent years to meet the needs of the island's burgeoning foreign trade. Due to recent trend of vessel developed to huge load-capacity, the existing port of Taiwan district is inconvenient to the ULCC or VLCC. For decreasing the shipping cost and accomodating the cargo handling of over 100,000 DWT, the deep water port is urgent to be developed in order to promote the competent capability of port cargo handling.

This research is divided into two parts, at first, the prediction of cargo handling and the cargo sources which are adapted to the huge vessel shipping need to be studied for the development of deep water port. the next, then the oceanographical data for the design and the planning of deep water wharf and breakwater need to be surveyed around this Island for possible site of deep water port.

This study deals with the related problems of deep water breakwater construction and discusses how to apply the present design and construction method to the deep water wharf and breakwater. Further analyses are conducted for this research in the coming three fiscal years.

1. Introduction

In general, relatively small ships are employed in the principal five ports except Kaohsiung. The shipping industry has anticipated the nautical restrictions of the ports of Keelung, Suao, Hualien to receive the range of larger ships and the navigational constraints are much less severe than in the other four ports. Nautical constraints have severe effects on the large vessels, the container trade. Special attention is thus required to keep one or two of Taiwan's ports accessible to larger container vessels in the near future. A deepwater port provides Taiwan with several, distinct advantages. First of all, it allows coal transportation by large bulk carriers, resulting in savings in the costs of transport to Taiwan. For Taichung port the additional costs of inland transportation by barge are more than compensated for by these savings; central handling of coal at other deepwater locations would yield approximately the same outcome. Furthermore, the development of a deepwater port, either in Taichung or Keelung or at another location, would enable Taiwan to create or to include the possibility for creating extra port capacity, which could be used to boost the country's transshipment function in containers and bulk commodities. Moreover, it would facilitate Taiwan's

adequate reaction to suddenly emerging trade opportunities in the region. The proposed "Free Trade Zone" would also fit in well with the deepwater port concept. Finally, such a port can provide the special facilities required for the landing of LNG.

2. Research Procedure

1. Research of requirement and capacity of five international trade-ports in Taiwan district
 - (a) Reduce all the data of the future developing plan, facilities, wharves and navigational channel, and then evaluate the present and future burdening operation capacity.
 - (b) From the economic growth rate and all item products (including in the agricultural and industrial huge plan), based on the import and export cargo quantity of all harbors and then predict the future (10 or 25 yrs) total gross import and export cargo quantity and operation requirements and finally determine the site of deep water port.
2. Research of the field survey and investigation of the alternative sites of deep water port.
 - (a) Investigate and measure all the oceanographic data including wind climate, offshore waves, currents, bathymetry, tide, geotechnical conditions and the transportation system around the hinterland.
 - (b) Based on the Taiwan district and international cargo transportation and transshipment, and deal with the requirement quantity of harbor, for considering the long-term developing of port policy, and then the scale of the deep water port and engineering feasibility is determined.

3. Study Under Going

To promote the port integrated development of the Taiwan district, it is suggested that the deep water port construction is necessary in the very near future for the demand of coal import as shown in Table 1. and stevedoring of the large container vessel. To this end, the feasibility study of deep water port of Taiwan district is initiated and studied by the Institute of Transportation, Ministry of Communications and therefore, the author is appointed to take charge of the project research of the deep water port of Taiwan district. This is the first phase study of the project.

The research is divided into three parts. The first part is to study the capacity and requirement of five international ports and predict the future demand, now this part of preliminary study is completed. The second part is based on the study of the first part, if the future demand is required, the result show a positive answer, therefore, the excavation of the deep water port is necessary. So the hydrographic survey and oceanographic measurement is planned and will be under way in the coming fiscal year. The collection and analyses of data on its conditions are necessary for this phase study.

The third part is then proceeded to the harbor planning and detail design. Therefore, the feasibility study will be the base for the future deep water port construction.

4. Coal Terminal is a Part of Deep Water Port

Based on the income requirement of the future coal import until 2000 D.C., in the eastern Taiwan district, coal import to Hualien harbor and then distributed to coal required plants. Accomodation of the construction of coal terminal of the Hualien harbor it does meet the requirement. In the northern Taiwan district, import from Su-Ao harbor could accomodate the civil use, and the coal restoration center of Su-Ao harbor area has much space to use. Therefore, there is no need of any harbor extension for the purpose of coal import either in Hualien port or in Su-Ao harbor.

In the middle of Taiwan district, Taichung harbor could be enlarged as the large scale of coal port. Since coal supplied to Seng-Ao power plant, Linkou power plant and Taichung thermal power plant (under construction) etc., need to use Taichung port coal terminal as the transshipment station. For the demand of huge coal carrier, it is economic to select the vessel of 200,000 DWT or over (See Table 2 & 3). Then, coastal shipping system is need to be planned for transshipment of coal to the above mentioned area. For constructing the deep water coal port, it would be a good idea to take the coal port as the coal storage center and then transferred by coastal shipping or inland transportation toward the concumption unit or power plant as shown in Fig.5. The alternative deep water harbor sites are 1.) the outer area of Taichung port industrial water front, dredging the outer navigational channel and reclaiming the coal wharf space., the layout of the Taichung deep water port is shown in Fig. 1. 2.) An offshore island of the Wai-San-Ding Sand Barrier, is planned as a deepwater coal terminal., the layout is shown in Fig. 2. 3.) Hsin-Ta thermal power plant or LNG terminal will be another deep water port site. 4.) For the northern port site Taoyuan coast offshore area including the single mooring buoy (SMB) for oil unloading toward Taoyuan oil refinery plant will be also the alternative harbor site of deep water port., it is shown in Fig. 4. For the above harbor sites, their orientation and arrangement are determined by using the typhoon attacking track (see Fig. 9) and wind rose and wavedistribution as shown in Fig 10 a & b). Coal import and shipping cost are also analyzed as shown in Fig. 6 & Fig.7 .

