1-5 Governmental Policy on Shipping

In accordance with the Government's policy of nationlizing major industries, the Pakistan Government decided the nationalization of ocean shipping industry, which provide an index to a nation's economic prosperity and play a vital role in promoting foreign trade. Management of 9 private shipping companies and 1 public shipping company (NSC) was taken over by the Federal Government on 1st January, 1974 in accordance with PAKISTAN MARITIME SHIPPING (REGULATION AND CONTROL) ORDINANCE. With more than the 50 percent of the stocks of NSC being held from the beginning by the Government, NSC continued to be managed by the Board of Directors appointed by the Federal Government. 9 private shipping companies were mergered into one Corporation and the PSC was established forming separate corporation with NSC, in accordance with the PAKISTAN MARITIME SHIPPING (REGULATION CONTROL) ACT 1974. The Federal Government is now taking further steps to unite NSC with PSC and to form PAKISTAN NATIONAL SHIPPING CORPORATION (PNSC).

1-6 Governmental Aid to Shipping

The Federal Government presently gives no direct aid to their national shipping. The only favorable treatment, which might be called as "aid", is that the initial depreciation of 30 percent of the purchase value of newly procured ships is allowed in the first year of installation under the Income Tax Act 1922 and thus payment of tax is deferred.

The legal depreciation term under the Act for newly built ship is 20 years and the same for second-hand ship is decided by the outstanding economic life time. The allowance is to be calculated on the original cost of the vessel and its special rates are as follows:

(1)	Newly built ships	5%
(2)	Second-hand age at the time of purchase	
	less than 10 years	10%
	10 years more	20%

This favorable method of initial depreciation is allowed on plants, machinery and on newly constructed buildings as well as on ships.

1-7 Fleet Replacement Plan in the FIFTH FIVE YEAR PLAN

In the FIFTH FIVE YEAR PLAN, US$2,354.3 million, 11.1% of the total investment budget is allocated to the transportation sector. US$472.1 million, 20% of the transportation sector budget is allocated to the shipping industry. The proposed investment progromme by type of vessels in the FIFTH FIVE YEAR PLAN and the composition of the fleet upon attainment of the plan at the end of 1982/83 are as follows:

TABLE 300 Investment Programme in Shipping

Type	Number	TDW	Cost (Million Rs)
General Cargo Ships	21	315,000	2,500
Passenger/roll-on-roll-off ships	3	15,000	250
Total	24	330,000	2,750

The Fleet Composition in 1982/83

Type	Age	Number	TDW	Disposition
Dry cargo vessels	0 - 15	25	375,000	Liner trade
- do -	16 - 19	16	200,000	Tramp trade
Ferries	0 - 15	3	15,000	Passenger/Ro-Ro
Total		44	590,000	

According to the fleet replacement plan prepared by PNSC which was submitted to the Federal Government on 23rd July, 1978, 28 overage ships (dry cargo ships and passenger ships) which exceed 16 years old in 1978 will have to be scrapped during the Fifth Plan period and are replaced with modern cargo vessels of 15,000 TDW according to a standard design. In view of the financial restraint the number of ships to be built is, for the time being, restricted to 16.

2 Merchant Fleet in Future

2-1 Past Performance and Operational Efficiency of Pakistani Fleet

2-1-1 Cargo Movement and Trade Share of Pakistani Flag Vessels (1977/78)

The sea-borne trade volume and the share of Pakistani vessels in respect of export/import and type of cargo in the transportation by sea are as follows according to the analysis made in the previous chapter.

Table 301 Cargo Movement and Trade Share by Export/Import in 1977/78

	Pakistani vessels		Foreign vessles		Total	
	(1,000K/T)	(%)	(1,000K/T)	(%)	(1,000K/T)	(%)
Export	380	42/13.4	2,460	23/86.6	2,840	25/100
Import	533	58/6.1	8,192	77/93.9	8,725	75/100
Total	913	100/7.9	10,652	100/92.1	11,565	100/100

Remarks: (1) Afghan cargoes in transit are excluded.

(2) Source: Table II-13

Table 302 Cargo Movement by Type of Cargo and by Export/Import in 1977/78

	Export		Import		Total	
	(1,000K/T)	(%)	(1,000K/T)	(%)	(1,000K/T)	(%)
General cargo	822	28.9	2,077	24.2	2,899	25
Dry bulk	806	28.4	1,660	19.8	2,466	21
Liquid bulk	1,212	42.7	4,988	56.0	6,200	54
Total	2,840	100	8,725	100	11,565	100

Remarks: (1) Afghan cargoes in transit are excluded.

(2) Source: Table II-4

Table 303 Assessed Trade Share by Export/Import and by Type of Cargo in 1977/78

	Total Export & Import (1,000K/T)	Trade Share (%)	Pak.Flag Liftings Total (1,000K/T)	Pak.Flag Liftings Export (1,000K/T)	Pak.Flag Liftings Import (1,000K/T)
General cargo	2,899	*28	*811	*340	*471
Dry bulk	2,466	*4	*102	*40	*62
Liquid bulk	6,200	-	-	-	-
Total	11,565	7.9	913	380	533

Remark: (1) Afghan cargoes in transit are excluded

(2) Figures with * is assessed one through the analysis of available data.

2-1-2 Operational Efficiency of Pakistani Fleet in 1977/78

The oeprational efficiency of Pakistani fleet which is estimated by the application of the tonnage seemed to have been engaged for the carriage of respective type of cargo is as follows:

Table 304 Average Yearly Number of Round Voyages Performed in 1977/78

Type of Ship	Type of Cargo	Total Liftings (1,000K/T)	Tonnage Engaged (1,000TDW)	Weight Basis Pay-Load Factor (%)	Number of Round Voyages per Year
Liner & tramper	General cargo	471	460	60	1.7
	Dry Bulk	102	100(50)	90	2.3
Total			560		

Remarks: The tonnage engaged per respective field is calculated from Tables III-1-1, III-1-2 and III-1-3.

The method of calculation to prepare the above Table is as follows:

(1) Only the import general cargoes, which is larger than that of export cargoes are being taken into consideration for the calculation of the performance as the same vessel can load both exports and imports on her round trip.

(2) As to the transportation of Dry Bulk Cargoes, the both export and import cargoes are taken into consideration for the calculation on the assumption of the vessel sailing in ballast on one way and export and import being transported by different vessel.

(3) The cargo of Liquid Bulk is not considered here, because Pakistani fleet has no tanker.

(4) Weight basis pay-load factor, which means the utilization ratio of the available carrying capacity in deadweight ton which can be obtained by deducting 10% out of the total deadweight tons, for both liner and tramper, to reserve the total weight of fuel oil, fresh water, stores and provisions and the vessels constant weight.

In case of liner, weight basis pay-load factor is calculated on the assumption of about 60% considering the past records of the conventional liners in the world.

(5) One half of the tramper fleet is taken into consideration as the Pakistani tramp vessels were often chartered out to foreign shipping companies.

(6) Number of voyages per year is calculated by the following formula:

$$\text{Number of round Voyages per Year} = \frac{\text{Total Liftings}}{\text{Tonnage engaged} \times \text{Weight Basis Pay-Load Factor}}$$

Table 304 shows that the operational efficiency of the Pakistani vessels has been markably low. This is also proved from the yearly round voyage performance in the major trade routes (UK/Continent, Asia, USA/Canada) in which comparatively younger ships are allocated. The record in the first half of 1978 is shown as follows:

Number of days required for one round voyage in major trade routes (A)	:	149 days (average)
Average number of days required for repairs (B)	:	30 days
Average number of days in operation per year (C)	:	335 days
Average number of round voyages per year (A)/(C)	:	2.24

2-2 Merchant Fleet to Cope with Future Transportation Requirement

2-2-1 Forecast of Trade Volume in 1978/79 and in 1982/83

The estimated cargo movements by type of cargo in 1978/79 and 1982/83 are respectively mentioned as follows:

Table 305 Trade Volume by Type of Cargo in 1978/79 and 1982/83

Type of Cargo	1978/79		1982/83	
	(1,000K/T)	(%)	(1,000K/T)	(%)
General cargo	3,118	25	3,705	23(20)
Dry bulk	2,854	21	4,332	27(23)
Liquid bulk	6,510	54	7,913	50(43)
Ore & coal for steel mill	-	-	(2,630)	(14)
Total	12,482	100	15,950 (18,580)	100(100)

Remarks: (1) Above table is prepared from Table 205, case 2.

(2) Figures in ( ) indicate ore & coal for steel mill.

2-2-2 Forecast of Trade Share in 1982/83

The trade share and the transportation requirement in the year 1982/83 are predicted in the following table, where the reasonable target of the trade share in general cargoes of Pakistani vessels could be set at 35% considering various factors surrounding the National Line. The liftings of Dry Bulk and Liquid Bulk by Pakistani flag vessels in 1982/83 could be set at about 600,000 K/T and 2,700,000 K/T respectively (these figures are studied in the subsequent sections in conjunction with fleet composition.).

Table 306 Prediction of Trade Amount in 1982/83

Type of Cargo	Type of Ship	Estimated Trade Volume (1,000K/T)	Trade Share of Pakistani Fleet (%)	Transportation Requirement (1,000K/T)
General cargo	Liner & tramper	3,705	35	1,297
Dry bulk	"	4,332	14	600
Liquid bulk	Tanker	7,913	34	2,700
Ore & coal	Bulk carrier	3,212	20	642
Total		19,162		5,239

Remarks: (1) In case of the trade share of Pakistani vessels in general cargoes is set at 28%, transportation requirement is 1,037 (10^3K/T) and in case 40%, 1,482 (10^3K/T).

(2) The figures for ore & coal are on the assumption that The Steel Mill starts operation in 1980/81 as scheduled.

At present, owing to the extreme inclination into liner business, although the trade share of general cargo is estimated as 28% but that of dry bulk is estimated as only 4%. It would be more advantageous for Pakistan to own well-balanced fleet so that it could enter more evenly into every sector of shippings which have close relations with all the industries in the country. In the above table, the target figures for tramp vessels and bulk carriers are set at low value as these are based on the considerably low past records. It is to be noted, however, that the importance in these sectors is nothing inferior to that in general cargoes even though the percentages are low.

2-2-3 How to Cope with Present and Future Transportation Requirement

(1) Comparison between the Carrying Capacity by the Existing Fleet and Future Trade Volume

The existing carrying capacity on the basis of existing fleet and its operational efficiency, are compared with the

predicted demands for the transportation of General Cargoes and Dry Bulk Cargoes in Table 307. In order to maintain present trade share of Pakistani fleet, the tonnage for general cargoes would be short by 232,000 TDW and ones for dry bulk would be excess by 14,000 TDW, on the assumption that the oeprational efficiency would not be worsened.

Table 307 Demand and Supply based on Existing Fleet

Type of Cargo	Trade Volume in 1982/83 (1,000K/T)	Trade Share of Pakistani Fleet(%)	Transportation Requirement by Pakistani Fleet (1,000K/T)	Round Voyages per Year	Required Tonnage (1,000TDW)	Existing Tonnage (1,000TDW)	Balance (1,000TDW
General Cargo	3,705	28	705	1.7	692	460	-232
Dry Bulk Cargo	4,332	4	178	2.3	86	100	14
Total	7,481	-	852	-	778	560	-218

Remarks:

1) Export/import composition of the Pakistani fleet for general cargoes obtained in Chapter II is 35/65 in the routes of U.K./ Continent and Asia and 15/85 in the rute of U.S.A./Canada. The average figure in three routes, namely 32/68, is applied to the above calculation. As to Dry Bulk, it is based on the assumption that whole cargoes are for import.

2) The calculation formula is as follows:

$$\text{onnage alance} = \text{Existing tonnage} - \frac{\text{Trade Volume} \times \text{Trade Share} \times \text{Ratio of Import}}{\text{Round Voyages per Year} \times \text{Weight Basis Pay-load factor}}$$

3) Weight basis pay-load factor for the generla cargo vessel of 60% and for dry bulk carrier of 90% are respectively applied quoting from Table 304 Remarks 4). Number of round voyages is quoted from the same table.

4) The existing tonnage is quoted from Table 304.

(2) Estimation of Tonnage Demand and Supply on the Basis of the Newly Built Vessels.

The operational efficiency of liners and trampers has been showing marked deterioration as studied in Chapter III-2-1-2 and it would be necessary to replace the old vessels by newly built ones by scrap and build. With the entry of newly built cargo ships into the fleet, the improvement in quality of fleet and consequential improvement of the operational efficiency can be expected. The average number of round voyages per year upon the completion of replacement plan would amount to 3.2. The national line has no bulk carrier nor tanker at present, but procurement of the both should be considered, in order to meet the demands in 1982/3.

