No. 128
July 1972

MARITIME PROSPECTS IN NORTHWESTERN SOUTH AMERICA

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Naval Architecture 591
Fall Semester, 1971
The University
of Michigan

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ABSTRACT

This report summarizes a study of the maritime details of the northern Pacific coast of South America. The ports and national fleets of Colombia, Ecuador, and Peru are tabulated to summarize the data relevant to preliminary ship design. A study of the prospects of shipbuilding is presented along with a proposal for a vertical hoist type dock, Syncrolift.

This report was prepared in the Fall Semester, 1971 to be used in preliminary ship design work involving the ports of the Northwest coast of South America, the countries of Colombia, Ecuador and Peru. The discussion and data represents a blend of readily available facts gleaned from publications like <u>Ports of the World</u> and correspondence with various South American maritime organizations. This method hopefully resulted in an up to date picture of the maritime prospects of this region.

On p. 50 of the March 2, 1972 issue of FAIRPLAY, an article describes the Japan Shipbuilders Association's efforts to refurbish declining export newbuilding contract prospects. A mission headed by Mr. Ogawa, deputy manager of export machinery, Mitsui & Co. Ltd., was dispatched to Latin America. This mission paid special attention to five nations, Peru, Mexico, Brazil, Argentina and Chile, and Mr. Ogawa's remarks are indeed revealing.

> "The entire region 'lacks bottoms' in Mr. Ogawa's opinion, and yet needs them badly to expand no less badly-required export cargoes. At present, only 12,000,000 tons gross of bottoms are of Latin American Nations' registry, but actually over 6,000,000 tons gross are available, accounted for under flags-of-convenience tonnage, meaning that the Latin American nations have only 5,700,000-5,800,000 tons gross of their own. On the other hand, a total of 500,000,000 tons of freight is now moving from the region annually with foreign-flag shipping moving the bulk of the key raw-material exports from Latin America, on an f.o.b. basis... Bottom potential is big also because the region is so lacking in shipbuilding facilities, and must rely on imports if ship self-sufficiency is to be attained."

Mr. Ogawa's mission also made a study of the ship-building productivity of Latin America.

> "By Japanese standards, area building costs are about 50 per cent higher with yards unable to compete with European, much less Japanese, builders whose costs are 10 per cent less than in Europe. In terms of productivity per worker, too, Latin American yards are far inferior to Japanese yards, with a building period four times as long in a Latin American yard as for a Japanese facility, in terms of a 10,000 ton d.w. cargo carrier."

This assessment of the maritime situation is a valuable addition to the following report.

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INTRODUCTION

This study covers the maritime details of the northern Pacific coast of South America. The countries included in this region are Colombia, Ecuador, and Peru. For the last decade, there has been a steady improvement in each of these countries' port facilities. This gradual improvement has received small notice from the maritime community. It is the aim of this report to present an updated picture of these countries and to discuss areas of interest to the naval architect, such as existing fleets and shipbuilding.

The Andes mountains have great impact on the development of these countries. This range, stretching from Colombia through Peru and into Chile, divides each country into an interior region and a highly developed coastal plain. Until recently, technical as well as economic barriers prevented any sizable development of the ore and oil reserves in the interior.

The Southern Colombian Pipeline illustrates the difficulty of any interior development. In 1969 this pipeline was completed over 200 miles of the Andean mountains to link the oil wells near Orito to the seaport of Tumaco (1)*. The deep water facility at Tumaco is reported to accommodate tankers up to 100,000 Dwt in a deep water anchorage. Fig. 1 illustrates the physical barrier which the Andes present to interior development. This pipe reached an altitude of 11,540 feet above sea level.

The recent development of slurry transport of ore could

*Numbers in brackets designate References at end of report.

possibly be used in a similar operation. Whether the 50 million dollars spent on this pipeline is too costly remains to be determined.

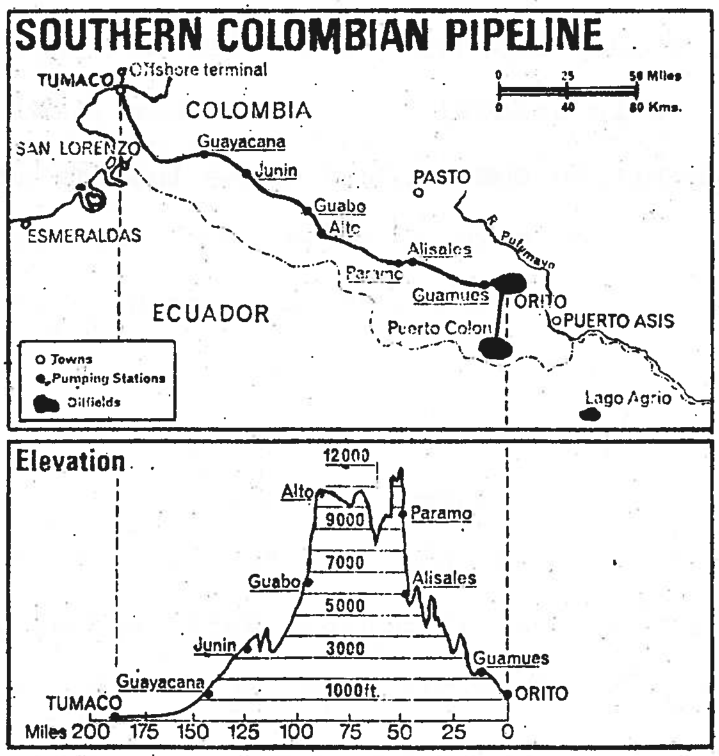


Fig. 1

These countries are attempting to coordinate the ports with the developing interior. In 1970, Peru enacted law No. 18027, which consolidated the entire country's port authorities into one organization called Empresa Nacional De Puertos Del Peru (ENAPU).

This organization simplified and unified the regulation governing port tariffs at the national level. It has also set a policy to develop the ports by "abandoning the numerous obsolete ports served by barges and to establish a few strategically situated ports -- modern, mechanized, and with terminals having direct mooring facilities." (2)

Recently there has been a regional agreement in regard to trade and development. The Andean Group or Andean Common Market, composed of Colombia, Ecuador, Peru, Bolivia and Chile, represents the regional development coordinator for this area. Its influence in the maritime affairs of each member country should be very great in that it requires each foreign company developing an industry in one of the member countries to participate in the local development. In terms of efficiency, the bottleneck at the port will be reduced by good organization and development.

In simplified form, these regulations state:

> Within the next 15 years (20 years for Bolivia and Ecuador), all foreign companies will be required to put up for sale sufficient stock to qualify as a "mixed company." A mixed company is one which has at least 51% ownership by citizens of the Andean Common Market.
>
> Companies which do not comply with this ownership requirement will be restricted to doing business within the border of the country in which they are located and will not be allowed access to the Andean Market as a whole. (3)

Oil Developments

Through correspondence with several port authorities, the development of a large oil field located in the Colombian and Ecuadorian border was outlined. As was pointed out before, the Colombian oilfields near Orito are linked to the deep water seaport of Tumaco. A similar trans-Andean pipeline has been constructed linking the deep water terminal Esmeraldas, Ecuador with the exploration fields in the interior. Presently, this pipeline has a daily capacity of 250,000 barrels and will reach 400,000 barrels in the future. (4)

Mineral Developments

Peru has an extensive reserve of mineral which is being mined to supply the steel mills in Europe, Japan, and the U.S. The major ore ports are located near the mines at San Juan. Marcona Corporation, which began its operations in 1953, has established a world-wide trading route as well as a large bulk carrier fleet. Fig. 3 and Fig. 4 (5)