5. An Idea of a Central Deepwater Port

The main characteristic of a deepwater port is its ability to permit large vessels of over 100,000 DWT to enter the port by virtue of its depth, entrance channel, turning basin and other special provisions. The primary advantage of a deepwater port lies in its capability to receive large bulk carriers, thus reducing shipping costs for the commodities considerably. The lower handling cost per unit of cargo is, the higher flexibility of a large terminal will be. Therefore, the large investment required for opening up and developing a deepwater port makes it necessary to adopt policies to concentrate

Table 1 Coal Supply and Demand

Year	Own Product	Import	Power Use	CSC Use	Unit: Thousand Tonnage	
					Other Use	Total Demand
1984	2,011	7,367	4,787	2,460	3,127	10,374
1985	1,800	11,303	6,235	2,540	4,328	13,103
1986	1,600	12,056	6,620	2,640	4,396	13,656
1987	1,400	12,480	6,950	2,640	4,290	13,880
1988	1,200	14,640	8,200	3,540	4,100	15,840
1989	1,200	17,373	9,814	4,430	4,329	18,573
1990	1,200	18,696	10,366	4,960	4,570	19,896
1991	1,200	22,325	13,827	4,960	4,738	23,525
1992	1,100	23,474	14,605	4,960	5,009	24,574
1993	1,100	23,802	14,743	4,960	5,199	24,902
1994	1,100	24,988	14,686	6,010	5,392	26,088
1995	1,100	28,758	17,223	7,040	5,595	29,858
1996	1,100	30,663	18,920	7,040	5,803	31,763
1997	1,100	29,911	17,955	7,040	6,016	31,011
1998	1,100	33,762	21,576	7,040	6,246	34,862
1999	1,100	34,171	22,045	7,040	6,186	35,271
2000	1,100	34,393	21,715	7,040	6,738	35,493
Yearly Mean Growth Rate						
1985 - 1990	-7.8%	10.6%	10.7%	14.3%	1.1%	8.7%
1990 - 2000	-0.9%	6.3%	7.7%	3.6%	4.0%	6.0%
1985 - 2000	-3.2%	7.7%	8.7%	7.0%	3.0%	6.9%

CSC : Chinal Steel Corporation

Table 2 Cost of Island Transportation by Barge

Unit: US dollars/ton

Ship Tonnage OWT Navigational Distance (N.M.)	5000	10000	15000	20000	25000	30000
100	2.8	2.4	2.4	2.4	2.5	2.7
120	3.0	2.5	2.5	2.5	2.6	2.7
140	3.1	2.6	2.5	2.6	2.6	2.7
160	3.2	2.7	2.6	2.6	2.7	2.8
180	3.3	2.8	2.7	2.7	2.8	2.8
200	3.5	2.8	2.7	2.7	2.8	2.9

N.M. = Nautical Mile

Table 3 Shipping Cost of Coal Import from Different
Navigational line

Unit: US dollars/ton

Ship Tonnage Navigational line	20000	30000	58000	66000	100000	120000	150000	200000
Australia (5000)	17.8	15.0	11.9	11.4	10.0	9.4	8.7	7.7
Canada (5400)	19.0	16.0	12.6	12.1	10.6	9.9	9.1	8.1
W. Coast.(USA) (6000)	20.8	17.5	15.7	13.2	11.4	10.7	9.8	8.6
South Africa (6300)	21.7	18.3	14.3	13.7	11.8	11.1	10.1	8.9
E. Coast (USA) (9000)	30.0	25.1	19.3	18.4				
E. Coast (USA) (10000)	33.1	27.6	21.1	20.1				

Remark : () indicates the navigational distance.