Table 308 Demand and Supply based on the Newly Built Vessels

Type of Vessels	Type of Cargo	Trade Volume (1982/83) (1,000K/T)	Trade Share of Pakistani Fleet (%)	Transportation Requirement for Pakistani Fleet (1,000K/T)	Round Voyages per Year (1982/3)	Required Tonnage (1,000TDW)
Liners & Trampers	General Cargo	3,705	35	882 (1,297)	3.2	394
-do-	Dry Bulk	4,332	14	600	5	129
Tankers	Liquid Bulk	7,913	34	2,700	36	90
Bulk Carriers	Ore & Coal	2,630	20	526	10	60
Total		18,580		5,123		673

Remarks:

1) The ratio between export/import of general cargo is estimated to be 32/68 and the one of other cargoes is 100% in each single voyage.

2) The round voyages per year per liner vessel in the above table is the one in major trade routes in 1982/83 quoted from Table III-3. The same for trampers, tankers, bulk carriers are respectively projected in consideration of the origin of cargoes.

3) Required Tonnage

$$= \frac{\text{Trade Volume} \times \text{Trade Share} \times \text{Ratio of Import}}{\text{Round Voyages per Year} \times \text{Weight Basis Pay-Load Factor}}$$

4) The weight basis pay-load factor is considered to be 70% for general cargo vessels and 90% for other types of vessels. The above table intends to show the required tonnage in case the demand for tonnage is to be covered by the newly built vessels.

(3) Summary

The shortage of tonnage through the comparison between the carrying capacity by the existing fleet and the requirement for transportation in 1982/83 is reckoned in the previous paragraph (1). The scale and composition of Pakistani fleet to be rehabilitated or newly created to meet demand in 1982/83 is examined in the paragraph (2).

As can be seen from Tables 307 and 308, it is quite clear that the existing fleet would not satisfy the demand in 1982/83. Furthermore, considering the further deterioration of the fleet as getting older, it would be almost impossible to maintain even the present trade share and could not survive the severe international competition.

In conclusion, these obsolete vessels should be replaced by the new most modernized general cargo vessels to build up a more efficient fleet.

2-2-4 Direction of the Fleet Modernization

Consideration should be given to procure such a well-balanced fleet as to meet the trade volume and the kinds of cargoes of Pakistan.

With such understanding, the means how to modernize the existing fleet will be studied hereunder in consideration of the shortage of the tonnage and the object of the fleet composition.

The following steps of examinations are taken:

(1) The carrying capacity in 1982/83 with selected available vessels in 1982/83 out of the present fleet, based on the analysis into the composition of the present fleet, tonnage and its operational efficiency.

(2) Operational efficiency of the fleet shall be improved by placing newly built vessels which have corresponding carrying capacity to those of the old vessels to be scrapped out because of their overage and deterioration.

(3) It might be unavoidable for Pakistan for the moment to put more weight on the transportation of general cargoes, a leading sector of Pakistani shipping, considering the possible restriction due to the financial restraint to implement the modernization of their entire fleet.

(4) Although the priority might be given to the transportation of general cargoes, the procurement of dry bulk carriers and liquid bulk carriers should not be neglected.

(5) Fleet modernization can be achieved in several ways such as purchase of newbuildings, second-hand vessels, or by chartering. It would be rather difficult to find out suitable second-hand vessels for the use in liner trades.

Purchase of modern cargo vessels according to a standard design to be constructed in series would be the best solution, considering the presently prevailing international price level for newbuildings. These sister-ships can also be built in KSEW and this would bear really significant effect in encouraging the domestic industries.

2-2-5 Sellection of Available Vessels for Liner and Tramp Services

The fleet disposition in 1982/83 can be predicted as follows:

(Refer to Tables III-1-1 to III-1-3)

Table 309 Fleet disposition in 1983

Age in 1983	Number	TDW(K/T)	Remarks
0 to 15 years	12	164,000	Ships built after 1968 coaster excluded
16 to 19 years	10	128,700	Ships built between 1964 and 1968
20 years and above	22	226,800	Passenger/cargo ships excluded

It is difficult to select still available vessels for liners and/or trampers in and after 1983, from the available data only as it requires to carryout each vessel's detailed site inspections. Generally speaking, the vessels not exceeding 20 years old are deemed still available as trampers unless serious defect can be find out. Therefore, 22 vessels (292,700 TDW) out of the above vessels could be judged still available as liners and/or trampers. Efficient vessels among those of less than 15 years old (12 vessels in total), can be deemed still available as liners. Ships over 20 years old (22 vessels in total, about 266,800 TDW) might be placed on the list for scrapping.

2-2-6 Required Tonnage for General Cargo Vessels

(1) Predictions on Macroscopic Viewpoint

The required newly built vessels tonnage and required total tonnage of the fleet will be calculated hereunder, considering the scale of the vessels still available out of the present fleet as liners and/or trampers in 1983, although in previous paragraph, Table 308, the same study has been

made on the premise that all the ships engaged in transport of the general cargoes have equal efficiency to the new-buildings.

Table 310 Trade Volume of General Cargo

Volume of General Cargo (1982/83) (1,000K/T)	Liftings by Pakistani Fleet (Share: 35%) (1,000K/T)	Import Cargo (1,000K/T)
3,705	1,297	882

Table 311 Estimated Liftings by Old Ships

Old Ships Tonnage Available for General Cargo (1,000 TDW)	Number of Annual Voyage	Weight Basis Pay-Load Factor (%)	Total Liftings (1,000 K/T)
200	2.5	70	350

Table 312 Required Newly Built Vessels Tonnage

Volume of Cargo to be Carried by the Newly Built Vessels (1,000 K/T)	No. of Annual Voyages	Weight Basis Pay-Load Factor (%)	Required Tonnage (1,000K/T)	No. of Vessels to be Newly Built (15,000TDW)
532	3.2	70	238	15.9

Above calculation are based on the following assumptions:

1) The trade share of Pakistani fleet and the ratio between export and import are the same figures as used in the previous chapter.

2) The scale of old ships to be engaged in the transport of general cargoes is calculated at 200,000 TDW, 68% of the estimated total tonnage of old ships in previous paragraph III-2-2-5.

3) The average yearly number of voyages to be performed by old ships is estimated at 2.5 voyages on the premise that the assessed poor past performance of 1.7 voyages/year, would be improved by scrapping old ships of low efficiency and also the berthing delays at Karachi port would be eased.

4) The weight basis pay-load factor is estimated to be 70%.

The number of new vessels required in the cases of the trade share being 28% (present level) and being 40% (national target level) can be calculated as follows:

In case of the share of 28% .... 10.6 ships
In case of the share of 40% .... 19.6 ships

Table 313

Trade Share (%)	No. of Ships to be Built	Tonnage of New-buildings (1,000TDW)	Tonnage of Old Ships (1,000TDW)	Total Required Tonnage (1,000TDW)
28	11	165	200	365
35	16	240	200	440
40	20	300	200	500

(2) Forecast by Trade Route

In the preceding paragraph, estimation on the macroscopic view has been made on the required tonnage and the required number of newbuilding vessels on the basis of the trade volume of general cargoes. The required number of vessels to be built by trade route would be predicted considering the forecast of the cargo movements by trade route.

The main trade routes are U.K./Continent, Asia, and U.S.A./Canada which are the most important from the view point of the cargo movements. The processing of the prediction is based on the following assumptions:

1) Tonnage of old ships available for continuous use together with newly built vessels

In accordance with the study in the preceding paragraph 2-2-5, the following bottoms of the less aged and considerably efficient vessels in the existing fleet are premised to be available.

Number of ships: 8

Tonnage: 113,200 KT (39% of estimated available tonnage)

Remarks: The above tonnage is based on the vessels built later than 1970 and the vessels of more than 13,500 TDW, built later than 1968.
(Refer to Tables III-1 to III-3)

2) Efficiency of old vessels available for continuous use

The efficiency of old ships could be gained as follows on the premise that heavy port congestions at Karachi port would be eased in 1982/83.

Table 314 Number of Round Voyages per year

Trade Route	No. of Round Voyages per Vessel Year	Average Cargo Liftings on Homeward Voyage (R/T)
U.K./Continent	2.5	15,000
Asia	2.8	15,000
U.S.A./Canada	2.2	15,000

Remarks:

The above number of round voyages per year is based on the assumptions that the old vessels would be engaged in the short distance transportations on three major routes, as the existing old ships performance in three trade routes is 2.2 voyages/vessel/year, is inefficient in comparison with newbuildings, and also the present congestion at Karachi port would be eased.

3) Efficiency of newly built vessels etc.

The newly built vessels would be 15,000 TDW class, the most modernized general cargo vessels in accordance with the analysis result of the subsequent paragraph III-3 and their efficiency is estimated as follows:

Table 315 Number of Round Voyages per Year

Trade Routes	No. of Round Voyages/Vessel·Year	Average Cargo Liftings on Homeward Voyage (R/T)
U.K./Continent	3.23	15,000
Asia	3.16	16,000
U.S.A./Canada	3.28	15,000

Remarks:

Number of round voyages and average cargo lifting in 1982/83 are cited from Table III-10.

4) Ratio of export/import by trade route

The ratio of export/import and and the ratio of freight tons/weight tons are as follows in accordance with preceding chapter.

Table 316 Ratios of Import/Export and of Freight Ton/Weight ton

Trade routes	Ratio of Export/Import Carried by Pakistani Fleet	Ratio of Freight Ton/Weight Ton (R/T) / (K/T)
Continent	35 : 65	70 : 100
Asia	35 : 65	70 : 100
North America	15 : 85	70 : 100

Table 317 Required Number of Vessels to be Newly Built to maintain the present Trade Share of 28%

Route	U.K. Continent	Asia	U.S.A./ Canada	Total
Cargo Liftings by Pakistani Fleet (1,000 K/T)	397	353	132	882
Amount of Cargoes carried by Pakistani Fleet on Homeward Voyage (1,000 R/T)	369	328	160	857
Number of Old Ships in Service (Estimated)	3	3	2	8
Carrying Capacity of Old Ships (1,000 R/T)	113	126	66	305
Amount of Cargoes carried by Newly Built Vessels (1,000 R/T)	256	202	94	552
Required Number of Newly Built Vessels (Calculated)	5.3	3.9	1.9	-
Required Number of Newly Built Vessels	6	4	2	12

Table 318 Required Number of Vessels to be Newly Built to meet the Trade Share of 35%

Route	U.K./ Continent	Asia	U.S.A./ Canada	Total
Cargo Liftings by Pakistani Fleet (1,000 K/T)	496	441	165	1,102
Amount of Cargoes Carried by Pakistani Fleet on Homeward Voyage (1,000 R/T)	461	410	200	1,071
Number of Old Ships in Service (Estimated)	2	4	2	8
Carrying Capacity of Old Ships (1,000 R/T)	75	168	66	309
Amount of Cargoes carried by Newly Built Vessels (1,000 R/T)	386	242	134	762
Required Number of Newly Built Vessels (Calculated)	8.0	4.8	2.7	
Reuqired Number of Newly Built Vessles	8	5	3	16

Table 319 Required Number of Vessels to be Newly Built to meet Trade Share of 40%

Route	U.K./ Continent	Asia	U.S.A./ Canada	Total
Cargo Liftings by Pakistani Fleet (1,000 K/T)	567	504	189	1,260
Amount of Cargoes Carried by Pakistani Fleet on Homeward Voyage (1,000 R/T)	427	468	216	1,111
Number of Old Ships in Service (Estimated)	3	4	1	8
Carrying Capacity of Old Ships (1,000 R/T)	113	168	33	314
Amount of Cargoes carried by Newly Built Vessels (1,000 R/T)	414	300	183	897
Required Number of Newly Built Vessels (Calculated)	8.5	5.9	3.7	-
Required Number of Newly Built Vessels	9	6	4	19

The summary of the above talbes is as follows:

Table 320 Allocations of Vessels by Route

Case No.	Trade Share in 1982/83 (%)	U.K./ Continent		Asia		U.S.A./ Canada		Total	
		NB	OS	NB	OS	NB	OS	NB	OS
1	28	6	3	4	3	2	2	12	8
2	35	8	2	5	4	3	2	16	8
3	40	9	3	6	4	4	1	19	8

Remarks:

1) Abbreviation NB: Vessels to be newly built
OS: Old Ships

2) Estimated cargo liftings by Pakistani fleet in each case is derived from analysis result in preceding chapter. (See Tables 215(1), 215(2) and 215(3))

It is to be noted that the above estimation is based on the assumption of smooth vessels operation and is subject to change due to (1) seasonal fractuations of cargo canvassing and (2) physical port conditions at home port and in other countries etc. However, considering the resultss of preceding evaluations and also that considerable volume of cargo may be carried by trampers, the transport of general cargoes in each case would be covered by the comparatively young 8 - 12 existing vessels together with the above estimated newly built ones.