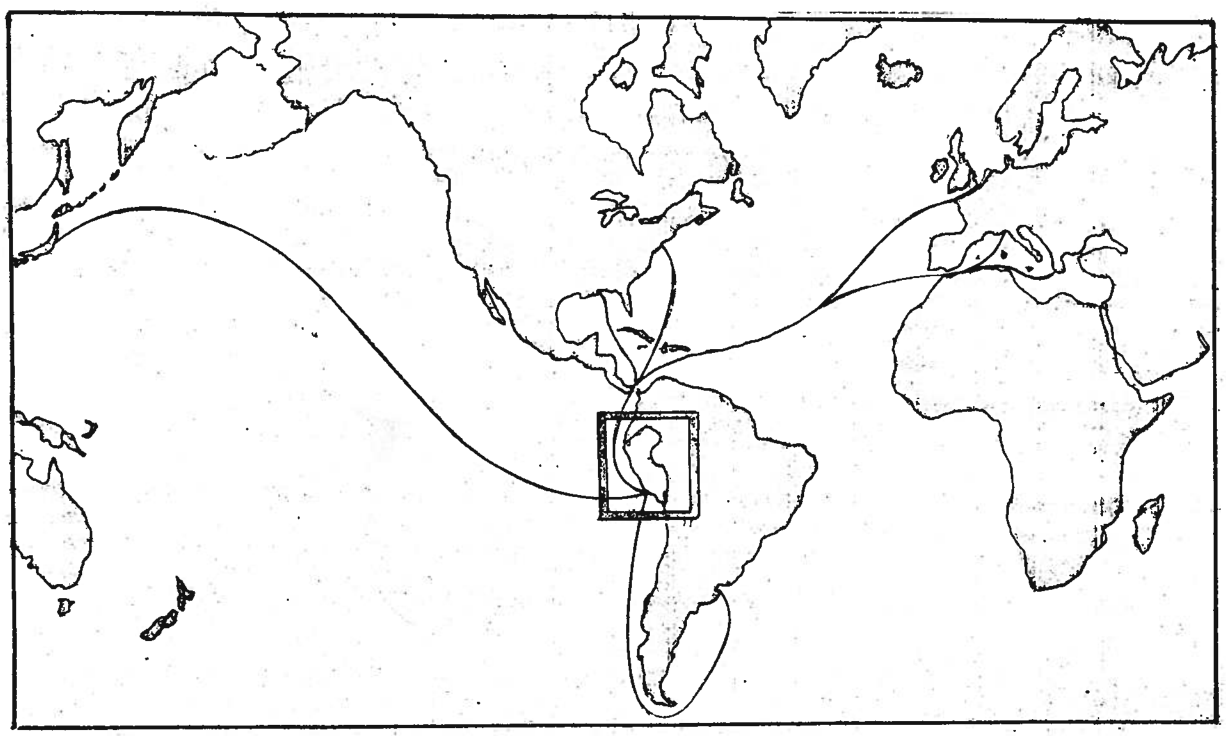


Fig. 3. Peruvian Iron Ore Trade Routes

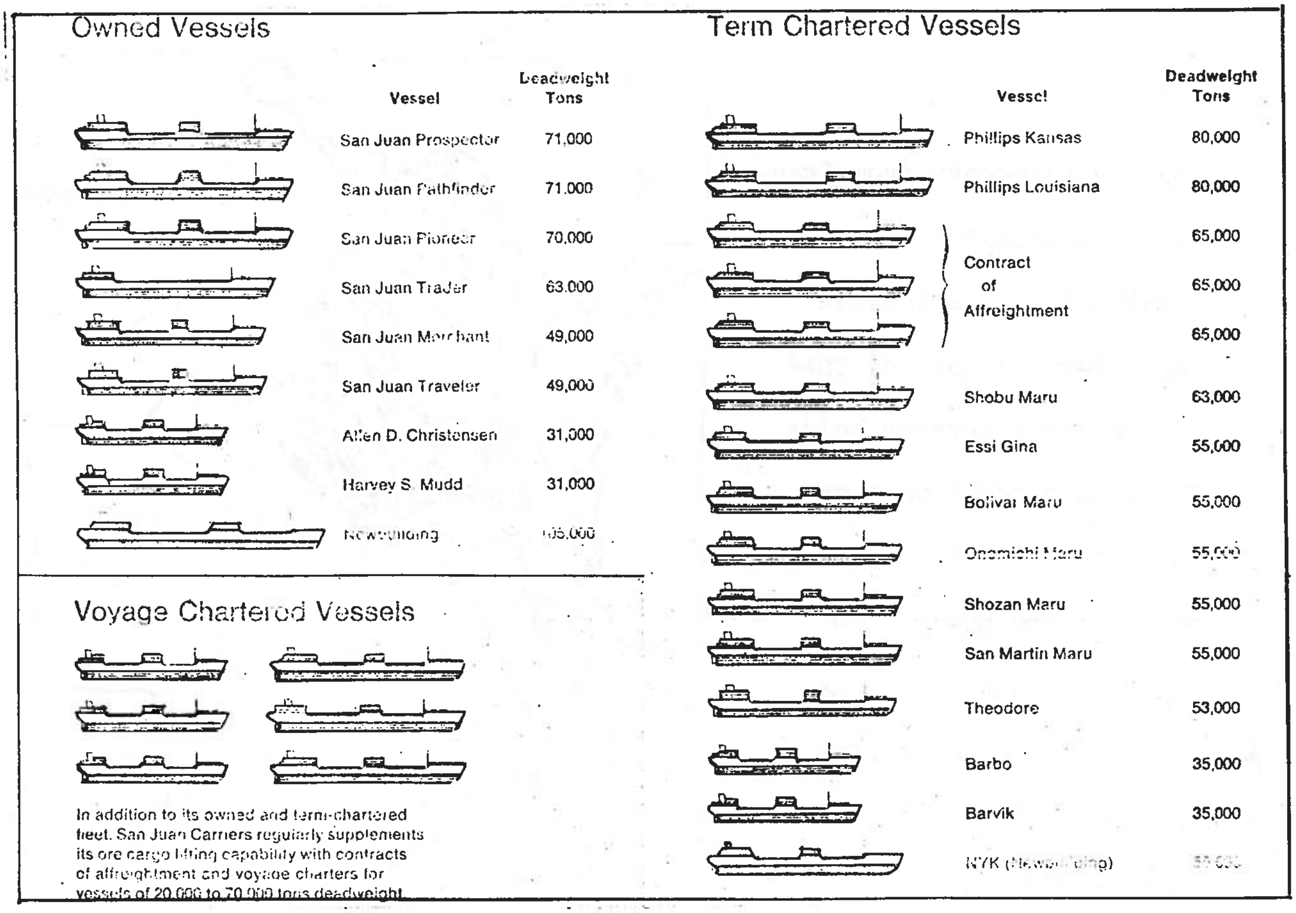


Fig. 4. MARCONA Corporation's Bulk Carrier Fleet

Colombia has been shipping coal and ore from its Pacific port of Buenaventura. It is reported that Colombia is "the only South American coal exporter with 64% of the known coal deposits in Latin America." (6) This coal is of good coking quality for steel making. In Fig. 5, the location of the coal fields and mines are presented. With reserves of 13,224 million short tons of both anthracite and bituminous coal, Colombia ranks 12th in the world. (6)

With the development of coal shipments from Buenaventura and ore shipments from Peru, it seems feasible to design a bulk carrier which can load mixed cargoes of coal and ore in alternate holds for simultaneous delivery to steel mills in other parts of the world. An OBO design could also be considered to accommodate the oil ports of Tumaco and Esmeraldas.