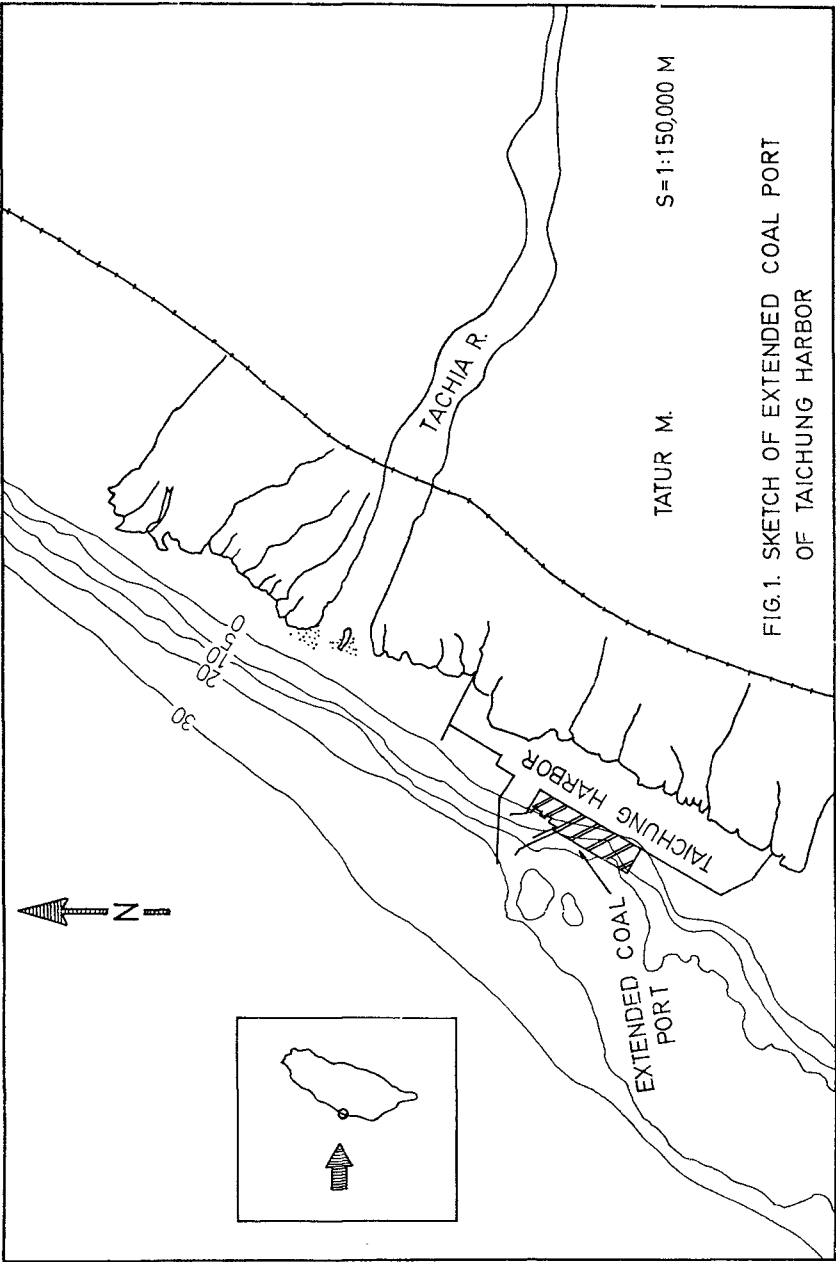


FIG.1. SKETCH OF EXTENDED COAL PORT
OF TAICHUNG HARBOR