(3) Required Number of Vessels to be Newly Built

The realistic maximum target of the trade share of general cargoes could be set at 35% as mentioned in the preceding chapter II-4-2, considering (1) estimated growth rate of general cargo movements, 4.4% per annum in average, (2) present cargo canvassing network, and (3) various restrictions imposed by the relevant Shipping Conferences. Therefore, it is modeste to adopt the above 35% as trade share of Pakistani vessels to be achieved by the last stage of the 5th 5 year plan period. Under the circumstances, the required number of vessels to be newly built can be indicated to be 16 as the moderate figures which also would be justified from the view point of effect of investments as mentioned in Chapter V. In conclusion, the Pakistani fleet composing from liners including semi-liners and trampers which shall be engaged in transport of general cargoes may be shown as follows:

Table 321 Composition of General Cargo Vessels

Newly built ship	16 ships	about 240,000 TDW
Old ships	8-12 ships	about 113,200-164,000 TDW
Total	24-28 ships	about 353,200-404,000 TDW

The considerable portion of the semi-bulk cargoes, the share of which seems to be 4% at present, is supposed transported in bale by the liners and/or trampers. The available tonnage for the carriage of Semi Bulk Cargoes are estimated as follows (See paragraph III-2-2-5).

Numbers and tonnage of trampers: 10 vessels
(about 128,700 DWT)

Further detailed consideration about trampers for the exclusive use of the Semi Bulk Cargoes will be given in Chapter III-2-2-8. As the tonnage as above mentioned exceeds the estimated present fleet scale of about 50,000 TDW engaging in the carriage of Semi-Bulk Cargoes, it is considered that Pakistani fleet has sufficient tonnage to maintain the present trade share in this field. Therefore, even if overage ships are scrapped, there seems to have no difficulties in maintaining the target share of General Cargoes (35%) and the present trade share of the Semi-Bulk Cargoes.

Under the circumstances, in keeping pace with taking delivery of newly built vessels, 22 overage ships (about 266,800 TDW) could be scrapped.

2-2-7 Liner Fleet

The studies concentrated in liners will be made hereunder, following the estimations on the required tonnage for the transport of general cargoes by liners and trampers in the preceding paragraph III-2-2-7.

Table 322 Number of Ships Required to Maintain the Present Sailing Frequencies in the Three Main Trade Routes

Trade Route	Sailing Frequencies per Year	Round Voyages per Vessel/ Year	Required No. of Vessels (calculated)	Required No. of Vessels
U.K./Continent	30	3.23	9.3	10
Asia	18	3.16	5.7	6
U.S.A./Canada	18	3.28	5.5	6
Total	66		20.5	22

Remarks:

Above calculation is based on the following assumptions:

1) Ships in service are premised to be all newly built ones.

2) The number of round voyages per vessel/year is cited from the preceding paragraph III-2-2-6.

Comparing the required number of ships as above mentioned and the results of the required tonnage by trade route in 1982/83 in preceding paragraph III-2-2-6 case (2), the liner fleet by trade route would be composed as follows:

Table 323 Liner Fleet in 1982/83

Newly built ships	16	(about 240,000 DWT)
Old ships	8	(about 113,200 DWT)
Total	24	(about 353,200 DWT)

The allocations of new and old liner vessels in 1982/83 by trade route would be plotted as follows.

Table 324 Allocation of New and Old Liner Vessels by Route in 1982/83

Trade Route	No. of Newly Built Vessels	No. of Old Ships	Total
U.K./Continent	8	2	10
Asia	5	4	9
U.S.A./Canada	3	2	5
Total	16	8	24

In order to maintain the present sailing frequencies in 3 main trade routes, 1 or 2 additional old ships could be allocated to U.S.A./Canada route.

2 or 3 ships out of 4 ships in Asia route would be used as liners in short distance transportations other than Far East route.

2-2-8 Fleet of Trampers (Semi-Bulk Cargoes), Bulk Carriers and Tankers

(1) Tramper

The majority of Pakistani fleet is engaged in the transportation of general cargoes as liners and trampers, however, the tramper fleet being solely engaged in carrying Semi-Bulk Cargoes is limited to about 100,000 TDW only and substantial number of the vessels are chartered out to the foreign shipping companies. In 1977/78, the quantities of such Semi-Bulk Cargoes such as fertilizer, wheat, rice and etc. carried by trampers show about 810,000 tons in imports and about 1,770,000 tons in exports, the total figures of which come up to about 2,580,000 tons.

However, it is revealed that only about 100,000 tons out of the above total figures was the carriage by the Pakistani flag including those carried by liners. The rest was carried by foreign flags. The volume of Semi-Bulk Cargo Movements is not negligibly small, as shown in the results of the study about anticipated Dry Cargo Movements, in the previous Chapter.

In the meantime, the existing fleet for Semi-Bulk Cargoes transportation is consisting of such older vessels as those dropped from liners and are so called general cargo vessels from view point of the type of the vessel. Therefore, those vessels are not suitable for the most efficient loadings and unloadings of the Dry Bulk Cargoes but suitable for the transportations of such cargoes as bagged rice, which is the main export commodity of the country. The share in volume to be lifted by the existing fleet would be as shown in Table 325.

Table 325 Predicted Trade Share of Dry Bulk in 1982/83

No. of Trampers	Tonnage (TDW)	No. of Voyages per Year/ Vessel	Pay-Load Factor (%)	Carrying Capacity (1,000K/T)	Estimated Cargo Movements in 1982/83 (1,000K/T)	Trade Share (%)
10	128,700	5	90	600	4,332	14

Note:

(i) Number of voyages per vessel/year is the one estimated taking into consideration of the improvement in operational efficiency.

(ii) Anticipated cargo volume is those shown in chapter II (Table 205).

(iii) All tramp vessels are assumed shall be engaged for the transportation of the Pakistani maritime cargoes and not to be chartered out.

(2) Bulk Carriers for KARACHI STEEL MILL

The necessary fleet for the transportations of raw materials for KARACHI STEEL MILL, which is now under the construction, should be made in keeping pace with the construction of the STEEL MILL, the port facilities and the transportation requirements of the necessary raw materials for the said steel mill. Upon completion of the above mentioned steel mill and all facilities concerned, the volume and route of transportation shall be fixed unless some unpredictable causes should affect this line of business. Therefore, the size of vessel to be engaged in such fixed pattern of transportation, should be as big as possible within the physical limit of facilities of ports and harbors from the viewpoint of the operational profitabilities.

1) The Size of the Vessel:

The suitable size of the vessels which shall be exclusively engaged in the abovementioned transportations. would be 60,000-85,000 TDW class, considering the depth of approaching channel and facilities of Qasim Port when they are completed as per the original plan.

The raw materials for this steel mill will be iron ore (abt. 70%) and coal (abt. 30%) both of which must be imported simultaneously. Therefore, the recommendable type of the vessel should be combination carrier of both ore and coal from view points of efficient transportations, which seems better than those of either exclusive iron ore carrier or coal carrier.

2) Necessary Tonnage:

The scale of the bulk carrier fleet are as shown below in order to keep 100% trade share of these cargoes by the national fleet.

Table 327 Scale of Bulk Carriers for Karachi Steel Mill

Imports of Raw Materials to meet Full Operation of the Steel Mill; (Figures from the previous chapter)	about 3,222 (1,000 K/T)
No. of voyages per vessel/year (Based on the assumption that raw materials being imported from Australia)	10 (voyages)
Necessary tonnage	350,000/400,000 (TDW)

3) Counter-measure at present:

If the Karachi Steel Mill is expected to come into partial operation in 1980/81, it will be necessary to acquire the required chartered vessel on long-term contract basis in good timing. Constant market research, particularly those for handy size bulk carriers, would be required.

Preparing for the comming their own bulk carriers operation, it would be better still if the present depressed market opportunity is seized to acquire a few second-hand bulk carriers (say 50,000 TDW class) in order to get

operational and commercial experience as the Steel Mill goes into full operation and tonnage of raw materials are increased.

(3) Tanker Fleet:

All the transportations of crude oil and petroleum products are entirely depend on the foreign vessels as Pakistan has no tanker at present. The total amount of foreign currency being paid out for foreign tanker fleets seems just run up to around US$10 million.

In view of the importance of the transportation like this indispensable cargo for the national economy, it would be most desireable to switch the substantial portion of its transportation by their own vessels.

1) Types and Sizes:

The operation of tankers for curde oil (including petroleum products in low quality) would be recommended. Among the cargoes for the tankers other than crude oil, the oil products which accounts for about 15% of the total petroleum cargo volume.

As to the size of the tankers for Pakistan, the easy operational medium size tankers of 70,000 TDW class are recommendable by the following reasons, than those of bigger size:

(1) Most crude oil is imported from the neighbouring countries in Arabian Gulf, and it does not require long distance run.

(2) Facilities of Karachi Port, including oil storage facilities are not enough to accommodate more bigger size tankers.

2) Required Tonnage

To secure the target trade share, the study shows the figures in the table below, based on the transportation of crude oil only and the petroleum products are not taken into consideration as its movement by route is unascertainable.

Table 328 Required Tonnage of Tankers

Trade Amount of Crude Oil (1,000K/T)	Pakistani Share of 75% (1,000K/T)	No. of Voyages per Year/Vessel	Pay-Load Factor	Required Tonnage (1,000TDW)
3,600	2,700	36	90	83

Assumption:

(1) All crude oil is to be imported from neighbouring countries in Arabian Gulf.

(2) The quantity of oil to be imported is calculated based upon those in 1982/83.

(3) Number of voyages per vessel is based on three voyages per month.

The above study proves that necessary tonnage is a little over one vessel of 70,000/75,000 TDW.

2-2-9 Projected performance of New 15,000 TDW General Cargo Vessels

(1) Pattern of Operation

The newly built vessels are to be allocated on the three main routes, U.K./Continent, Asia and U.S.A./Canada.

(2) Calculations of Loss & Profit for 20 Years

Based upon the present value, the financial review for 20 years (lawful durable years in Pakistan) is tried under the following conditions.

1) Cargo liftings

The average cargo liftings for each round voyage in the first year is based upon the actual results in 1977 and until the 11th year it shall be increased with a little more than 1 percent growth rate per annum and after that it shall be diminished gradually.

2) Cargo Handling

Cargo handling capacity per day is raised by 20 percent from the actual results of the existing liners and it shall be increased gradually until the 7th year, then shall be left unredeemed, further shall be diminished after the 15th year.

Accordingly, necessary cargo handling days are calculated in the way what the cargo quantity per each voyage should be divided by cargo handling capacity per day.

3) Days lost for waiting berth

Expecting the improvement of port conditions at Karachi Port, the voyage delays for waiting berth is diminished by 2 days per year until the 6th year, then shall be left unredeemed, further shall be increased by 1 day per year after the 15th year. The oepration speed of the ship in the 1st year is 16 knots, then shall be diminished graudually.

4) Days required for annual survey & special survey

Necessary period for annual survey & special survey at the first time are 5 days and 10 days respectively, then shall be increased gradually due to deterioration of the vessel.

5) Freight rate

Average freight rate of respective service in the 1st year is based upon the actual results in 1976/77, then shall remain static.

6) Operating expenditure for cargo handling, port charges, crew wages & miscellaneous expenses.

Operating expenses for cargo handling, port charges, crew wages & miscellaneous expenses are based upon the actual results in 1976/77 and shall remain static.

7) Ship's stores, spare parts & repairing expenses

Ship's stores, spare parts & repairing expenses are based upon the actual results in 1976/77, then shall be increased gradually due to deterioration of the vessel.

8) Fuel consumption & banker price

Fuel consuptions per day on sea are assumed as follows:

Diesel Oil : 2.4 KT
Heavy Oil : 30.8 KT

Fuel consuptions per day in port are as follows:

Diesel Oil : 3.9 KT (working days)
Heavy Oil : 1.5 KT (no working days)

Bunker Price

Diesel Oil : U.S.$130.-/KT
Heavy Oil : U.S.$ 80.-/KT

The above-mentioned price shall remain static.

9) Agency fee

The agency fee is 5 percent of total freight revenue and shall remain static.

10) Insurance fee & claim

Hull & Machinery	U.S.$118,000.-
P & I	U.S.$137,000.-
Claim	U.S.$ 25,000.-
Total	U.S.$280,000.-

The above-mentioned fees are based upon the actual results in 1976/77 and shall remain static.