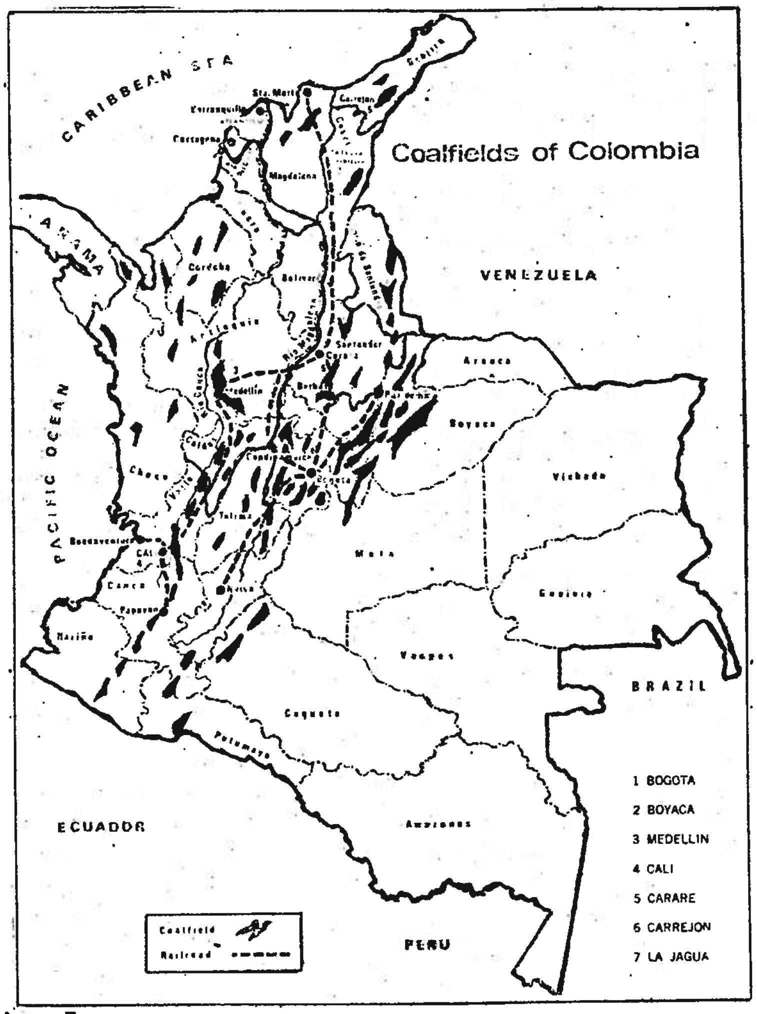


Fig. 5

Fishing Industry

The northern Pacific coast of South America is rich in fishing because of the tropical currents which provide the proper environment for the rapid growth of plankton. These coastal areas in the sea are the feeding grounds for many varieties of fish. Peru began the export of nitrates through the guano industry, but in recent years the use of fishmeal has supplanted guano.

The Peruvians have developed the ports of Pisco and Chimbote for the shipment of the fishmeal which is processed in nearby plants. The previously mentioned law concerning the port organization has been implemented with the help of World Bank loans. The old port of Pisco, which required lighters due to its shallow draft, was phased out and a new port named General San Martin 35 kilometers from the old location was developed with a loan equivalent to $14,700,000. (7) The facilities are very modern, so that "A boat arriving to load 1,000 tons of fishmeal at the old port by the barge system took two days for the operation; using the facilities of the new port, it now waits only seven hours." (7)

Colombia is also interested in developing its fishing industry beyond its present annual catch of 60,000 metric tons, which represents less than one-tenth of one per cent of the world catch. (8) Peru, in comparison, is the overall leader with 17 per cent and Chile ranks 12th with about two per cent. (8)

The Colombian INSTITUTE DE FOMENTO INDUSTRIAL (IFI) has studied this prospect of Colombian economy and helped to form a firm called the CONSORCIO PESQUERO COLOMBIANO, S.A., Colombian Fishing Consortium, which is building fishing vessels and the fish processing plants. On the Pacific coast, the port of Buenaventura has been selected to establish a processing plant with a four ton daily capacity and the CENTRO NAUTICO PESQUERO, national fishing center, to train the personnel who will run the plants and fishing vessels.

At Tumaco another fishmeal plant will be constructed. (8) Fig. 6 summarizes the capital investment of Colombia in its future fishing industry.

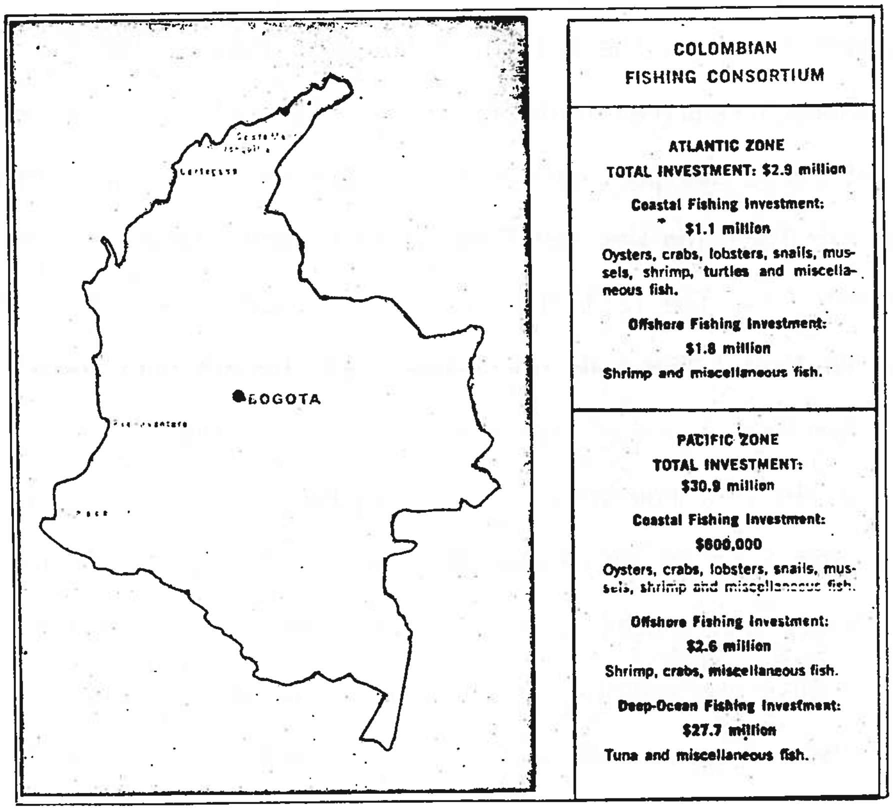


Fig. 6

In this introduction, recent developments which should play an increasingly larger part in the maritime affairs of the study region have been summarized. The following sections include tabulations of the ports and fleets of each country to be used as design aids. In addition, a survey of shipbuilding with some cost estimates is presented for the reader interested in this area of development.

Port Study

The recent improvement and development of ports located in Fig. 7 has not been well publicized. There has, however, been a steady increase in foreign as well as in coastal trade. The port characteristics relevant to the preliminary design of merchant ships were updated using information obtained from correspondence with each country's port authority. References other than Ports of the World, 1970, used for this study are listed in the bibliography.

A national trade summary and major export list is also tabulated to aid the designer in selecting a trade route. It should be noted that trade with Japan and other Asian nations has increased and should assume a larger proportion of the total trade in the next decade.

In some ports a heading titled "lighters" has an entry. This implies that the vessel must anchor out in the harbor, discharging its cargo into small draft lighters which can unload onto the pier. The magnitude of this time consuming operation has been pointed out in the drastic reduction in time to load fishmeal at Peru's General San Martin Port when the lighter system was eliminated by dredging.

In their correspondence, the port officials from Colombia, Ecuador, and Peru mentioned plans for container shipments. In the larger ports, the storage space necessary for efficient handling of containers is being developed or is already available. It seems logical to utilize refrigerated containers to carry the temperature-sensitive seasonal crops rather than to utilize specially designed ships for part of the year.