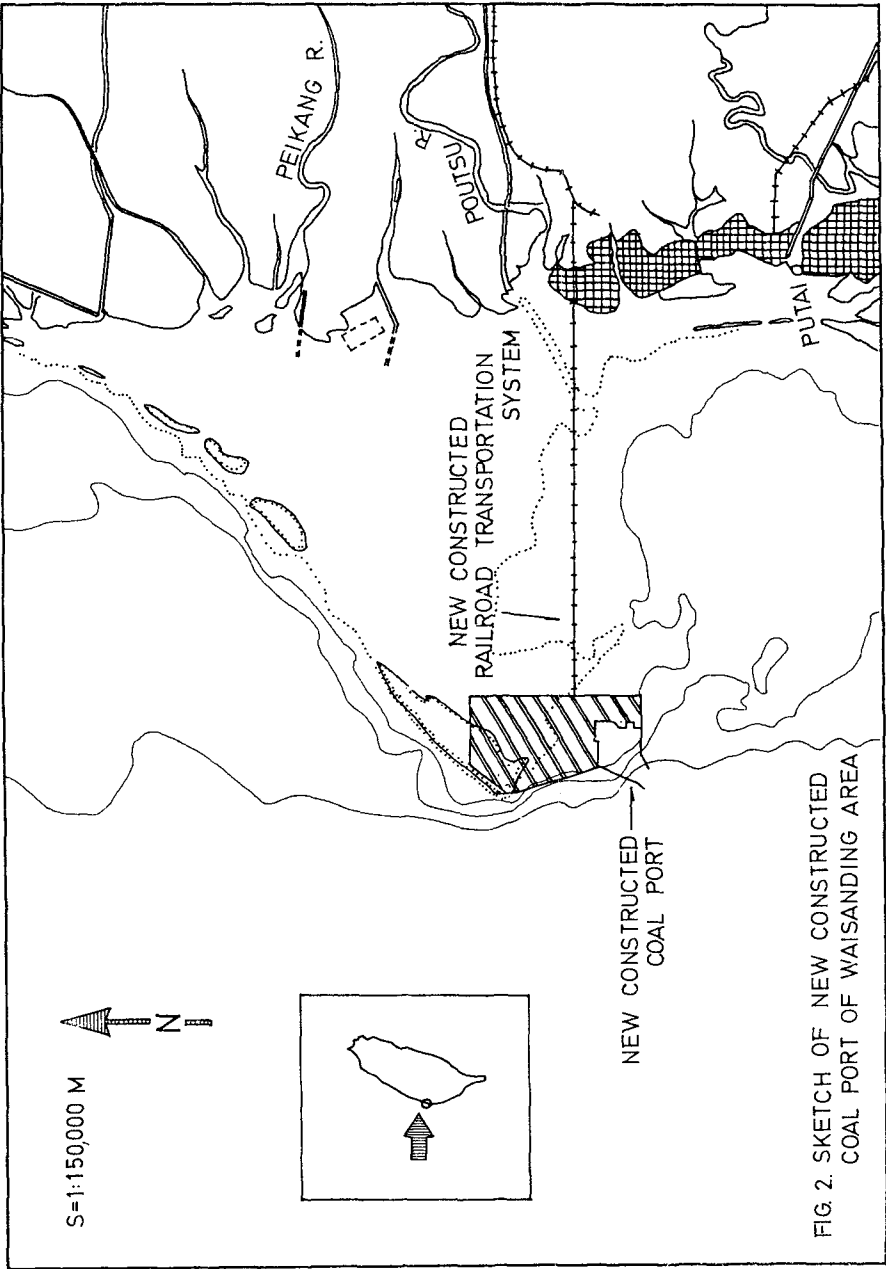
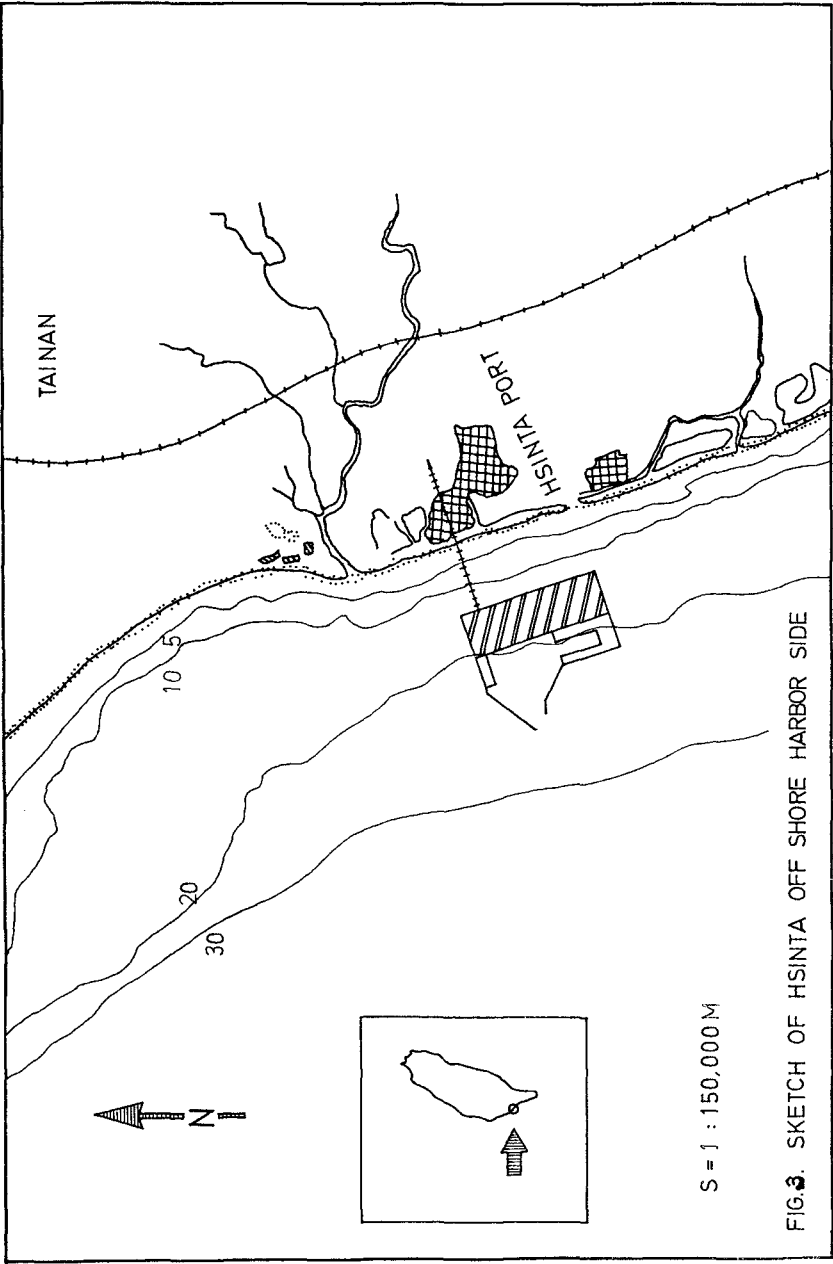
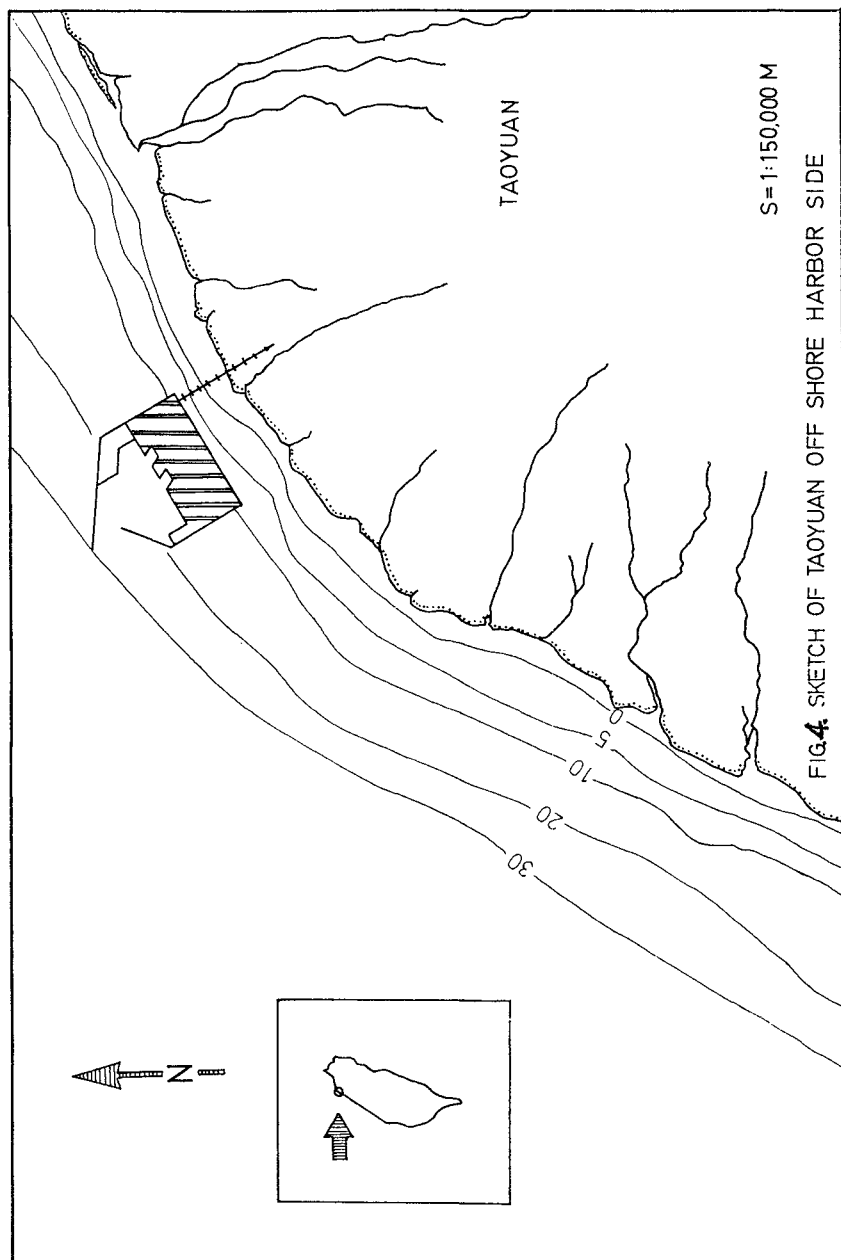