(3) Estimation of Loss & Profit by Route

The estimation of loss & profit in each route in accordance with the above-mentioned premises is as per Charts III-10 to III-12. The order of profitability is as follows:

1st ..... U.K./Continent Route
2nd ..... U.S.A./Canada Route and
3rd ..... Asia Route

The average freight rate in Asia Route is based upon the actual results of N.S.C. in 1976/77. Even considering the unstable situation in the subject route and the low freight revenue derived from the cargoes taken at several way ports, the said average freight rate seems to be too low. However, the study could not but to use the data presented by N.S.C. With respect to the details of the estimated effects of the investments for shipping, based upon the above-mentioned projection, please refer to Chapter V.

3. STUDY OF SUITABLE TYPE OF SHIP FOR LINER SERVICE

3-1 Introduction

The suitable type of ship for the reinforcement of Pakistan's national fleet is studied in view of regular liner service exclusively, for which a necessity of replacing aged ships has urgently been felt by all the people concerned.

3-2 Type of Ship

Ships are roughly divided in terms of cargo carrying mode into two categories, i.e. specialized ship and generalized one.

As for the transportation of general cargoes, a specialized ship is a full container ship, while a generalized one is the so-called general cargo ship.

A full container ship can enjoy a higher transportation efficiency than a general cargo ship of an ordinary type, although in the former case the establishment of the related infrastructure of transportation in ports and inland areas is indispensable to the complete functioning of the whole system.

On the other hand, a general cargo ship has an advantage of transporting much more varieties of general cargoes without any special facilities to be added in ports and inland areas.

According to the analysis on current cargo movements, cargo collecting capacities and port and inland transport facilities, an employment of full container ships for the transportation of general cargoes seems to be rather premature in Pakistan within the period of the Fifth Five Year Plan, and, it has better count on further investigations. Consequently, the types of ships to be recommendable for the fleet improvement for the time being should be nothing but general cargo ships in a short term view up to 1983 or so.

In view of specific cargoes to be handled, various points should be taken into consideration for respective kinds of cargoes as enumerated hereunder.

(1) General sundry cargoes (Machines and instruments, chemical products, textile goods, agricultural and stock-farming products, rubber products, hide and leather products, paper, daily sundry goods, etc.)

These cargoes are considered to be most profitable for freight revenue, and therefore the containerization in the future can be most likely to occur for these cargoes.

As aforementioned, a hasty take-off in containerization is not recommendable from a practical viewpoint, so it naturally follows that these cargoes have to be transported by means of conventional cargo transport systems for the time being.

In order to improve the present cargo handling efficiency, however, the type of ship and its general arrangement (including cargo gears) should be such that will enable it to handle these kinds of cargoes having been unitized to a greater extent than in traditional transportation systems.

(2) Long-sized cargoes and heavy cargoes

The transportation demand for these cargoes can be expected to grow up in proportion to an increase of industrial investments. In view of this, the intended ship should preferably be of such type as can deal with these cargoes to the greatest extent and furthermore expand its applicability to as many varieties of cargos as possible.

(3) Bale cargoes and bulk cargoes

These cargoes can be taken in even by a general cargo

ship of a conventional type, requiring no special consideration.

(4) Liquid cargoes (excl. petroreum)

These cargoes, if canned in drums, can be dealt with in the same way as in the case with general cargoes. In case sufficient and steady movement of these cargoes can be expected, it might be noteworthy that the ship had better be fitted with special tanks for the exclusive use of liquid cargoes.

3-3 Ship Size (DW) and Speed

The ships now placed on main liner routes consist mainly of 12,500 to 13,500 TDW ships designed for nominal speeds of 16 to 17 knots (cf. Table 380). On some of such routes, these ships are usually operated in the full load condition.

In view of the above, the size of ships suitable for the fleet replacement plan are desired to be at least larger than the prevailing range by all means.

The evaluation in terms of ship size and speed is carried out on the basis of the assumed specification of the most modernized multi purpose general cargo ships i.e. of 13,000 TWD (a popular size at present), 17,000 TDW (a comparatively larger size for general cargo ship) and 15,000 TDW (an intermediate size between the above two).

Particulars of the said sample models are shown in Tables 381(1) to 381(4).

As a criterion for the evaluation, an operation cost necessary to transport one K/T cargoes (hereinafter called marginal freight rate) is used, assuming that the span of economic life of each ship is 20 years.

Table 380 Typical Operating Results of NSC on Main Routes during 1976/77

	NAME OF SHIP	VOYAGES NO.	NO. OF CALLED PORT/ROUND-VOYAGE (Average)	VOYAGE DAYS/ROUND VOYAGE (Average)	NO. OF TRIP/YEAR (Average)	FREIGHT TONS (R/T, Average)		PARTICULARS OF SHIP		
						OUTWARO	HOMEWARO	DW (M. TONS)	VS (KNOTS)	YEA OF BUILT
	m/v PUSSUR	43-47 th	14.8	163.6	2.14	6,852	8,387	12,741	15	1965
	m/v KAPTAI	32-35 th	13.5	138.0	2.53	3,129	7,950	13,209	16	1967
	m/v TAXILA	34-38 th	13.2	154.0	2.27	2,481	7,292	12,569	17	1968
	m/v MOENJTDARO	30-33 th	12.5	158.0	2.21	7,440	9,719	12,569	17	1968
	m/v LALAZA	08-12 th	15.2	160.0	2.19	3,289	10,731	13,400	16	1974
	m/v S. RAFIQI	50-55 th	13.0	130.0	2.69	6,203	13,803	13,340	16	1966
	m/v WARSAK	35-36 th	13.0	159.0	2.20	10,500	15,068	13,544	16	1968
	m/v RANGAMATI	34-38 th	12.4	159.2	2.20	13,226	13,142	13,069	17	1968
	m/v NUNDARBANS	37-38 th	11.0	154.0	2.27	9,381	12,321	12,569	17	1968
	m/v SHALAMAR	30-32 th	13.3	174.0	2.01	6,421	13,685	13,066	16	1970
	m/v CHENAB	46-47 th	11.0	150.0	2.33	1,089	10,376	12,787	16	1965
	m/v BHATTI	52-55 th	9.5	173.5	2.02	3,059	10,341	13,340	16	1966
	m/v WARSAK	38-41 th	9.5	120.5	2.90	970	6,923	13,544	16	1968
	m/v TARBELA	34-36 th	10.7	180.7	1.94	3,458	14,919	13,544	16	1968
	m/v SUSDERBANS	35-36 th	11.0	170.0	2.06	5,985	12,154	12,569	17	1968

NOTE : ABOVE FIGURES ARE ONLY TYPICAL ONES PICKED OUT FROM THE ACTUAL RESULTS OF NSC
NO. OF TRIP/YEAR ARE CALCULATED BASED ON THE ASSUMPTION THAT ANNUAL WORKING DAYS ARE 350 FOR EACH VESSEL
SOURCE : COMPILED FROM NSC'S DATA
"NSC DESCRIPTION OF SHIP'S ROUTE (DURING 1976/77)"

Table 381(1) Particulars of 13,000TDW Models

Model No.		1－1	1－2	1－3
DW	(L/T)	13, 000	13, 000	13, 000
Carrying Cargo at full	(K/T)	11, 600	11, 600	11, 600
GT international	(T)	11, 500	11, 500	11, 500
Speed with 20% S.M.	(Knots)	15. 0	16. 5	18. 0
Lb.p	(M)	140. 0	140. 0	140. 0
Bmld	(M)	22. 0	22. 0	22. 0
Dmld	(M)	12. 8	12. 8	12. 8
dmld	(M)	8. 8	8. 8	8. 8
M.Engine MCO	(PS)	8, 370	10, 750	15, 600
M.Engine CSO	(PS)	7, 110	9, 140	13, 260
Ship Price	(¥10^8)	25. 8	26. 5	28. 0

Table 381(2) Particulars of 15,000TDW Models

Model No.		2－1	2－2	2－3
DW	(L/T)	15, 000	15, 000	15, 000
Carrying Cargo	(K/T)	13, 500	13, 500	13, 500
GT international	(T)	13, 000	13, 000	13, 000
Speed with 20% S.M.	(Knots)	15. 0	16. 5	18. 0
Lb.p	(M)	145. 0	145. 0	145. 0
Bmld	(M)	23. 0	23. 0	23. 0
Dmld	(M)	13. 4	13. 4	13. 4
dmld	(M)	9. 0	9. 0	9. 0
M.Engine MCO	(PS)	8, 620	11, 200	16, 950
M.Engine CSO	(PS)	7, 330	9, 540	14, 400
Ship Price		27. 3	28. 0	29. 7

Table 381(3) Particulars of 17,000TDW Models

Model No.	3－1	3－2	3－3
DW (L/T)	17, 000	17, 000	17, 000
Carrying Cargo at full (K/T)	15, 400	15, 400	15, 400
GT international (T)	15, 100	15, 100	15, 100
Speed with 20% S.M. (Knots)	15. 0	16. 5	18. 0
Lb.p (M)	155. 0	155. 0	155. 0
Bmld (M)	24. 0	24. 0	24. 0
Dmld (M)	14. 0	14. 0	14. 0
d mld (M)	9. 2	9. 2	9. 2
M.Engine MCO (PS)	8, 900	11, 600	17, 250
M.Engine CSO (PS)	7, 560	9, 680	14, 650
Ships Price (¥10^3)	29. 5	30. 3	32. 0

Table 381(4) Particulars in case of Carrying Cargo: 11,600K/T

Used Model (Model No.)	1－2	2－2	3－2
Carrying Cargo (K/T)	11, 600	11, 600	11, 600
Speed with 20% S.M. (Knots)	16. 5	16. 5	16. 5
Necessary M.E. output (PS)	9, 140	8, 880	8, 760

Note: Particulars and ships price in Table 381(1),(2),(3) & (4) to be used only for evaluation study.

Table 382 Assumption for Calculations of Operating Cost

Evaluation Period	:	20 Years
Economic Life of Ship	:	20 Years
Route Distance UK/Conti.	:	15,000 Nautical Miles/Round Voyage
" " Far East	:	14,000 Nautical Miles/Round Voyage
" " US/Canada	:	19,000 Nautical Miles/Round Voyage
Waiting Time at Ports	:	20 Days/Rlund Voyage
Working Days/Year	:	355 Days (No Fluctuation)
Ship Speed	:	Constant (No Age Effect)
Carrying Cargo	:	Constant (No Fluctuation)
Inflation Rate	:	Non
Number of Crew	:	40 Persons

Expenditure (Capital Cost)

Interest

Amount	:	100% of Ship Price
Payment	:	Non Deferred, 7 Year Payment, 2 Times/ Year
Interest Rate	:	10.5% for 30% of Total Amount & 8.5% for 70% of Total Amount

Depreciation

Amount	:	95% of Ship Price
Dep. Year & Method	:	Non Deferred 20 Years, Equal Depreciation
Scrap Value	:	5% of Ship Price
Resale Value	:	5% of Ship Price

Expenditure (Ship & Voyage Cost)

Item			Yearly up Rate (%)
Crew Cost	(¥):	890,000 x No. of Crew/Year:	8.5 (Fixed)
Store & Supply	("):	52.0 x DW (L/T)/Year :	1.9 (")
Lub. Oil	("):	0.48 x CSO (PS)/Hour :	0.0 (")
Repair (Hull)	("):	145.0 x DW (L/T)/Year :	3.2 (")
" (Mach.)	("):	695 x MCO (PS)/Year :	3.2 (")
Miscellaneous	("):	6,000,000/Year :	0.0 (")
Administration	("):	10,000,000/Year :	4.0 (")
Insurance	("):	0.013 x Ship Price/Year :	1.0 (")
F. O.	("):	16,000/K/T :	3.0 (")
D. O.	("):	26,000/K/T :	3.0 (")
Port Charge	("):	75.5 x GT :	0.0 (")

Expenditure (Ship & Voyage Cost) (Cont'd)

Item			Yearly up Rate (%)
Misc. for Nav.	(¥):	1,080,000/Voyage	: 0.0 (Fixed)
Cargo Handling	("):	(UK/Conti. Route) 4,000/K/T:	5.0 (")
		(US/Canada Route) 6,000/K/T:	5.0 (")

Fuel Oil Consumption

Main Engine	:	150g/Hr. ps (L.C.V. 10,200K Cal/Kgr)
Generator at Sea	:	2.4 - 2.6 K/T/Day
at Port	:	4.6 - 5.0 K/T/Day
at Waiting	:	1.5 K/T/Day

What really matters in this case is not the absolute value of marginal freight rate, but for finding the correlation between freight rate and ship size and/or ship speed.

Table 382 shows the bases for calculation of the above marginal freight rate.

As far as the pattern and the condition of shipping are concerned, Far East Route is considered to be quite similar to UK/Continent Route, which justifies an omission of the studies concerning Far East Route in the subsequent study.