FIG. 7

MAP FOR PORT STUDY

PORTS OF COLOMBIA

PORT (STOWAGE FACTOR)	LIMITING DRAFT	FACILITIES: PIER	FORKLIFT # tons	TRACTORS # ton	CRANES # tons	STORAGE meters²	EXPORTS: COFFEE 55-70	COTTON L00-120	OIL 45	SUGAR 45-50	SOY 50	WOOD 40 (log)	IMPORTS: LIQUID	GENERAL
PACIFIC COAST O														
BUENAVENTURA	32'	2.096m(13)	158 2-5	24 2-5	5 5-7	66,462	270.000	5.331		116.985	14.307	7.664	23.453	507.605
			16 5-10		6 10	Container								
			4 20		1 20	12.699								
					2 25									
					1 30									
					2 40									
					1 60									
PLANNED						70.595								
TUMACO	20'	310m (2)	10 2-5	2 2-5	2 5	10.409			36" pipeline					
			1 7		1 7				30.000 barrel/hr.		413	33.911	- -	14.331
					1 10									
PLANNED						17.409								
CARIBBEAN COAST O														
BARRANQUILLA	34'	710m (4)	124 2-5	56 2-5	6 2½	32.831	773	10.029				1.896	8.029	313.339
			8 5-10		1 7									
			2 20		5 10									
					2 25									
					1 60									
PLANNED		1,058 (6)				44.930								
CARTAGENA	33'	1.085 (5)	57 2-5	24 2-5	7 2½	14.938	30.701	16.337				8	25.427	146.350
			7 5-10		6 10									
			2 20		2 25									
					1 40									
PLANNED		1.293 (6)				30.338								
SANTA MARTA	50'	1.150 (6)	72 2-5	25 2-5	3 10	14.871	63.724	25				611	1.547	276.982
			10 5-10		1 25									
			2 20		1 30									

FOREIGN TRADE SUMMARY 1968	IMPORT SOURCES		EXPORT DESTINATIONS	
MAIN EXPORTS	U.S.	50%	U.S.	42%
COFFEE 61%	W.GERMANY	9%	W.GERMANY	13%
CRUDE OIL 4%	SPAIN	6%	NETHERLANDS	8%
	U.K.	5%		

NOTE:
CARGO VALUES FROM
"PRINCIPALES CARACTERISTICAS
DE LOS PUERTOS. 10/71"

SOURCE:
CORRESPONDENCE WITH
HUMBERTO ZEA GONZALEZ
SUB-GERENTE DE OPERACIONES
PUERTOS DE COLOMBIA 11/22/71

PORTS OF THE WORLD 1970

PORTS OF ECUADOR

	PORT (STOWAGE FACTOR)	LIMITING DRAFT	FACILITIES: LIGHTERS	PIER	CRANES	STORAGE	EXPORTS: BANNAS 120-130	COCO 80-100	COFFEE 55-70	IVORY NUT 45	OIL 45	RICE 50	RUBBER 65	IMPORTS: CARS 150-300	GEN. CARGO
	ESMERALDAS OIL	Anchorage		2- 656' 2- 328'			/				250,000 max 400, barrel/hr				
	BAHIA DE CARAQUEZ	28½' Anchorage	6 Σ280t				/	/	/	/			/		
	MANTA	35' 15' 31' 25'	40- 10t	656' 300' 645' 495'	3 & 6 t. 30 t.	25,000rt^2 7,862rt^2	/	/	/	/		/	/		/
	Planned														
AE	LA LIBERTAD OIL	Anchorage 16' 25'			5-100 t.						10" Pipeline 350 ton/hr				/
	GUAYAQUIL	31' +9' canal +12' pier		3055' (5 ships)	75 t 2- 35 t 25 t 3- 15 t 6- 7 t	167,091m^3 Container 54,360m^2	/	/	/	/	/	/		/	/
	BOLIVAR	26'	/	690'		4,032m^2	/								/
	Planned			(2 ships) 394'											

NOTES: AE Anglo-Ecuadorian Oilfields Ltd Supply Port

SOURCES:

CORRESPONDENCE WITH ING. HUGO TOBAR, AUTORIDAD PORTUARIA DE GUAYAQUIL, 9/24/71

PORTS OF THE WORLD 1970

FOREIGN TRADE SUMMARY 1968		IMPORT SOURCES		EXPORT DESTINATIONS	
MAIN EXPORTS		U.S.	46%	U.S.	38%
BANNNAS	50%	W.GERMANY	13%	W.GERMANY	16%
COCOA	19%	ITALY	10%	JAPAN	16%
COFFEE	16%	JAPAN	7%	ITALY	5%
		VENEZULA	6%		
		U.K.	5%		

PORTS OF PERU

	PORT (STOWAGE FACTOR)	LIMITING DRAFT	FACILITIES: LIGHTER	FACILITIES: PIER	FACILITIES: CRANES # tons	FACILITIES: NOTES	COASTAL OIL 45	COPPER 15-20	FISHMEAL 65	IRON ORE 12-15	TOTAL COASTAL tons	IMPORT: DRY CARGO tons	IMPORT: LIQUID tons	EXPORT: DRY CARGO tons	EXPORT: LIQUID tons
	TALARA +16.4%*	21'		770 ft	3 5	°Bulk	/				2,753,235	39,212	30,613	563	1,817
		38'		250 ft°	2 18	OIL									
	PAITA +36.2%	32.5'	17 700t	1,000	1 5				/		53,263	31,329	7,998	42,959	8,358
					1 10										
					1 25										
	SALAVERRY +28.1%	27'		(2)1,500	2 25	Submarine	/				295,071	80,718	- -	261,393	88,175
					Bulk	PIPELINE									
					Sugar: 350t/hr										
	CHIMBOTE -16.0%	29'	46 2,190	800	15 10	•Steel	/		/	For STEEL	409,318	171,025	- -	650,675	104,788
	DAMAGED BY 1970 EARTHQUAKE	36'		850•	1 40	Mill '5				MILL					
	CALLO -3.4%	33'	43 3,740	(4)2,400	138 FORK	WHEAT	/		/		1,054,764	1,362,793	162,152	1,277,920	41,000
					25 5-25	300t/hr									
					1 150	UNLOAD									
	PLANNED			(11)											
	GEN. SAN MARTIN (PISCO) +31.5%	36'		2,300	1 15	FISHMEAL 150t/hr			/		256,417	18,746	5,412	557,816	29,143
M	SAN JUAN +5.1% (SAN NICOLAS)	25-49'		720	IRON ORE LOADER 4,500 t/hr					/	- -	70,689	79,438	10,043,737	- -
	MATARANI -51.6%	29'		1,200	3 5						16,549	131,700	- -	98,438	- -
	BOLIVIAN TRADE				1 22½						- -	64,104	794	118,621	- -
	ILO +22.4%	42'	38 1900	280	3 50			/	/		125,116	30	- -	115,157	11,690
SP	ILO SOUTHERN +23.0%	33-55'		600	COPPER LOADING			/			14,691	25,286	169,342	150,518	-- -
	IQUITOS +19.9%	AMAZON RIVER TRADE			4						84,417	39,825	- -	7,827	- -

FOREIGN TRADE SUMMARY 1969	IMPORT SOURCES		EXPORT DESTINATION	
	U.S.	34%	U.S.	39%
MAIN EXPORTS	W.GERMANY	11%	JAPAN	15%
COPPER 30%	ARGENTINA	10%	W.GERMANY	11%
FISHMEAL 23%	JAPAN	6%	BELGIUM	7%
IRON ORE 8%	U.K.	5%	NETHERLANDS	6%

NOTES: M = MARCONA MINING CORP.
SP = SOUTHERN PERU COPPER CO.
♦ VARIATION 1969-1970

SOURCES: CORRESPONDENCE WITH
C. ALM. MELITON CARVAJAL PAREJA
GERENTE GENERAL
EMPRESA NACIONAL DE PUERTOS
DEL PERU 10/11/71

PORTS OF THE WORLD 1970

The limiting size of the Panama Canal poses a restriction on the size of the ore and oil terminals. Marcona Corporation's SS San Juan Prospector, 71,000 Dwt, is reported to be the largest cargo ship to transit the Panama Canal. (5) Professor Norman J. Padelford, M.I.T., is currently studying "Ocean-Borne Commerce and the Future of the Panama Canal, Some Tentative Observations." (9) Fig. 8 summarizes the alternatives and their costs.