FIG. 2. SKETCH OF NEW CONSTRUCTED COAL PORT OF WAISANDING AREA





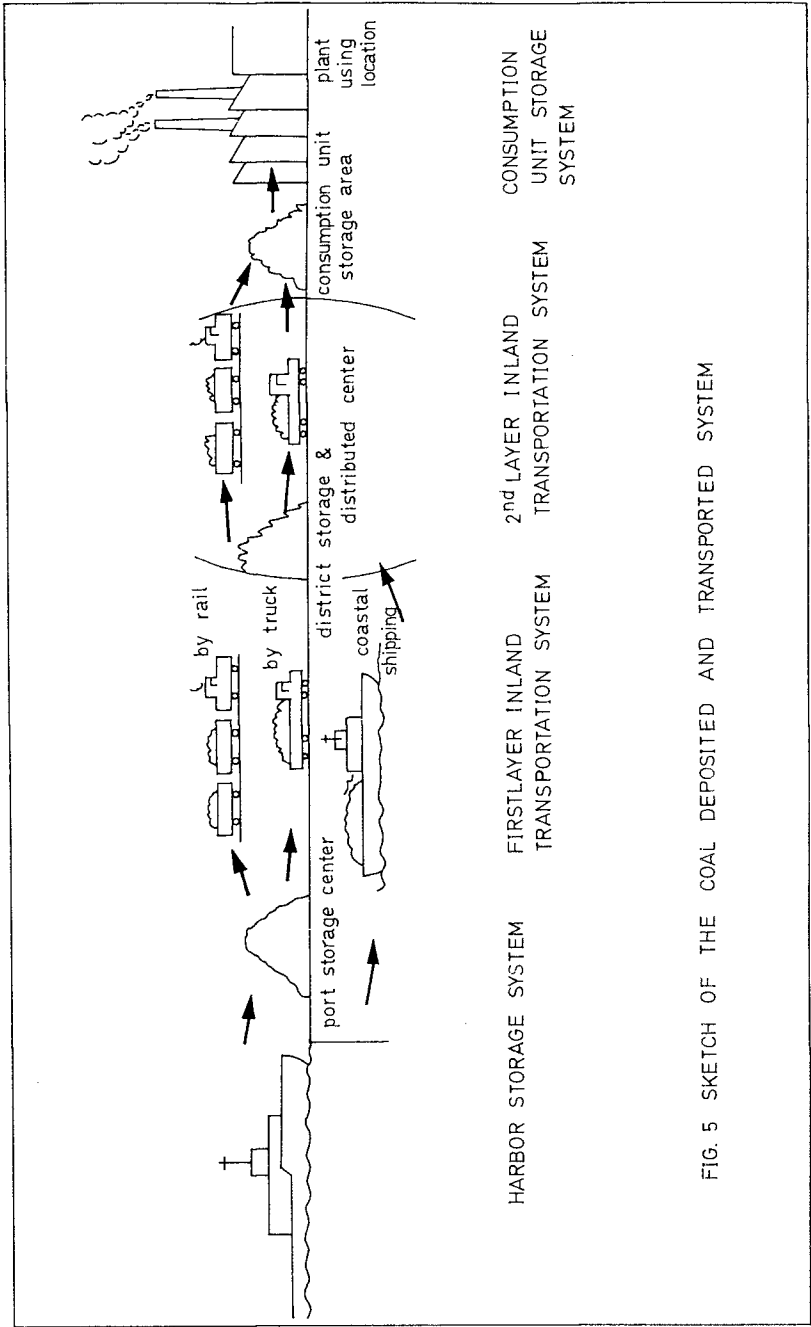


FIG. 5 SKETCH OF THE COAL DEPOSITED AND TRANSPORTED SYSTEM