3-3-1 Ship size (DW)

The graphs on Charts 383(1) and 383(2) show the calculated marginal freight rates for the said three types of ships (Model No.s 1-2, 2-2 and 3-2 in Tables 381(1), 381(2) and 381(3)) in full load conditions of respective models - the curves marked with "A" and "A'" in Charts 383(1) and 383(2) - and also in partial load conditions in which these ships are loaded with cargoes equivalent to the full load of current liner ships of 13,000 TDW or so - the curves marked with "B" and "B'" in Charts 383(1) and 383(2) - on the basis of the fixed service speeds and the same conditions in all the cases.

The curves marked with "A" and "B" in Charts 383(1) and 383(2) represent the cases where the total cargo lifting capacity of every ship is the same with each other, regardless of ship size, while the curves with "A'" and "B'" are the other cases where the total cargo lifting capacity varies according to respective ship size.

The overall cargo lifting capacity depends not only on the cargo handling gears aboard, but also on the cargo loading and unloading facilities set up in ports and inland areas together with the competency of longshoremen available. However, it may be more reasonable to recognize some

difference than not, in cargo lifting capacity according to the size of ship.

From Charts 383(1) and 383(2), the following facts can be pointed out.

(a) It is a matter of course that, if the cargo booking capacity adequate to the sizes of ships is assured, the larger the ship size is, the lower marginal freight rate can be expected - the curves with "A" and "A'" in Charts 383(1) and 383(2).

(b) Theoretically speaking, in case sufficient cargo booking capacity is not available, the undersized ships corresponding to the low booking capacity are most desirable.

Practically speaking, however, it might well be noted that there exists almost no difference in marginal freight rates among various sizes of ships of this class.

For instance, in the case of the cargo volume, suited by nature for a 13,000 TDW ship, to be carried onboard a 15,000 TDW one instead, the difference in marginal freight rate between both the cases is only 1% or less, provided that their cargo lifting capacities are the same in both cases.

On the other hand, if the cargo lifting capacity varies in proportion to the ship size, the marginal freight rate of the 15,000 TDW ship will be lowder than that of the 13,000 TDW one - the curves marked with "B" and "B'" in Charts 383(3) and 383(2).

In view of the above facts, it can be said that for a general cargo ship, the ship size defined with a certain surplus within the allowable limits of funds is advantageous, because a great fluctuation is expected in cargo volume and cargo type in the case of this kind of ship, as is no case with specialized ship.

Chart 383(1) Operating Cost on UK/Continent Route against Deadweight (DW)

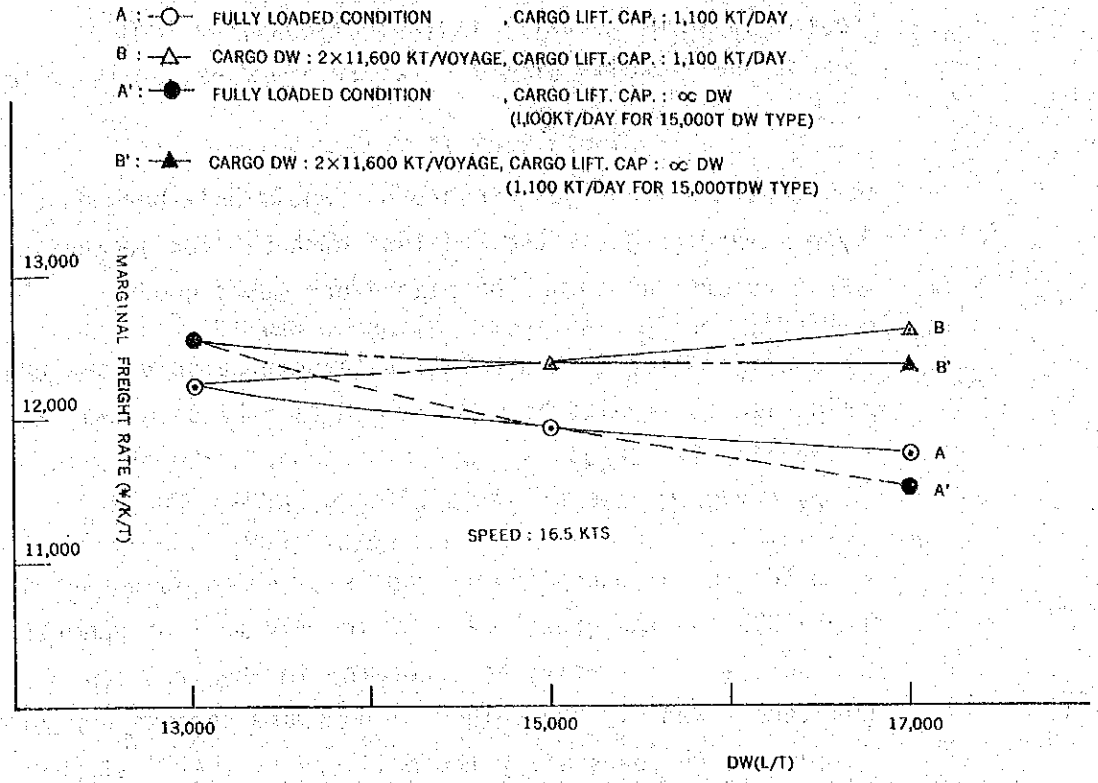
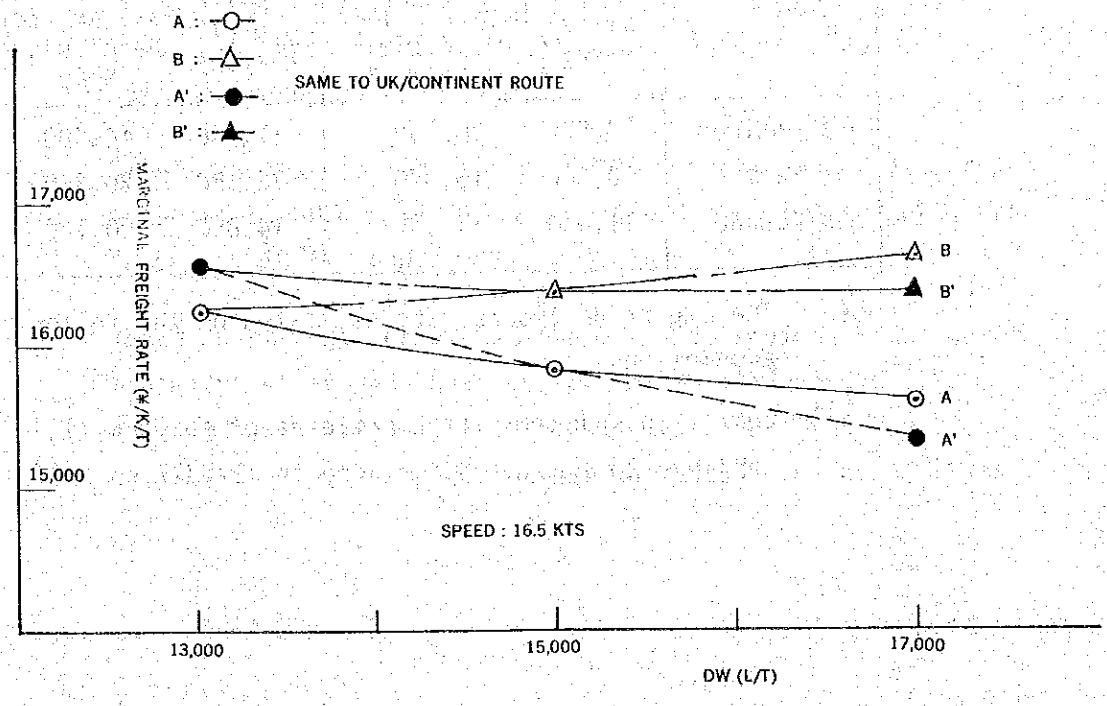


Chart 383(2) Operating Cost on USA/Canada Route against Deadweight (DW)



Now, the cargo movement per round voyage on main liner routes is studied next. Table 380 shows the typical operational results of NSC's fairly new fleet on three main liner routes in 1976/77.

Now that the trade pattern has overwhelmingly been governed by homeward cargoes, the greatest emphasis for increasing a cargo volume cannot but be placed on import goods.

In consideration of the relation between cargo volume and ship size as studied before, it can also be said that the desirable size should be such as to enable the ship to carry homeward cargoes without inconvenience.

From the actual operational results of ships as shown in Table 380 and the growth rate of the movement of general Cargoes (4.4% per year) as predicted in the previous Chapters I and II, the volume of homeward cargoes per voyage in 1983/84 (5 years after the delivery of the first ship expected in 1979/80) can be estimated as follows:

Table 384 Homeward Cargoes per Voyage by Route

Route	Actual Results (R/T) in 1976/77		Expected Volume (R/T) in 1983/84	
	Overall Average	Max. Av. per Particular Ship	Overall Average	Max. Av. per Particular Ship
UK/Continent	8,820	10,730	11,920	14,500
Far East	13,600	15,070	18,380	20,370
USA/Canada	11,010	14,920	14,880	20,170

Note: The expective figures are estimated on the following assumptions:

i) Operation and allocation patterns of ships will continue to stay as these were in 1976/77.

ii) Therefore, the growth rate of cargo movement will straightly represent the increase in cargo booking capacity.

iii) In the course of this consideration, the reason why the cargo movements in 1983/84 have been taken up is that any longer-range forecast than the above is not so much meaningful because the shipping system as well as the economic situation are most likely to change and deviate to an unpredictable extent after such a long lapse of time.

As the above study implies, the most desirable size for Far East and USA/Canada routes is 15,000 TDW class and for UK/Continent route, 12,000 TDW one.

3-3-2 Ship speed

The expected values of service speed, just like ship size, are estimated according to the transportation plan which aims at meeting the future demand for sea-borne trade.

From this moment on, the effect of ship speed on the marginal freight rate is studied, tentatively on the basis of speeds of 18 knots (relatively high speed range for this class of ship), 15 knots (medium range) and 16.5 knots (intermediate speed between the above two).

Sample models used for the evaluation study are of nine types as shown in Tables 381(1) to 381(3) and the study results are in Charts 385(1) and 385(2).

These Charts explicate that the marginal freight rate can be minimized at around 15 knots for each of three ship sizes, and seemingly, the higher speeds up to about 16.5 knots can be included in the optimum range for these classes of ships.

Chart 385(1) Operating Cost on UK/Continent Route against Ship Speed

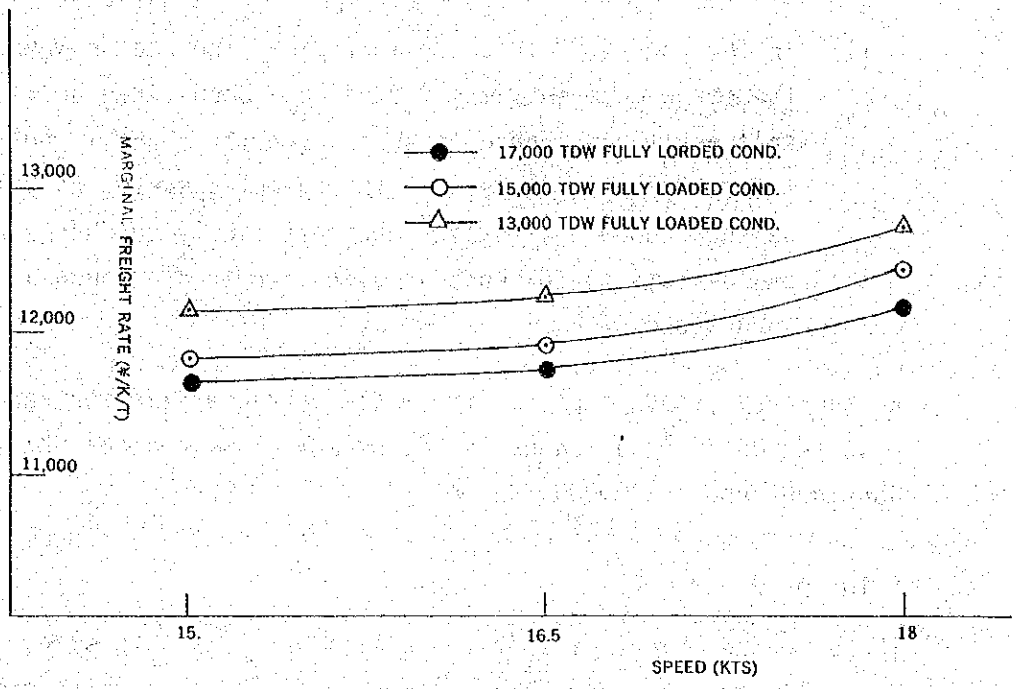
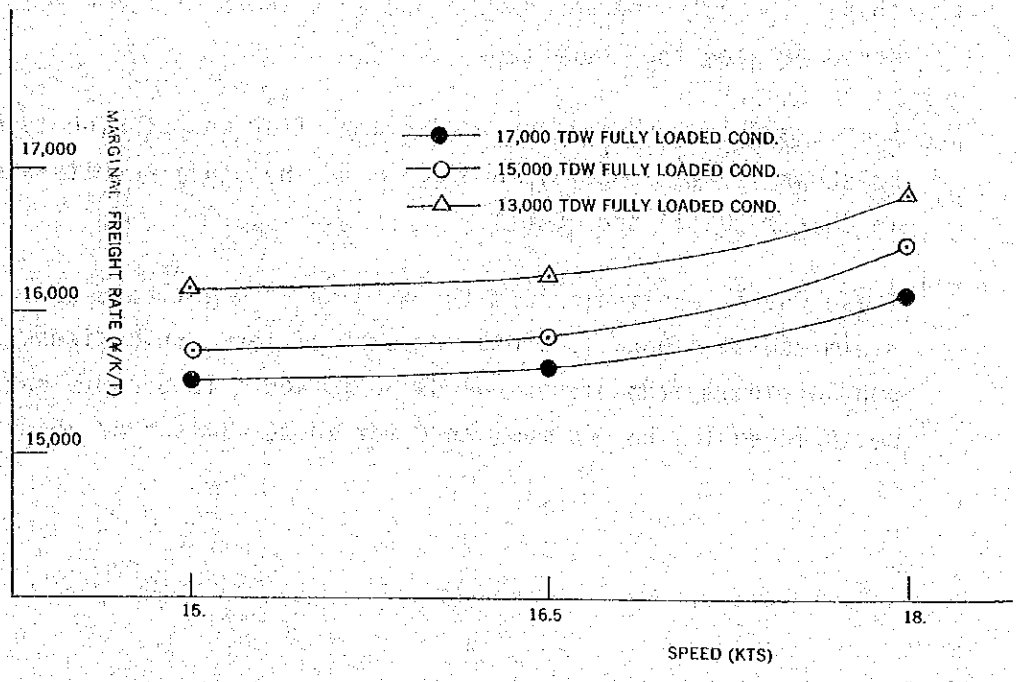