Professor Padelford's colleague, Professor John Devanney III has made a study of "The Conferences and the West Coast of South America," (9) which is summarized in Appendix 1. The conference refers to shipping agreements formed to eliminate freight rate competition among member shipping companies, to standardize shipping practices, and to provide regularly scheduled service between regional ports. Critics of this system cite as disadvantages the elimination of competition and the consequently higher rates as well as exclusive patronage of one shipper towards a shipping line.

Professor Devanney examined the existing conference to determine how applicable these criticisms are. His conclusions appear in Appendix 1.

With every export, a stowage factor has been listed. However, as Reference 10 warns:

> Nothing could be more dangerous than to look up in one of the books of tables the stowage factor of a particular commodity and then to divide a ship's total (bale) cubic capacity by it, with a view to establishing how many tons she would be able to carry. Sawn softwood, for example, has a stowage factor of about 60 cubic feet to the ton. But, a

Fig. 8

EXHIBIT 3

ALTERNATIVES FOR FUTURE INTEROCEANIC CANAL

1. Keep Panama Canal as it is now. Let largest ships go around.

2. Retain present Canal but enlarge locks to 1,450 x 160 x 65 ft. Take 150,000 Dwt ships. 35,000 tr./yr. Estimated construction cost: $1,530,000,000.

3. Build Sea Level Canal through Canal Zone. Dimensions 550 x 65 ft. Take 150,000 Dwt ships. 39,000 tr./yr. Estimated construction cost: $2-3,000,000,000 depending upon route.

4. Construct Sea Level Canal outside of Zone. Will require new treaty. Recommended by I.C.S.C. 1970. Dimensions as in No. 3. Estimated construction cost exclusive of treaty arrangements: $2,880,000,000.

5. Turn to other countries for route. Preferred alternatives: Colombia or Nicaragua.

> ship with a total (bale) cubic capacity of 300,000 cubic feet positively would not be able to load 5,000 tons of it under deck. On the contrary, she would be lucky, with most careful stowage, to ship anything over 3,750 tons.

This illustrates that the stowage factors can act only as a rough guide to the vessel's capacity in a certain product. They make allowance neither for the space lost in packing nor the interference of the ship's structural members in the cargo hold.

For the ports in this study there is an additional point which the designer must take into consideration:

> Present examples include the shipment from the North Pacific of metal ingots combined with sawn wood . . . Combinations like these avoid the wastage of space which occurs when the heavy materials are shipped on their own as full cargoes, or the loss of deadweight involved in filling entire ships with goods of very low density. The aim must be to put the ship down to her loadline and at the same time make use of all available cubic capacity. (10)

National Fleet Study

As part of the shipbuilding and ship repair study which follows, a survey of each country's national fleet was made. The book La Marina Mercante Iberoamericana, published by the Instituto de Estudios de la Marina Mercante Iberoamericans, has completed this survey and publishes yearly an updated revision. Using the 1969 listings, it was possible to prepare the tabular data on the National Fleets of Colombia, Ecuador, and Peru. The survey results are plotted in Figs. 9 and 10. In Fig. 9, post 1950 and post 1955 vessels are

NATIONAL FLEET OF COLOMBIA

	COMPANY	YEAR	LENGTH Meter	LENGTH Feet	BREADTH Meter	BREADTH Feet	1/D	DEPTH Meter	DEPTH Feet	DRAFT Feet	ENGINE	SHP	SPEED Knots	LIGHT-SHIP
	GRANCOLOMBIANA S.A.													
	1	1968	92.9	305.1	14.5	47.6	6.4	6.1	20.0	17' 5"	B & W	3,900	15	1,432
	2	1968	92.9	305.1	14.5	47.6	6.4	6.1	20.0	17' 5"	B & W	3,900	15	1,432
	3	1958	144.8	475.05	18.9	62.0	7.7	10.9	35.8	23' 6"	M.A.N.	7,860	16	4,500
C-C	4	1958	78.5	257.5	11.5	37.7	6.8	6.2	20.3	18' 7"	B & W	1,400	10	972
	5	1960	144.8	475.1	18.9	62.0	7.7	10.9	35.8	23' 6"	Sulzer	7,300	17	4,577
	6	1958	144.8	475.1	18.9	62.0	7.7	10.9	35.8	23' 6"	M.A.N.	7,860	16	4,500
	7	1964	165.9	544.5	21.18	69.5	7.8	12.9	42.3	30' 1"	Sulzer	14,400	19	8,000
	8	1965	165.9	544.5	21.18	69.5	7.8	12.9	42.3	30' 1"	Sulzer	14,400	19	8,000
	9	1966	165.9	544.5	21.18	69.5	7.8	12.9	42.3	30' 1"	Sulzer	14,400	19	8,000
	10	1953	128.2	420.5	16.8	54.9	7.6	10.21	33.5	22' 3"	Sulzer	4,275	14	3,209
	11	1966	165.9	544.5	21.18	69.5	7.8	12.9	42.3	30' 1"	Sulzer	14,400	19	8,000
	12	1955	106.4	349.2	14.7	48.2	7.2	8.6	28.0	22' 4"	M.A.N.2	2,940	13	2,085
	13	1958	144.8	475.1	18.9	62.0	7.6	10.9	35.8	24'	Sulzer	7,300	17	4,585
	14	1953	128.1	420.5	16.7	54.9	7.6	10.2	33.5	22' 3"	Nordberg	4,274	14	3,209
	15	1949	128.17	420.5	16.7	54.9	7.6	10.2	33.5	22' 3"	Nordberg	4,274	14	3,099
	16	1951	129.1	423.5	16.8	55.1	7.7	10.2	33.5	22' 9"	Fairfield	4,600	14	3,594
	17	1955	106.4	349.2	14.7	48.2	7.2	8.55	28.1	22' 4"	M.A.N. 2	2,940	13	2,085
	18	1958	144.8	475.1	18.9	62.0	7.7	10.9	35.8	23' 7"	Sulzer	7,300	17	4,560
	19	1959	144.8	475.1	18.9	62.0	7.7	10.9	35.8	24'	Sulzer	7,300	17	4,577
	20	1955	106.4	349.2	14.7	48.2	7.3	8.6	28.0	22' 4"	M.A.N.2	2,940	13	2,085
	21	1949	128.2	420.5	16.8	54.9	7.6	10.2	33.5	22'	Nordberg	4,275	14	3,099
	22	1955	106.4	349.2	14.7	48.2	7.3	8.6	28.0	22' 4"	M.A.N. 2	2,940	13	2,085
	23	1957	144.8	475.1	18.9	62.0	7.7	10.9	35.8	23' 6"	M.A.N.	7,860	16	4,500
	24	1945	103.2	338.7	15.3	50.3	6.7	8.9	29.0	23' 5"	Sulzer	1,700	10	2,350
C-C	25	1967	85.3	279.9	14.6	47.9	5.8	7.0	22.9	12' 9"	CAT. 2	1,530	12	912
C-C	26	1968	85.3	279.9	14.6	47.9	5.8	7.0	22.9	12' 9"	CAT. 2	1,530	12	912
	27	1957	144.8	475.1	18.9	62.0	7.7	10.9	35.8	23' 6"	M.A.N.	7,860	16	4,500
	28	1964	165.9	544.5	21.2	69.5	7.8	12.9	42.3	30' 1"	Sulzer	14,400	19	8,000
	29	1965	165.9	544.5	21.2	69.5	7.8	12.9	42.3	30' 1"	Sulzer	14,400	19	8,000
	30	1968	165.9	544.5	21.2	69.5	7.8	12.9	42.3	30' 1"	Sulzer	14,400	19	8,000
C-C	31	1943	99.9	327.9	14.1	46.5	7.0	7.7	25.2	20'	REC. STEAM	1,280	10	1,311
	MINISTERO DEFENSA NATIONAL													
T-C	32	1966	183.6	605.5	23.4	76.7	7.8	12.8	41.9	32'	Sulzer	10,500	16	6,819
T-C	33	1950	157.1	515.4	19.1	62.5	8.2	11.6	38.0	30' 6"	Gotaverkin	7,350	14	5,996
T-C	34	1945	99.1	325.16	14.6	47.9	6.8	6.6	21.7	19'	Nordberg	1,700	11	2,165
T-C	35	1945	99.1	325.16	14.6	47.9	6.8	6.6	21.7	19' 9"	Enterprise	1,400	11	1,730
T-C	36	1968	183.7	602.5	23.4	76.8	7.8	12.8	41.9	32'	Sulzer	10,500	16	6,800