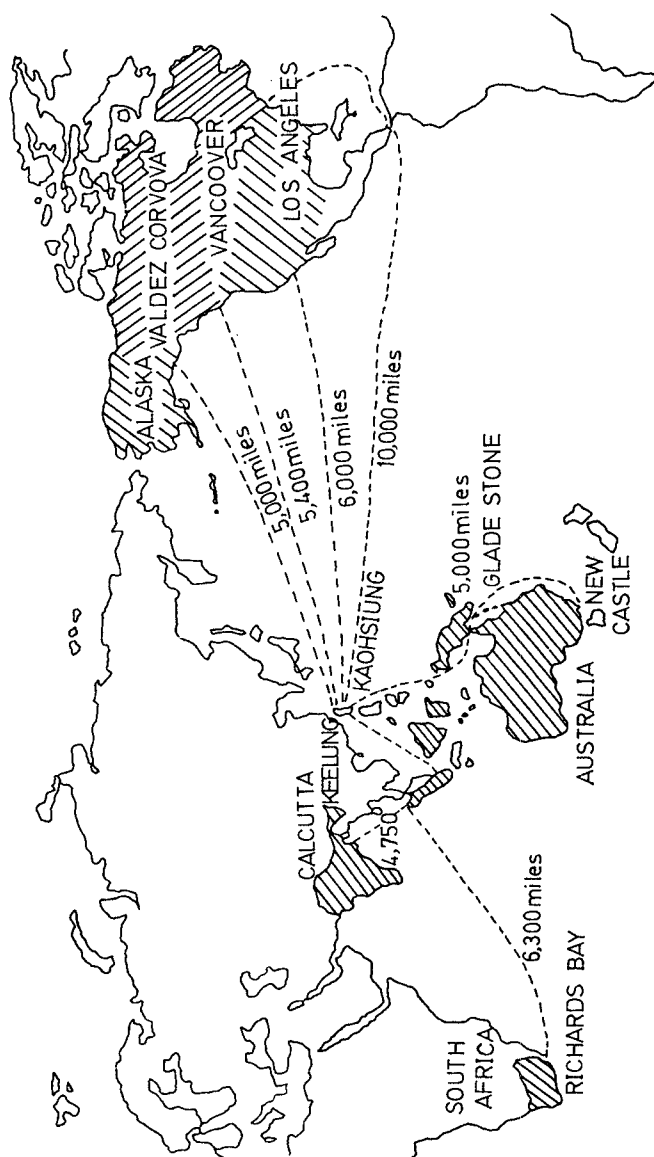


FIG. 6 DISTRIBUTION OF COAL IMPORT FROM FOREIGN COUNTRIES

U.S.DOLLARS/TON.

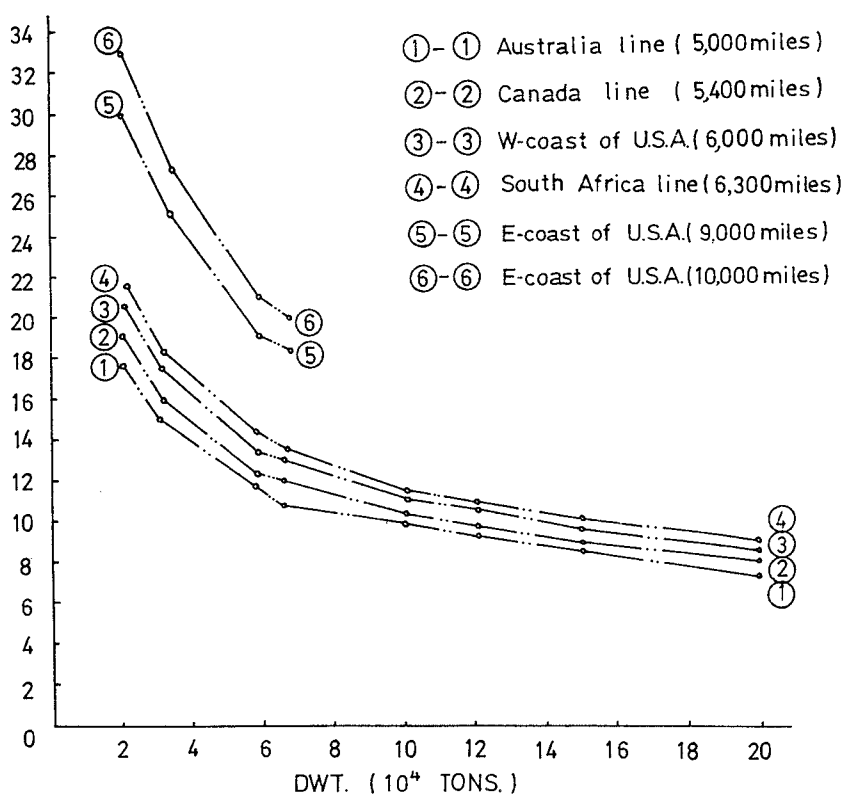
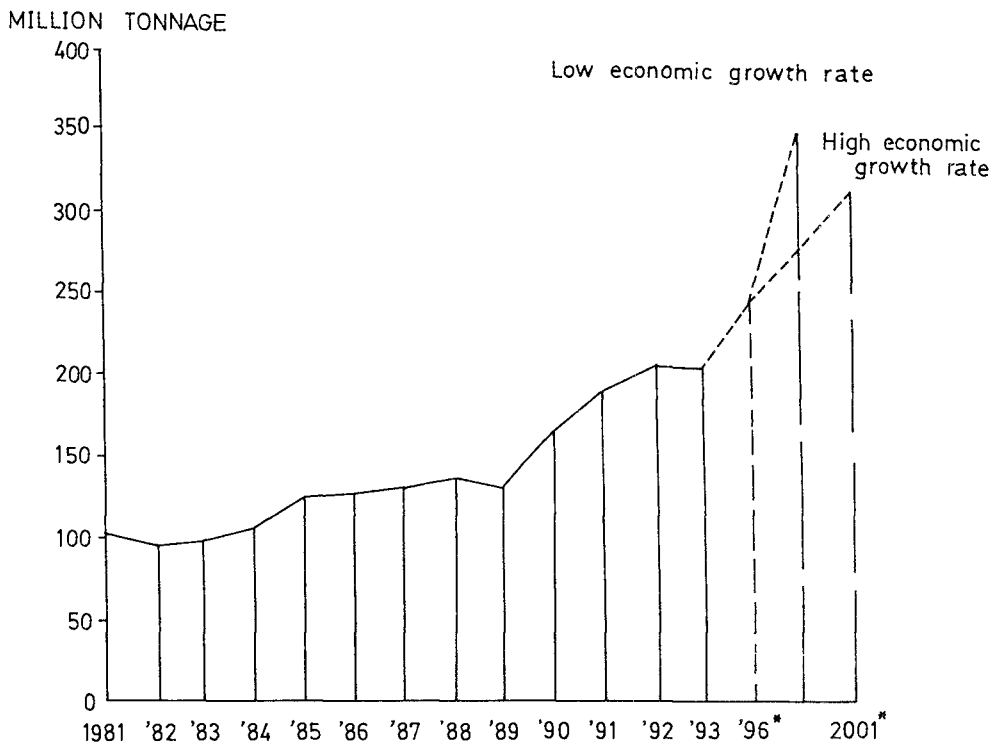