Chart 385(2) Operating Cost on US/Canada Route against Ship Speed



3-4 15,000 TDW Multipurpose General Cargo Ship

3-4-1 Selection of optimum type of ship

According to the study results in Section 3-2 in this chapter, the most desirable type of ship for the fleet improvement plan is a modern multipurpose general cargo ship incorporating the following matter into itself.

(1) In view of the present restrictions in the infrastructure such as ports, roads and railways, the transportation of general cargoes by conventional cargo handling systems will keep playing the leading role in sea-borne trade for some time from now on.

Therefore, even though the ship is endowed with sophisticated transportation functions as a modern multipurpose general cargo ship - as will be mentioned later -, it should never fail to be efficient in conventional handling of general cargoes.

(2) The ship should be of such a type that can deal with as many varieties of cargoes as possible to cope with the qualitative changes in sea-borne trade likely to occur in the future.

This would result in an extension of the economic life of the ship and in strengthening of its cargo booking capacity.

(3) The containerization for the transportation of general cargoes in Pakistan is supposed to need a fairly long time before it takes off. However, a certain necessity to carry containers together with ordinary general cargoes in bulk may arise to satisfy the special demand to do so from some clients.

Furthermore, in view of the possibility of the ship being remodeled into a semi-container vessel in the future, the intended ship had better be given a due consideration in advance so that it may turn completely functionable as a semi-container ship without an extensive remodeling work to be added in such a case.

3-4-2 Evaluation of 15,000 TDW ship

From the previous study results and for the undermentioned reasons, the optimum types of ships for the fleet improvement plan are a combination of a 15,000 TDW vessel and its sister ships.

(1) In view of the actual results in the past

As the main force of the existing liners (12,500 - 13,500 TDW classes) have often been operated in full load conditions, the ship size to be newly adopted had better be at least larger than the existing range.

(2) In view of prospective cargo movements

Assuming that the general cargo movement would grow up at a yearly rate of 4.4% for years to come, a collectable cargo volume per voyage in 1983/84 may increase to as big an amount as justifies the use of 15,000 TDW ship.

(3) In view of the present situation of ship allocation and operation

Under the present situation of ship allocation, the ships placed on main liner routes call at more than ten ports per voyage for collecting cargoes (cf. Table 380), insinuating that their cargo booking capacity is staying at a low level. From this point of view, the following can be said.

If the cargo movement may grow up beyond the original

expectation, it is possible that cargoes per voyage may be collected over the full load capacity of 15,000 TDW ship.

In such a case, however, it might be recommendable to keep the ships sticking to the normal liner schedules by skipping out some ports of call, relying upon some other means for the surplus amount, even at the risk of loosing part of cargoes.

(4) In view of physical limitations in ports

Karachi Port which is the home port for the liner fleet has a water depth of up to 32 to 33 feet, and the maximum permissible load draft is presumed to be about 9 meters.

Meanwhile, many of ports of call on main liner routes are provided with wharves limiting the mooring draft to about 9 meters.

In light of the necessary speed between 16 and 16.5 knots which is inevitable for maintaining the present order in an allocation of ships under the said draft limitations, the class between 15,000 TDW and 16,000 TDW is considered to be the maximum and reasonable size, assuring the greatest economy in a ship operation.

(5) In view of main liner routes

As previously pointed out, the ship of 15,000 TDW appears to be a little too large for UK/Continent Route. For the undermentioned reason, however, it is more desirable to allocate the sister ships of identical design to this route also, than to distinguish this route from the rest of all in way of the size and the type of a ship in service. The reason consists of the following elements.

(i) UK/Continent Route deserves the top priority in view of the cargo movement concerned and its operational profitability.

(ii) There exists little difference in transportation cost between 12,000 TDW and 15,000 TDW ships (cf. the study in Chap.III-3-3-1)and that, the advantage of reinforced function of transportation due to enlarged ship sizes could easily cover the cost increase therefrom. For instance, there may arise a new possibility of carring cargoes which used to be beyond the capacity of the existing fleet and its cargo booking capacity will thereby be strengthened to some extent.

(iii) In order to obtain the most functionable arrangement of cargo gears and cargo holds to be applicable to modern multipurpose general cargo ships which can serve not only as conventional general cargo ships but also as something capable of loading containers to appear in the future, the most desirable type of the ship is 15,000 TDW or the like.

(6) In view of the effects caused by sister ships

As aforementioned, the collectable cargo volume per voyage may vary, to a certain extent, according to respective liner routes. Nevertheless, the adoption of sister ships of identical design which are interchangeable among these routes is recommendable for the reasons described hereunder.

(i) The types of cargoes and the pattern of ship allocation are almost the same throughout three main liner routes.

(ii) It is justifiable to select modern multipurpose

general cargo ships instead of specialized ships for these liner route servises.

(iii) The advantages brought about by sister ship construction can be expected as follows:

(a) Operation planning and procedural matter in shipping business, such as in cargo booking and ship allocation, are expected to be done with more ease.

(b) A reduction in the construction cost of the ship can be anticipated through the economic benefits of a series construction of sister ships and also through a purchase in package of materials and outfittings of the ships concerned.

(c) Considerable cost and time for repairs can be saved because machines and outfittings for all the ships can be unified in specifications and also because all spare parts can be exchangeable with each other among all the ships. Furthermore, a commonness in operation of machines and equipment for all the sister ships will lessen the operational difficulty likely to occur in case of transposition of the crew, thus ensuring smoother operations than before.

(7) In view of shipbuilding and repairing capacities of KSEW

KSEW has nominal capacities of shipbuilding and repairing of 27,000 TDW. Notwithstanding this, when the parallel building of sister ships is scheduled simultaneously on No. 1 and No. 3 building berths in compliance with the fleet improvement plan, the buildable size has to be limited to 15,000 TDW and under (the shipbuilding

facilities at KSEW and these performance are to be referred to in Chapter IV).

From all the above considerations, a series construction of the 15,000 TDW prototype and its sister ships is most recommendable for the fleet improvement plan presumably.

3-5 Basic Consideration on Initial Design

Principal particulars, various arrangements and machinery and outfittings to be used for 15,000 TDW modern multipurpose general cargo ship are studied in the following descriptions.

3-5-1 Capacity of cargo holds

The necessary capacity of cargo holds can be derived from the volume and the stowing rate of the cargoes concerned, except for a general cargo which makes it hard to estimate its stowing rate and accordingly, its necessary capacity also by its complexity of kind and shape.

In the present case, the weight/space ratio as undermentioned in employed as a tentative guide for such an estimation, but needless to say, the cargo hold capacity had better be determined to be as large as possible.

Deadweight/Hold Capacity = 0.62 - 0.64

therefore,

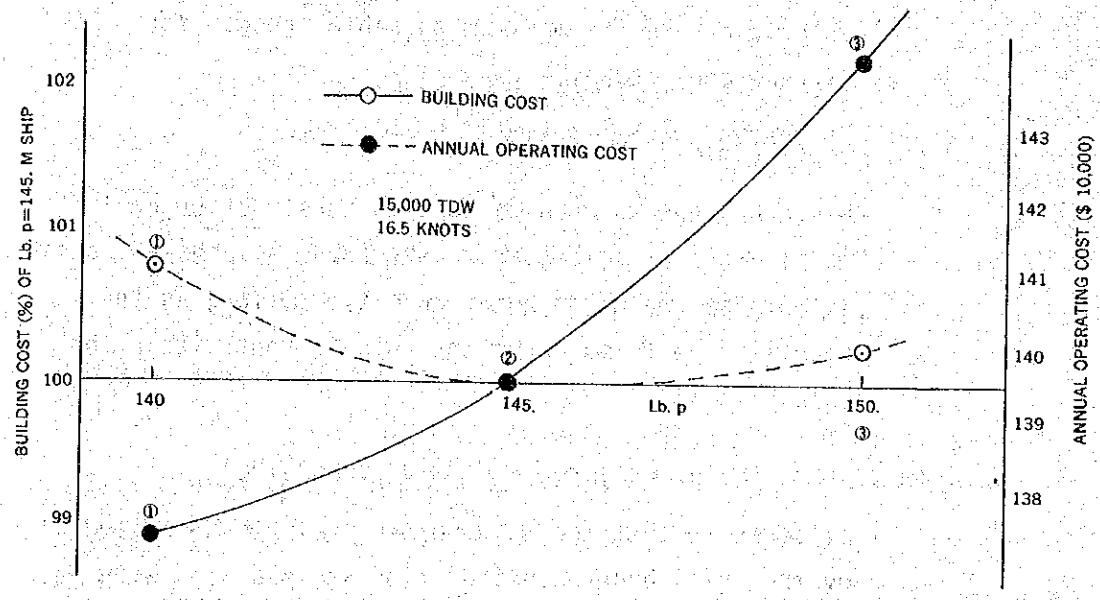
Hold Capacity = 23,500 - 24,000M^3 (in Grain Capacity)

3-5-2 Principal dimensions

(1) Length (Lb.p. and Lo.a.)

Chart 386 shows the values of Lb.p. which satisfy the requirements of ship tonnage and speed for the given ship breadth and draft and the cost variation in shipbuilding and ship operation against various values of Lb.p.

Chart 386 Effect of Ship Length on Cost



MODEL		①	②	③
DW	(K/T)		15,240	
C. PAY VOL	(M^3)		24,000	
SERVICE SPEED	(KNOT)		16.5	
DIMENSION				
L D.P.	(M)	140.00	145.00	150.00
B med.	(M)	23.00	23.00	23.00
D med.	(M)	13.70	13.40	13.10
d med.	(M)	9.00	9.00	9.00
Cb		0.716	0.700	0.688
WEIGHT				
H. STEEL	(K/T)	3,500	3,750	4,050
H. FITT. LEQ.	(K/T)	1,520	1,560	1,600
MACH.	(K/T)	760	750	740
OTHERS	(K/T)	290	290	290
LIGHT SHIP WT	(K/T)	6,070	6,350	6,680
DISP. (d=9.0)	(K/T)	21,310	21,590	21,920
ENGINE				
MCO	(PS)	12,100	11,200	10,600
CSO	(PS)	10,300	9,540	9,030
F.O CONSUMPTION (M. TONS)		9,657	4,313	4,082
BUILDING COST	(US $ 10,000)	1,385	1,400	1,432
	(%)	98.93	100.00	102.29
F.O COST	(US $ 10,000)	37,256	34,504	32,656
ANNUAL OPERATING COST	(US $ 10,000)	141,13	139.50	140.06

NOTE :

ASSUMPTION : F.O CONSUMPTION : 156 g/ ps.hr (HEAVY FUEL) PLUS 5% RESERVE
F.O COST : US $ 80/K/T
TIME AT SEA : 115 DAYS/YEAR
STRAIGHT-LINE DEPRECIATION
20 YEAR ECONOMIC LIFE
5% SIMPLE INTEREST
2.5% SCRAP VALUE
ANNUAL OPERATING COST=0,075 (BUILDING COST)+ANNUAL FUEL COST
OTHER OPERATING COSTS ARE CONSIDERED TO BE SAME FOR EACH MODEL
AND NOT TO BE INCLUDED IN ABOVE ANNUAL OPERATING COST.