NOTE: T = TANKER, C = CARGO
-C = COASTAL TRADE

SOURCE: LA MARINA MERCANTE IBEROAMERICANA 1969

NATIONAL FLEET OF ECUADOR

	COMPANY	YEAR	LENGTH Meter	LENGTH Feet	BREADTH Meter	BREADTH Feet	L/B	DEPTH Meter	DEPTH Feet	DRAFT Feet	ENGINE	SHP	SPEED Knots	LIGHT-SHIP
	PRIVATE OWNERS													
T-C	37	1968	138.9	455.9	17.78	58.33	7.81	11.6	35.2	24'11"	FIAT	10,500	20	4,500
T-C	38	1944	59.48	195.14	10.36	33.98	5.74	5.4	17.7	12'	FAIR-MORSE	860	8	1,445
T-C	39	1947	71.40	234.24	11.58	37.99	6.16	4.0	12.9	12' 8"	DAVY-PAX	1,200	9	1,664
C-C	40	1943	99.95	327.91	14.17	46.48	7.05	7.8	25.2	20'10"	REC-STEAM	1,280	10	1,310

NOTE: T = TANKER
C = CARGO
-C = COASTAL TRADE

SOURCE: LA MARINA MERCANTE IBEROAMERICANA 1969

NATIONAL FLEET OF PERU

	COMPANY	YEAR	LENGTH Meter	LENGTH Feet	BREADTH Meter	BREADTH Feet	L/B	DEPTH Meter	DEPTH Feet	DRAFT Feet	ENGINE	SHP	SPEED Knots	LIGHT-SHIP
	PRIVATE OWNERS													
	1	1936	157.67	517.3	18.99	62.3	8.3	12.1	39.6	27'	M.A.N.	8,000	16	5,225
	2	1955	100.61	330.0	12.70	41.7	7.9	7.4	23.9	15'	M.A.N.	1,500	11	1,381
T-C	3	1955	170.1	561.3	22.58	74.1	7.5	12.1	39.8	31' 1"	TURB. 2	10,000	15	6,300
	4	1950	146.9	482.0	19.05	62.0	7.7	11.9	38.9	25' 7"	Sulzer	8,240	15	5,483
	5	1953	110.8	363.5	16.0	52.5	6.9	8.4	27.5	22' 1"	M.A.N.	3,360	14	2,214
T-C	6	1952	164.0	537.9	21.10	69.3	7.8	11.5	38.1	29' 9"	TURB. 3	6,000	14	5,705
	7	1951	82.0	269.12	12.8	41.9	6.4	7.7	26.1	17'11"	COMP. 2	1,500	12	2,170
	8	1943	158.6	520.3	19.3	63.3	8.2	11.7	39.2	30'	STORK	8,000	15	6,670
	9	1951	146.9	482.1	19.1	62.5	7.7	11.8	38.8	25' 7"	Sulzer	8,240	15	5,379
	10	1947	78.61	257.9	12.24	40.15	6.4	5.7	18.9	18' 9"	Allis	2,250	12	1,290
	11	1954	121.4	398.3	15.5	50.8	7.8	9.4	30.7	24' 1"	M.A.N.	3,000	13	3,014
T-C	12	1944	159.7	523.9	20.75	68.1	7.7	11.9	39.1	30' 2"	TURB. 1	6,500	14	5,653
	COMPANIA PERUANA DE VAPORES													
	13	1957	141.8	465.3	18.3	60.0	7.8	11.2	36.5	26' 9"	Sulzer	4,500	14	4,000
	14	1968	156.9	514.8	19.7	64.0	7.9	11.9	39.3	29' 9"	Sulzer	9,600	17	5,121
	15	1968	156.9	514.8	19.7	64.0	7.9	11.9	39.3	29' 9"	Sulzer	9,600	17	5,111
	16	1959	144.5	474.2	18.6	61.0	7.8	11.4	37.2	27' 7"	Doxford	4,400	14	4,201
	17	1956	142.9	468.8	18.1	61.3	7.6	8.5	27.7	27'	Doxford	6,800	15	4,071
	18	1957	137.9	452.3	12.1	39.7	11.4	8.8	28.8	27'	Doxford	4,400	13	3,965
	19	1957	140.0	459.9	18.4	60.2	7.6	8.9	29.5	26' 1"	Doxford	4,400	13	3,720
	MINISTERO DE MARINA													
C-C	20	1938	138.0	452.8	17.0	56.4	8.0	7.0	22.9	24'	M.A.N.	3,300	14	4,200
C-C	21 LST-WWII	1943	99.9	327.7	15.2	49.9	6.6	7.6	25.2	17'	G.M.	1,800	10	1,700
	22 TRAINING	1941	140.0	459.3	19.2	62.9	7.3	9.3	30.6	25' 7"	Nordberg	6,000	15	5,320
T-C	23 SIMA	1965	117.4	385.0	16.1	52.9	7.2	7.9	25.9	24'	B & W	2,400	12	2,700
C-C	24	1962	163.0	534.7	22.0	72.2	7.4	11.7	38.8	29' 8"	B & W	7,500	15	6,084
C-C	25 LST-WWII	1943	99.9	327.7	15.2	49.9	6.6	7.7	25.1	17'	G.M.	1,800	10	1,700
T-C	26 SIMA	1968	134.3	440.6	18.9	62.0	7.1	9.4	30.7	24'	B & W	5,400	14	3,325
	27	1954	109.0	357.6	15.5	50.8	7.0	6.8	22.4	19' 6"	B & W	2,200	12	2,248
T-C	28 SIMA	1959	117.4	385.0	16.1	52.9	7.2	7.9	25.9	24'	B & W	2,400	12	2,700

NOTE: T = TANKER
C = CARGO
-C = COASTAL TRADE
SIMA = PERUVIAN SHIPYARD, CALLO, PERU

SOURCE: LA MARINA MERCANTE IBEROAMERICANA 1969

plotted number against length to help in estimating the change in each country's fleet. In Fig. 10, the length/beam ratio against the ship's length is plotted from the tabulated data of each national fleet. These dimensions are critical in laying out the dockyard facilities.