FIG. 7 COAL SHIPPING COST OF EACH NAVIGATIONAL LINE

FIG. 8 COAL SHIPPING QUANTITY RECORD & PREDICTION



* PREDICTION

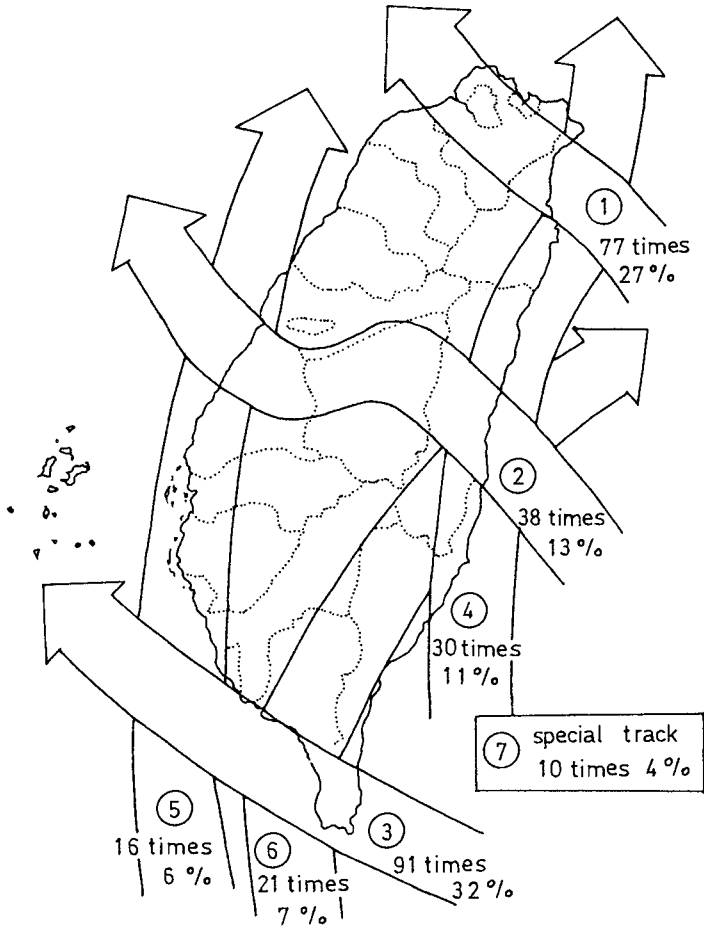


FIG. 9 STATISTICS OF TYPHOON TRACKS
(1897 ~ 1976)