(2) Breadth (Bmld.)

For the breadth of this class of ship, it may be reasonable to assume the maximum passable breadth for St. Lawrence Seaway.

(3) Depth (Dmld.)

Depth has not so much to do with construction cost, and therefore had better be selected as large as possible to enlarge the cargo hold capacity, so long as the stability performance of the ship is kept within the safety limits.

(4) Draft ($d_{mld.}$ designed and $d_{mld.}$ scantling)

It is known that the main ports likely to be called at by the ships under consideration are provided with fairly large number of cargo handling wharves which limit the permissible draft to about 9 meters and the maximum ship length to about 160 to 170 meters (cf. Port of the World, 1978).

It is noteworthy that the deeper the draft is, the higher propulsive performance can be expected. So, the designed draft had best be taken as deep as the above limitation allows.

Separately from the said designed draft, it is desirable to assign a deeper scantling draft which is a legally permissible maximum and to be used in case of carrying heavy cargoes such as grains in bulk.

3-5-3 Arrangements of cargo holds, gears and hatches

(1) Cargo holds

The adoption of four cargo holds is preferable for the following reasons:

(i) To avoid a mutual interference with neighbouring cargo handling gears in their simultaneous operations.

(ii) To facilitate the loading of long-sized and/or heavy cargoes which require considerable shares of the space.

(iii) To shorten the ship length as far as possible in view of reducing the ship construction cost.

(2) Cargo hatches

It is preferable to adopt double row hatches with as wide hatch opening as possible, except for the foremost cargo hold, for the following advantages:

(i) Improved efficiency of cargo handling

(ii) Increased effective capacity of cargo holds

(iii) Reduced weight leading to improved stability performance of the ship and hence lowered cost of hatch covers.

(3) Cargo handling gears

The installation of a pair of cargo handling gears for each cargo hold except the foremost one is preferable in that the speeding up of cargo lifting can be expected by simultaneous operation of them.

Besides these, a single gear capable of handling semi-heavy cargoes of about 40 to 50 tons is advisably to be added (refer to next Article).

3-5-4 Hull outfitting

(1) Type of deck machinery

There are two driving systems for deck machinery: one is

by electric motors and the other, by electro-hydraulic motors.

The electric motor system is simple in its construction, but the change of load on this system directly affects the driving motors and the power generators, which is apt to cause much trouble in the electro-mechanical apparatus. Furthermore, these electric motors are usually to be installed on exposed decks of the ship, and accordingly, these are subject to corrosion due to sweepting sea water.

On the other hand, the electro-hydraulic motor system is more recommendable for this class of ship in that this system is assured of less troubles, an easier maintenance/repair, etc.

(2) Type of cargo handling gear

(i) For general cargoes

The undermentioned three types of cranes are studied and evaluated as typical ones. These are a deck crane, a guyless single boom derrick crane and a double boom derrick crane (7 winch parallel boom system).

The particulars and the study results are shown in Table 387(1) and 387(2) and Tables 388(1) and 388(2). Each type has been evaluated on the basis of the respective particulars defined by its typical standard specification, and therefore, it is possible for each type to slightly modify its performance by a partial alteration of the specification (cf. Tables 387(1) and 387(2)).

(a) Deck crane

Deck cranes are considered to be the best type of all in performance.

Its price, however, is most expensive and its structure is so complicated that some experts must attend to its repair and maintenance.

(b) Guyless single boom derrick crane

This type is somewhat superior to a double boom derrick crane in performance except in the case of union purchase cargo handling of the latter.

The price of this system is supposed to be the lowest and the reliability is the highest of all.

(c) Double boom derrick crane (7 winch parallel boom system)

In lifting a light load (less than 5 tons), the performance of union purchase cargo handling is comparable to that of deck cranes.

On the other hand, in lifting a heavy load (more than 10 tons), the operation is most complicated and the performance falls down to the worst level of all.

Besides, in this case much longer booms than those shown in Table 387(1) are necessary to secure enough outreach.

The price of this system is almost as high as deck crane's, and this type is inferior to other systems in operational reliability and performance of repair and maintenance.

Table 387(1) Particulars of Typical Cargo Handling Gears 1/2 Hull Part
(per Gang or Set)

MODEL NO.		1	2	3
SYSTEM		DOUDLE BOOM SYSTEM *1	SINGLE BOOM SYSTEM *2	DECK CRANE
BOOM	No.	2	1	1
	CAPACITY (t)	11	22	22
OPERATION CAPACITY	TWIN SLEWING (t)	22	—	—
	SINGLE SLEWING (t)	11	22/11	22/11
	UNION PURCHASE (t)	5	—	—
OPERATION RANGE	SLEWING (deg.)	65×2	72×2	360
	TOPPING (deg.)	25~75	15~75	25~77
OUTREACH	22T USE (m)	1.5	5	5
	5~11T USE (m)	5	5	5
TYPE OF DERRICK POST		TWIN POST	SINGLE POST	—
NO. OF RIGGING	CARGO FALL	2	1	1
	TOPPING LIFT	2	2	1
	SLEWING GUY	3	—	—
MAX. CARGO HOOK	LOAD (t)	22	22	22
	SPEED (m/min)	abt. 13	abt. 12	abt. 21

NOTE

*1 : 7-WINCH PARALLEL BOOM SYSSEM

*2 : GUYLESS SINGLE BOOM SYSTEM

Table 387(2) Particulars of Typical Cargo Handling Gears 2/2
Machinery Part (per Gang or Set)

MODEL NO.		1*1	2*2	3*3
TYPE		ELECTRIC DRIVEN	EL-HYDRAULIC DRIVEN	EL-HYDRAULIC DRIVEN
NO. OF WINCHES		7	3	2
CARGO WINCH	No.	2	1	1
	CAPACITY (t)	5.5	6	abt. 12.5
	SPEED (c/mim)	39	48	abt. 42
	DRIVING	ELECTRIC MOTOR	HYDRAULIC MOTOR	HYDRAULIC MOTOR
TOPPING WINCH	No.	2	1	1
	CAPACITY (t)	1.6	6.5	51 sec.
	SPEED (m/mim)	16	45	
	DRIVING	ELECTRIC MOTOR	HYDRAULIC MOTOR	HYDRAULIC MOTOR
SLEWING WINCH	No.	3	1	1
	CAPACITY (t)	2.5	6.5	0.95 rpm
	SPEED (m/mim)	18	45	
	DRIVING	ELECTRIC MOTOR	HYDRAULIC MOTOR	HYDRAULIC MOTOR
POWER UNIT	No.	—	1	2
	TYPE	—	HYDRAULIC PUMP	HYDRAULIC PUMP
	MAX. RATED OPERATION	HOISTING+SLEWING or TOPPING WITHOUT LOAD	HOISTING or SLEWING or TOPPING WITH FULL LOAD	HOISTING +SLEWING +TOPPING WITH FULL LOAD
REMOTE CONTROL SYSTEM		FITTED	FITTED	FITTED

NOTE : These models and particulars of each model are typical samples for evaluations.
*1 7 Winch Parallel Boom System
*2 Guyless Single Boom System
*3 Single Deck Crane

Table 388(1) Evaluation of Typical Cargo Handling Gears 1/2

Duty Cycle Times (per Gang or Set)

(Unit : second.)

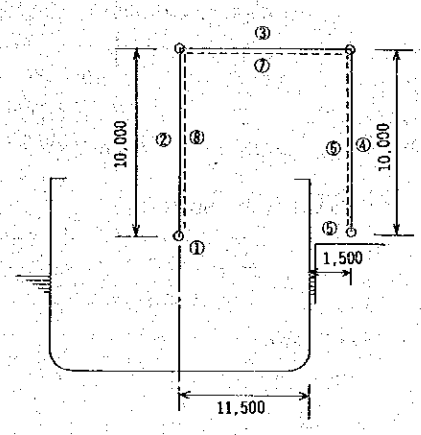
MODEL			*1 1	*2 2	*3 3
22T LOAD ONE DUTY CYCLE	LOAD HOOK CYCLE TIME	HOOK	15	15	15
		HOIST	47	50	28
		SLEW	70	28	8
		LOWER	23	17	10
		SUM	155	110	61
	LIGHT HOOK CYCLE TIME	UNHOOK	15	15	15
		HOIST	23	17	10
		SLEW	70	28	8
		LOWER	23	17	10
		SUM	131	77	43
	TOTAL TIME		286	187	104
5T LOAD ONE DUTY CYCLE	LOAD HOOK CYCLE TIME	HOOK	15	15	15
		HOIST	15	17	14
		SLEW	15	28	8
		LOWER	8	8	10
		SUM	53	68	47
	LIGHT HOOK CYCLE TIME	UNHOOK	15	15	15
		HOIST	8	8	10
		SLEW	8	28	8
		LOWER	8	8	10
		SUM	39	59	43
	TOTAL TIME		92	127	90

NOTE *1 : 7-WINCH PARALLEL BOOM SYSTEM

*2 : GUYLESS SINGLE BOOM SYSTEM

*3 : SINGLE DECK CRANE

ASSUMPTION FOR ESTIMATION OF DUTY CYCLE TIME



LOAD HOOK CYCLE TIME

LIGHT HOOK CYCLE TIME

① HOOKING
② HOISTING
③ SLEWING
④ LOWERING
⑤ DETACHING
⑥ HOISTING
⑦ SLEWING
⑧ LOWERING

Table 388(2) Evaluation of Typical Cargo Handling Gears 2/2

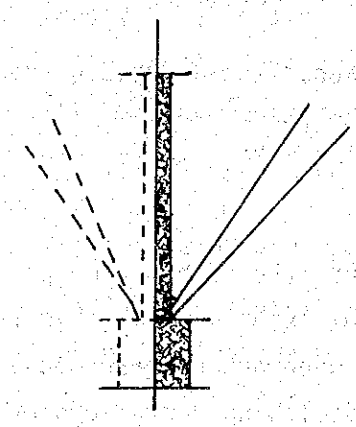
Cost and Weight (per Gang or Set)

MODEL	1	2	3
SYSTEM	7-WINCH, PARALLEL BOOM SYSTEM	GUYLESS SINGLE BOOM SYSTEM	DECK CRANE
WEIGHT (t)	56	46	53
COST (US $)	160,600	130,000	165,000

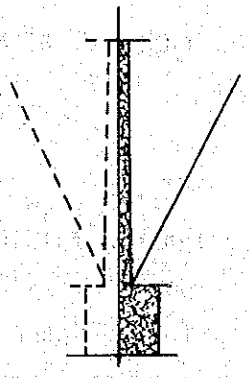
NOTE : Cost in above table is predicted for evaluation study and used only for reference.

Coated part of following sketches are included in above cost and weight

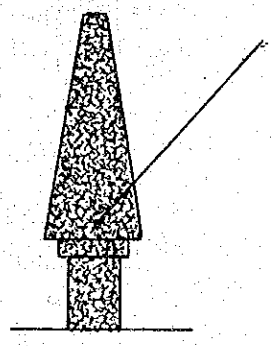
for Model 1



for Model 2



for Model 3



In the long run, the conclusion is that the guyless single boom system is most recommendable, so long as the special emphasis is placed on its economical features, operational reliability and high performance of cargo handling in its appraisal.

(ii) For heavy cargoes

The adoption of twin deck cranes which can efficiently be used for the handling of general cargoes is considered to be most economical and effective.

The lifting capacity of about 25 tons S.W.L. per each is adequate.

(3) Type of hatch cover

The adoption of the end folding type of hatch covers is most recommendable for this class of ship, becuase this type can do without much stowing space when hatches are opened and also because their opening and closing operations are quite easy.

3-5-5 Main Engine

As a prime moverfor this class of ship, the adoption of a slow speed diesel engine is most economical.

The main engine out-put necessary to sustain the ship service speed at 16 to 16.5 knots is estimated at about 10,000 to 11,000 Ps (BHP) at the maximum continuous rating.

Needless to say, in the selection of main engine type, it is primarily important to look for the one which can enjoy an international reputation for its world-wide service network and high operational reliability.

In the recent tendency, however, a high efficient new type of main engine, which can reduce its fuel oil consumption and highten its propulsive performance considerable by means of lengthened piston strokes (the so-called long stroke type), has been developed and delivered to the clients with high performance records. The adoption of these new types of main engines which have actually performed excellent operational results is most economical and safest.