Shipyard and Ship Repairing Study

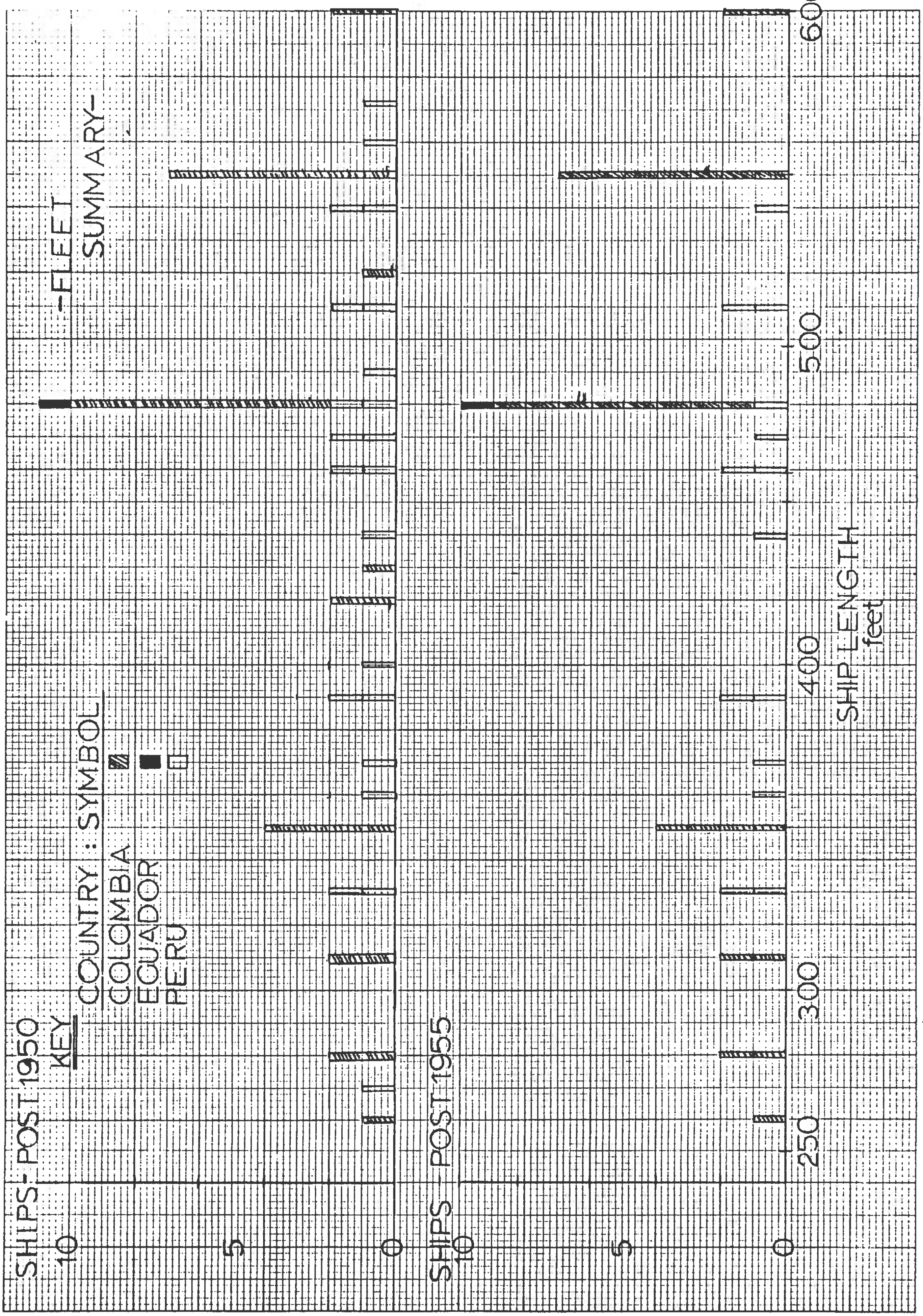
Since many types of ships can be considered for shipyard production, it is necessary to divide the vessels into three types: fishing, coastal ship, and international vessel. The particulars of these vessels are summarized in Table I.

TABLE I

VESSEL TYPE	SIZE	OPERATION	ENGINE
Fishing Vessels	up to 100' up to 500 t	Good work platform Low speed operation	Diesel
Coastal Ship	150-400' 800-10,000'	Cargo versatility Effective cargo handling	Diesel
International Trader	400-600' 6,000-16,000 t	Speed Cargo storage	Diesel Steam Turbine

The distinction between the coastal and international ship is not definite. However, from a shipbuilding point of view, coastal vessels and fishing boats seem reasonable candidates for production in shipyards located in the study region. Fishing vessels have been

FIG 9



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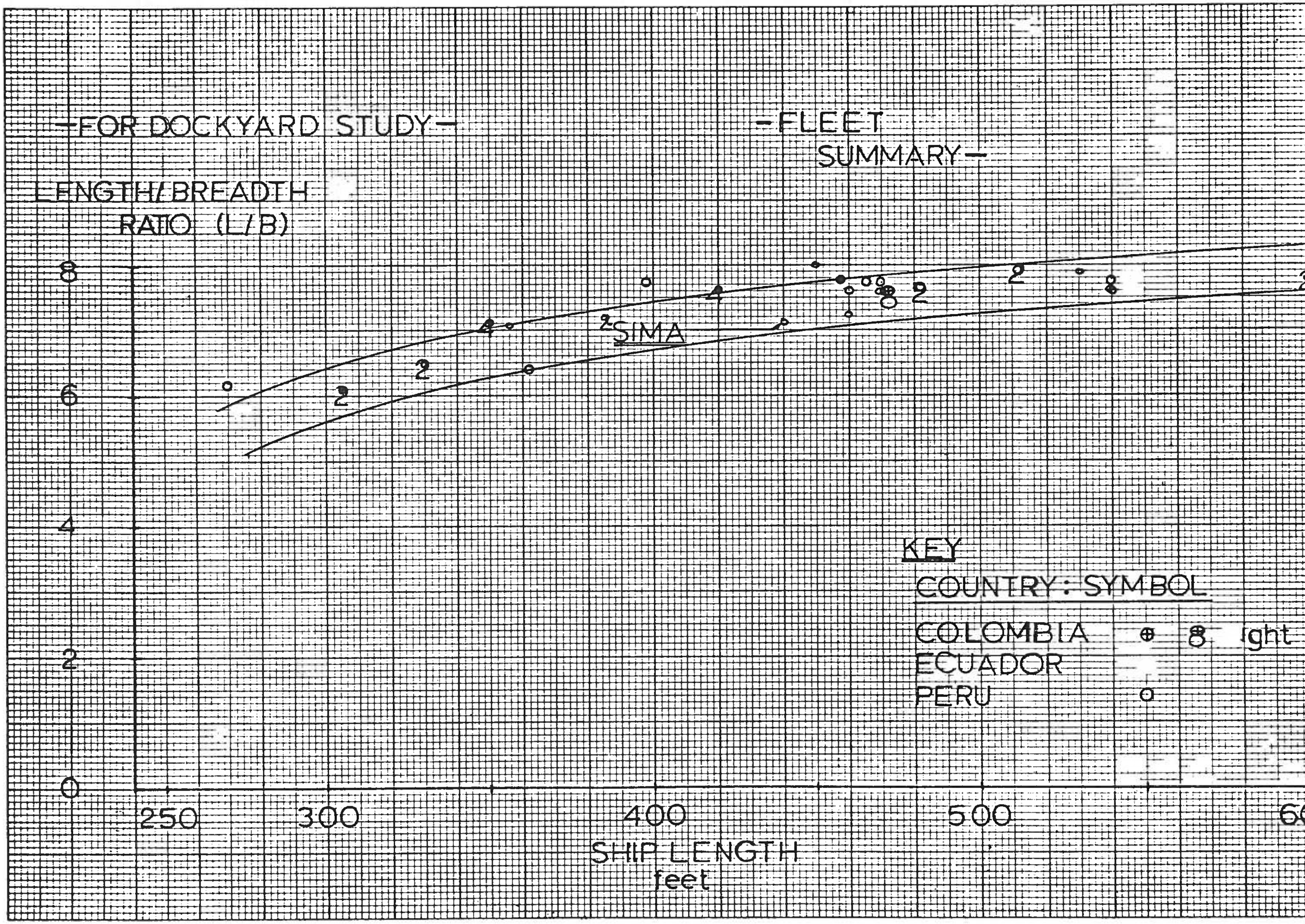

-FOR DOCKYARD STUDY-
-FLEET SUMMARY-
LENGTH/BREADTH RATIO (L/B)
8
6
4
2
0
250
300
400
500
600
SHIP LENGTH
feet
SIMA
KEY
COUNTRY: SYMBOL
COLOMBIA
ECUADOR
PERU

constructed in all three countries.

Each country has developed a different philosophy concerning the procurement of coastal freighters or tankers. Colombia and Ecuador usually have the vessel built in a European or Japanese shipyard. Peru has developed a yard in Callao, following the practice of building its coastal ships in a government yard. The Peruvian yard, Servicia Industrial De La Marine (SIMA) has construction facilities for ships up to 16,000 Dwt and repair facilities for ships of 19,000 Dwt. In the National Fleet of Peru, tabulation of these ships is noted.