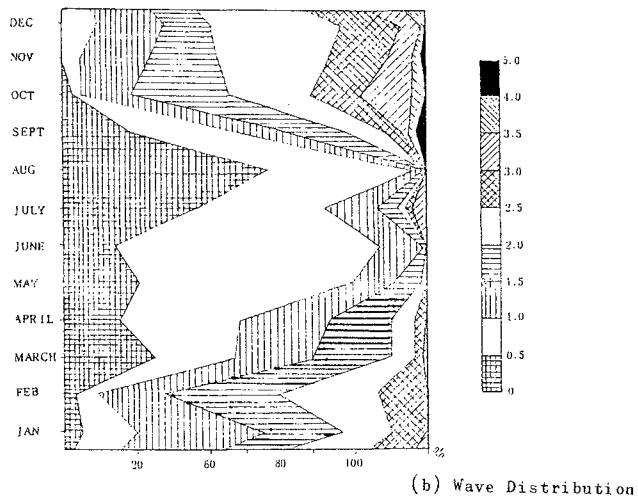
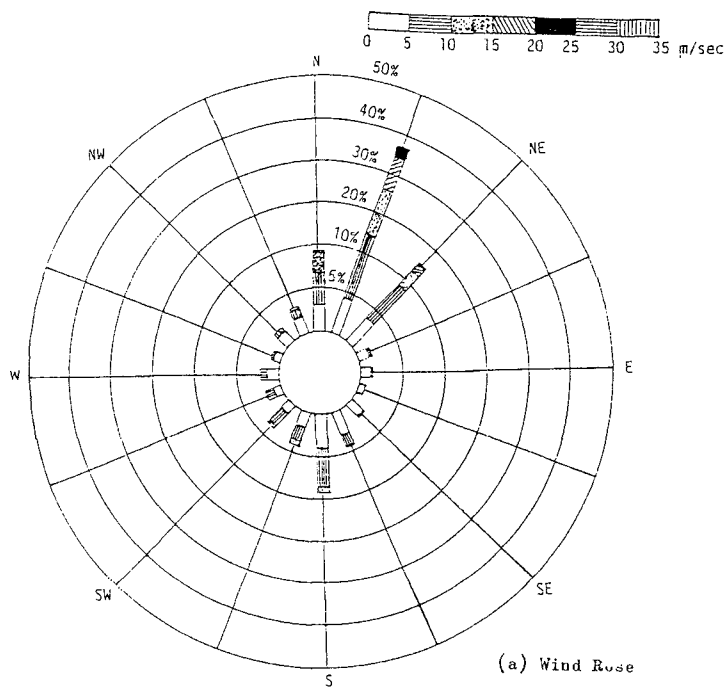


Fig.10 a&b Wind Rose and Wave Distribution of Taiwan Strait

the handling of certain commodities as to make the port feasible by the savings thus gained.

For a deepwater port of the Taiwan district, it may be of interest for the extended quantities of coals (see Fig. 8) and containers (Since Keelung port is congested) to be handled in the near future. A deepwater port would create a large, additional capacity, which would serve as a buffer for Taiwan port developments which cannot be foreseen at this moment. It may become possible to concentrate the capital outlays in one location and to construct, at a lower level of total costs, a safe and well-designed deepwater port instead of having a number of ports complete for the status of deepwater port ---- at a far higher combined cost ---- a status which most of the ports can never attain as a result of their physical and hinterland limitations.

Transshipment of containers, fertilizer and other products are considered as potentially promising port activities of Taiwan district. If transshipment for the East or South-east Asia region is to play an important role, an additional amount of port capacity is to be created over, Taiwan may be called upon to take over one or more port and economic functions from Hong Kong. In the future, Taiwan will import LNG for which a port with relatively large dimensions would be required.

The combined effect of these arguments, an investigation into a possible deepwater port of Taiwan district is warranted to be necessary.

5. Economical and Technical Adaptability of the Proposed Deepwater Harbor Sites.

A. Domestic transportation patterns of export and import commodities

In order to carry out system analysis of the proposed deepwater harbor sites from the viewpoint of transportation economics, domestic transportation patterns of export and import commodities must be estimated. For this purpose, it is desirable to investigate the commodity flow in detail, and to make up the tables of origin and destination. Thereafter, regional demand for international cargo transport is estimated on major items of export and import by above-mentioned pattern.

It is difficult to assume that the present pattern of regional distribution can be applied for the future without adjustment, but the changes are considered to be usually gradual. Our investigation based on present pattern, and modified cases are also calculated for check.

B. Study on proposed deepwater harbor sites based on transportation economics.

The investigation made clear that all the four sites are technically feasible and can reasonably be taken up as alternatives.

Thereafter, adaptability of each proposed site is divided by her locational characteristics as a deepwater port.

C. Natural conditions at the proposed deepwater harbor sites.

For the field oceanographic measurements, it is scheduled to be surveyed for the coming fiscal year, the items is listed as follows:

(1) Hydrographic survey: The deeper part from - 20M to - 30M or - 20M to - 40M need to be thoroughly surveyed. Since for the previous data, even nautical chart, there is not so detailly described.

(2) Coastal morphological investigation: The measurement includes the shoreline change, and topographic change of the nearshore area.

(3) Geotechnical investigation: Subsurface boring, soil sampling and foundation exploring are included.

(4) Wind, wave and current measurements: The offshore measurements are emphasized in each proposed deepwater harbor site.

(5) Coastal hydrology survey: The survey consists of measurements of water temperature, salinity, concentration, conductivity etc., for sufficiently analyzing horizontal & vertical distribution.

(6) Tidal records: This measurement need to be long-term records, at least one-year continuous record.

(7) Sea-bottom topographic change process: The survey need be detailly measured for realizing the deposition and scour around the proposed deepwater harbor sites, especially, for evaluating the littoral transport rate of the harbor sites.

(8) Seismic measurement: Geological distribution of deep layer of the sea-bottom need to be surveyed in detail. For complete seismic survey of the deepwater harbor sits, the design of breakwater and wharf could be carefully considered. The construction of those harbor structure will be safe.

From the above measurement and investigation, the natural conditions of the proposed deepwater harbor sites could be compared, the best conditions of the harbor site is then determined.

Referances

Ho-Shong Hou : " Research on the Development of Deep Water Port of Taiwan District " Annual meeting, 1985 J. of CICHE.
Dec. 1985

CEPD, executive Yuan, Taiwan, ROC "Port Development Study Taiwan" under Supervision of NEDECO Dec.1982.