At any rate, it is to be stressed that to ensure the intended merits of a series construction of sister ships (cf. Section 3-4-2 in this Chapter), the standardized specifications for all the machinery including main engines and hull outfittings are absolute prerequisites.

3-6 Provisional Prototype Design

Leading Particulars and General Arrangement Plan attached hereunder are the provisional results of a prototype design based on the study so far made in and before this Chapter.

LEADING PARTICULARS OF 15,000 TDW MULTI-PURPOSE GENERAL CHARGO SHIP

1. CLASSIFICATION & SURVEY

(a) Classification

LR ✠ 100A1 ✠ LMC or NK NS* MNS*

(b) Rule & Regulation

SOLAS 1960 & 1974
ILLC 1966
Suez Canal Regulation
Panama Canal Regulation
St. Lawrence Seaway Regulation
Maritme Rules & Regulations of Pakistan

2. PRINCIPAL DIMENSION

Length o.a.	Approx.	153.00m
Length b.p.	"	145.00m
Breadth mld.	"	23.00m
Depth mld. (to main deck)	"	13.40m
Depth mld. (to tween deck)	"	9.40m
Draft mld. (designed)	"	9.00m
Draft mld. (scantling)	"	9.65m

3. GENERAL OUTLINE (Refer to attached GENERAL ARRANGEMENT PLAN)

Type of Ship: Flush decker with f'cle,
Twin decker,
Aft engine & aft bridge

Kinds of Cargoes : General cargo,
Grain,
Container (ISO 8.5' x 8' x 20/40')
(Power receptacle for 10 TEU refrigerated container to be provided on main deck.)

Cargo Space : Four (4) cargo holds and
Four (4) tween deck cargo spaces

4. TONNAGE & CAPACITY

Gross Tonnage (International) .....Approx. 13,000 T

Capacities

Cargo Holds (100%)

Grain	Approx.	23,800m³
Bale	"	21,500m³

Number of Container

In Holds	Approx.	270 TEU
Above Main Deck	"	120 TEU
Total:	Approx.	390 TEU

Fuel Oil Tanks (100%)	Approx.	1,500m³
Diesel Oil Tanks (100%)	"	150m³
Fresh Water Tanks (100%)	"	300m³
Water Ballast Tanks (100%)	"	3,000m³

5. DEADWEIGHT

On designed Draft ..... Approx. 15,240 Metric Tons
(9.00m mld.) (Approx. 15,000 Long Tons)

On Scantling Draft ..... Approx. 17,000 Metric Tons
(9.65m mld.)

6. MAIN ENGINE

Type : Two-stroke, Single-acting, Crosshead, Direct-reversible, Turbocharged, Long-stroke Type Diesel Engine

Number : One (1) Set

Rating :

MCO	11,200 ps (BHP) x 119 rpm
Normal Output	9,540 ps (BHP) x 113 rpm

7. SPEED

Service Speed : Approx. 16.5KTs on mld. designed draft of 9.00m at Normal Output of Main Engine with 20% Sea Margine

8. FUEL OIL CONSUMPTION & ENDURANCE

Fuel Oil Consumption: Approx. 35.0 metric tons/day based on fuel oil of L.C.V. 9,800K cal/Kg at normal output of main engine.

Endurance : Approx. 15,000 Nautical Miles

9. COMPLEMENT

Total ..... 40 Persons

10. CARGO HATCH COVER

(a) Opening Size

Hold No.	Deck	No. x Length (m)	Breadth (m)
No. 1 Hold	Main	1 x 12.8	8.0
No. 2 "	"	2 x 19.2	"
No. 3 "	"	2 x "	"
No. 4 "	"	2 x "	"
No. 1 Hold	Tween	1 x 12.8	5.4
No. 2 "	"	2 x 19.2	8.0
No. 3 "	"	2 x "	"
No. 4 "	"	2 x "	"

(b) Type

Main Deck Hatch Covers : Weather Tight, End Folding Type
Tween Deck Hatch Covers: Non-Tight, End Folding Type

11. CARGO GEAR

(a) Deck Crane

Type	:	Electro-hydraulic Driven Fixed Type
Number	:	One (1) Set
Capacity (Max. Lead)	:	50t (2 x 25t) x 20m/min.
Max. Radius	:	19m
Position	:	Between Nos. 3 and 4 Hold

(b) Derrick Boom

Type	:	Gnyless Single Boom System with Anti-pendurum Appliance
Capacity (Max. Lead)	:	22t
Number & Position	:	Between Nos. 1 and 2 Hold: 2 Sets Between Nos. 2 and 3 Hold: 2 Sets After of No. 4 Hold : 1 Set Total: 5 Sets

(c) Cargo Handling Winch

Type	:	Electro-hydraulic driven
Number	:	Cargo Winch : 5 Sets Topping Winch: 5 Sets Slewing Winch: 5 Sets

12. DECK MACHINERY

(a) Windlass

Type	:	Electro-hydraulic Driven Ordinary Type
Capacity	:	22t x 9m/min. x 1 Set

(b) Mooring Winch

Type	:	Electro-hydraulic Driven Ordinary Type
Capacity	:	10t x 15m/min. x 1 Set

13. ELECTRIC GENERATOR

(a) Main Generator

Output & rpm:		580 KW x 720 rpm
Number	:	Three (3) Sets
Type	:	Drip-proof, Brushless, Self-ventilated Type
Prime Mover	:	Four Cycle Diesel Engine 1,000 ps x 720 rpm

(b) Emergency Generator

Output & rpm:		100 KW x 1,800 rpm
Number	:	One (1) Set
Type	:	Drip-proof, Brushless, Self-ventilated Type
Prime Mover	:	Two Cycle Diesel Engine

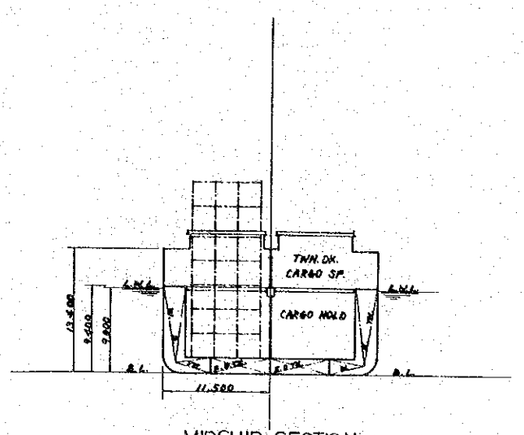
(c) Power Supply System

Generator	:	A.C. 450V
Power Equipment	:	A.C. 440V
Small Power Equipment	:	A.C. 220V
Frequency	:	60 Hz

14. AUTOMATION FOR MACHINERY

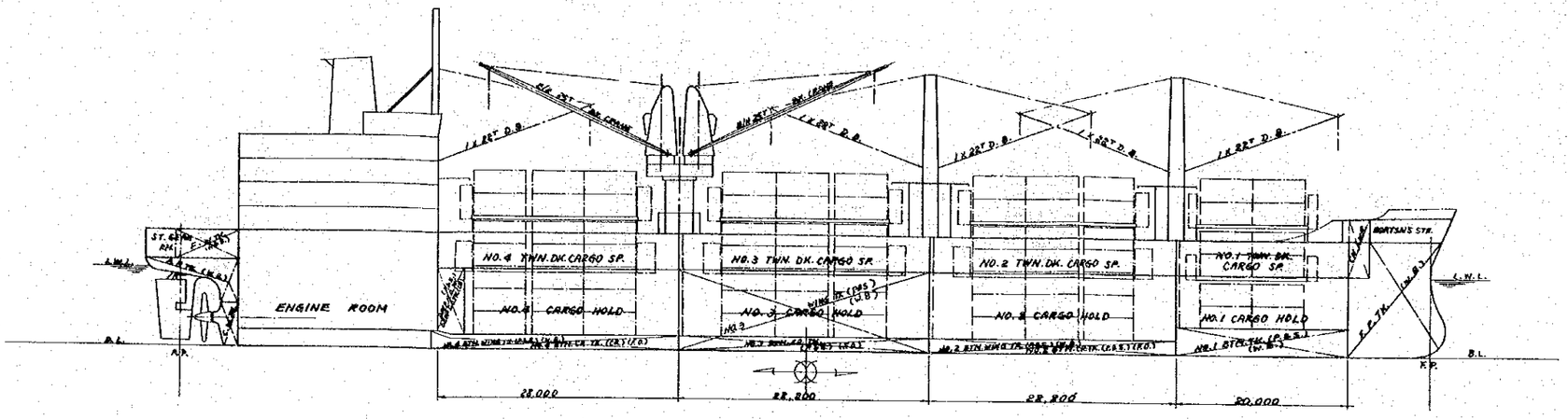
Centralized Control Room	:	Provided in Engine Room
Bridge Control	:	Provided
Monitor	:	Provided

GENERAL ARRANGEMENT

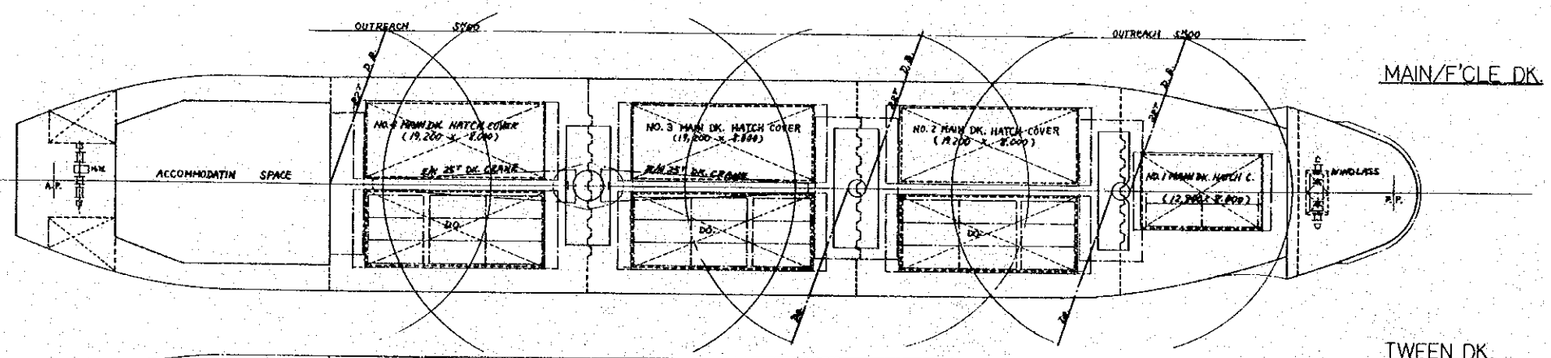


MIDSHIP SECTION

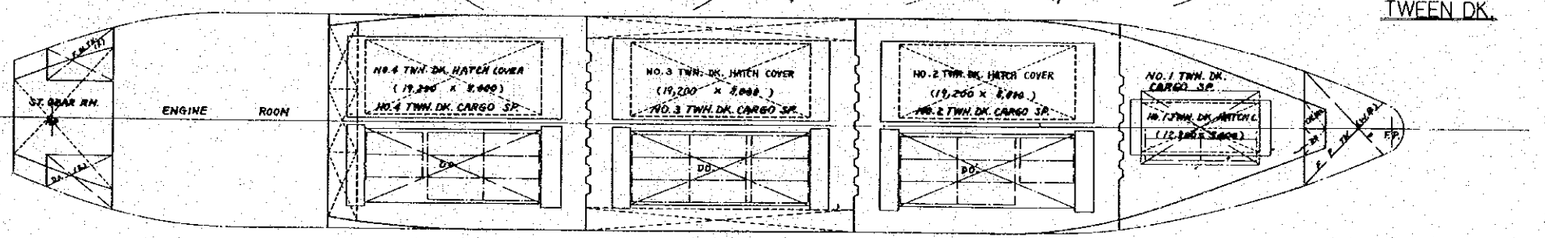
PRINCIPAL PARTICULARS		
LENGTH	P.P.	145M00
BREADTH	MLD.	23M00
DEPTH	MLD.	13M40
DRAFT	MLD. (DESIGNED)	9M00
DRAFT	MLD. (SCANTLING)	9M65
DEADWEIGHT	ABT. 15,000 LT ON MLD. DRAFT OF 9M00	
MAIN ENGINE	SLOW SPEED DIESEL ENGINE 1 SET	
M.C.O.	11,200 PS x 119 RPM	
NORMAL OUTPUT	9,560 PS x 113 RPM	
SPEED	ABT. 16.5 KTS ON MLD DRAFT OF 9M00 AT NORMAL OUTPUT OF MAIN ENGINE WITH 20% SEA MARGIN	



MAIN/F'CLE DK.



TWEEN DK.



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