The U.N. Food and Agriculture Organization has a Fisheries Division which has served as a technical agency for developing countries. In one discussion about shipyards, a point is made that "boat building is a capital-starved industry, working on extremely small margins of profits and usually relying on partial advance payment for orders to be able to lay in stocks of materials and to pay labour at regular intervals." (11) The recommendation continues:

> It would be useful if governments who decide to invest in boatyards would do so by giving small industries development loans to the existing yards rather than by creating new, state-owned boat-building facilities. They would in this way assure a better utilization of the existing facilities as well as avoid getting entangled in the administration of such marginal production centers as yards. (11)

In some instances, a new shipyard has been created through international cooperation. The Brazilian government, recognizing that the existing shipyards couldn't meet its planned fleet expansion, considered developing another yard.

The Japanese shipbuilding company, Ishikawajima-Harima Heavy Industries, Co., Ltd. (IHI) provided technical assistance and equipment for the new shipyard in Rio de Janeiro Guanabara. This yard, called Ishikawajima de Brazil, Estaleiros S.A., was founded in January 1959 and from the first ship in 1961 has manufactured a series of cargo vessels. IHI reports: "Besides these vessels, the shipyard also produced many diesel engines, iron and steel making machinery and other types of machinery." (12)

This is a typical situation, because of the ups and downs in shipbuilding. Several other South American shipyards have had diversified production for many years. Astilleros Astarsa in Argentina, for instance, builds hydroelectric plant equipment and, among other non-marine activities, builds and repairs railroad cars and locomotives as well as tanks for the Argentine Army.

A yard located in this northwestern Pacific region could be utilized in a similar scheme. The heavy equipment could be applied to erection of bridge and highway spans and to the pipefitting of drainage and irrigation projects. The construction materials could be loaded directly onto coastal barges or freighters bound for the developing area.

Viewing the yard in such a context, the major components to be utilized in ship construction are the cranes and the dock. These two areas were investigated for this report. The dock has many forms, ranging from a floating drydock to a rail docking system served by an elevator platform. It is outside the scope of this report to consider this at length. A report, "Modern Dock Structures for Large and Medium Size Ships," by Gleb Anatol'Yevich Vakharlovshiy, et al gives a full discussion and evaluation of the various docking systems. Fig. 11, reproduced from this report, gives some relative comparisons of the various systems considered.

Operating Time for Launching and Raising Ships For Different Types of Docking Installations, in hours

No.	Types of Installations	Operating time (approximate)				
		Launch	Lift	Transferring overland		
				In Launch	In Lift	Full Cycle
1	2	3	4	5	6	7
1	Graving dock:					
	for medium-size ships	2.0	4.5	—	—	6.5
	for large-size ships	3.0	8.0	—	—	11.0
2	Flooding dry ship repair dock	6.0	12.0	—	—	18.0
3	Flooding dock-chamber	6.5	6.0	7.0	7.5	27.0
4	Floating transfer dry dock	2.5	4.0	4.5	5.0	16.0
5	Vertical hydraulic ship hoists:					
	with lengthwise rolling (long-thrust jacks)	2.0	2.5	7.0	7.5	19.0
	with lengthwise rolling (short-thrust jacks)	3.0	3.5	7.0	7.5	21.0
	with crosswise rolling (long-thrust jacks)	3.0	3.5	7.0	7.5	21.0
	with crosswise rolling (short-thrust jacks)	3.0	4.5	7.0	7.5	22.0
6	Inclined ship hoists or slips:					
	single-place "rail dock"	2.5	3.0	—	—	5.5
	longitudinal slip	2.5	3.0	7.0	7.5	20.0
	transverse, two-stage slip	2.5	3.0	4.5	5.0	15
7	Floating dry docks (Q=10.000 t):					
	floating dry docks alone	1.5	4.5	—	—	6.0
	Dock-carrier with pontoon dock	5.5	8.5	—	—	14.0

Fig. 11

One system given a great deal of credit is the vertical lift linked to a rail transfer. Using this system, it is possible to berth many vessels and to do repair and survey without tying up the dock.

In Appendix 2, a proposal is presented for the erection of a vertical lift system dock or "Syncrolift Drydock" from Pearlson Engineering Company, Inc. The vessel size that can be accommodated by this proposed dock is 350 feet long with a beam of up to 85 feet. The capacity is 4,200 tons. Using the values from Fig. 12 (13), it is possible to correlate the vessel deadweight with its docking weight.

Characteristics of Several Representatives of Medium and Large Tonnage Ships

Parameters	Dry Cargo Ships		Ore carriers	Cargo-Passenger Ships		Tankers				Industrial Bases
Registered tonnage, GRT	7200	9500	5600	9600	17 900	8000	13 000	19 000	95 000	14 000
Deadweight, t.	10 600	12 000	7 200	5 300	7 750	11 600	20 000	30 000	150 000	10 000
Displacement at full load, t.	14 300	17 200	11 100	14 000	20 000	16 250	28 000	40 000	190 000	23 000
Weight empty, t.	3 750	5 150	3 900	8 750	12 100	4 700	7 000	9 300	35 000	9 000
Docking weight, t.	4 500	6 200	4 700	10 500	14 500	5 600	8 500	11 000	40 000	11 000
Length overall, m.	135	158	134	154	182	145	180	203	320	170
Beam, m.	17,5	19,5	17	18,5	22,5	19,2	24	26	48	23
Draft on docking, m.	3,0	3,5	3,5	7,0	7,0	4,0	4,0	4,5	5,5	6,0
Loading per running m. of length on docking, t/m.	60	70	60	100	170	65	90	120	200	110

Fig. 12

The Japanese company IHI markets shipyard cranes; a pamphlet illustrating the different arrangements and crane details was obtained to illustrate this part of the shipyard study. In Fig. 13, the various arrangements possible using a drydock basin and either a gantry or jib crane are shown. In Fig. 14, the capacities of each type of crane are given and correlated to the dock's capacity. (14)

While the construction of ships for coastal trading is still developing, the fishing vessel industry has made great progress in Colombia, Ecuador, and especially in Peru. The Peruvian fishing fleet has been expanded greatly in recent years; Peru has become the leading fishing nation with 17% of the world's catch. Colombia has organized several companies with the intent of developing a fishing industry to export shrimp to the United States and Europe. Details of this operation include the construction of fishing vessels. One shipyard, Astilleros Magdalena Limitada, in Barranquilla, is building ocean-going fishing vessels for export. (15) Its orderbook is summarized in Table II.

TABLE II. Orderbook of Fishing Vessels, Astilleros Magdelena Ltd.

NUMBER	VESSEL LENGTH	COST/SHIP	OWNER
15	68 feet	$74,000	Nicaragua
6	72 feet	$79,000	Nicaragua
8	72 feet	$62,000	Booth Fisheries, Chicago, Illinois

Fig. 13

Shipyard Layout is Important

Shown here are principal crane arrangement patterns at shipyard. The study of these patterns and their application can help you effect overall modernization of the material handling system in your shipyard.

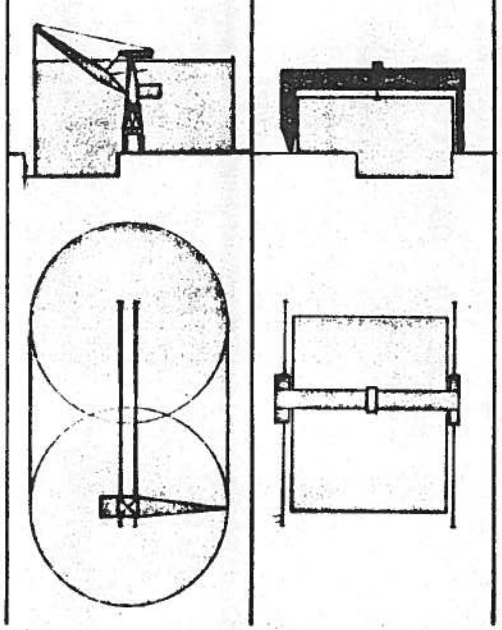
Features of jib and gantry cranes

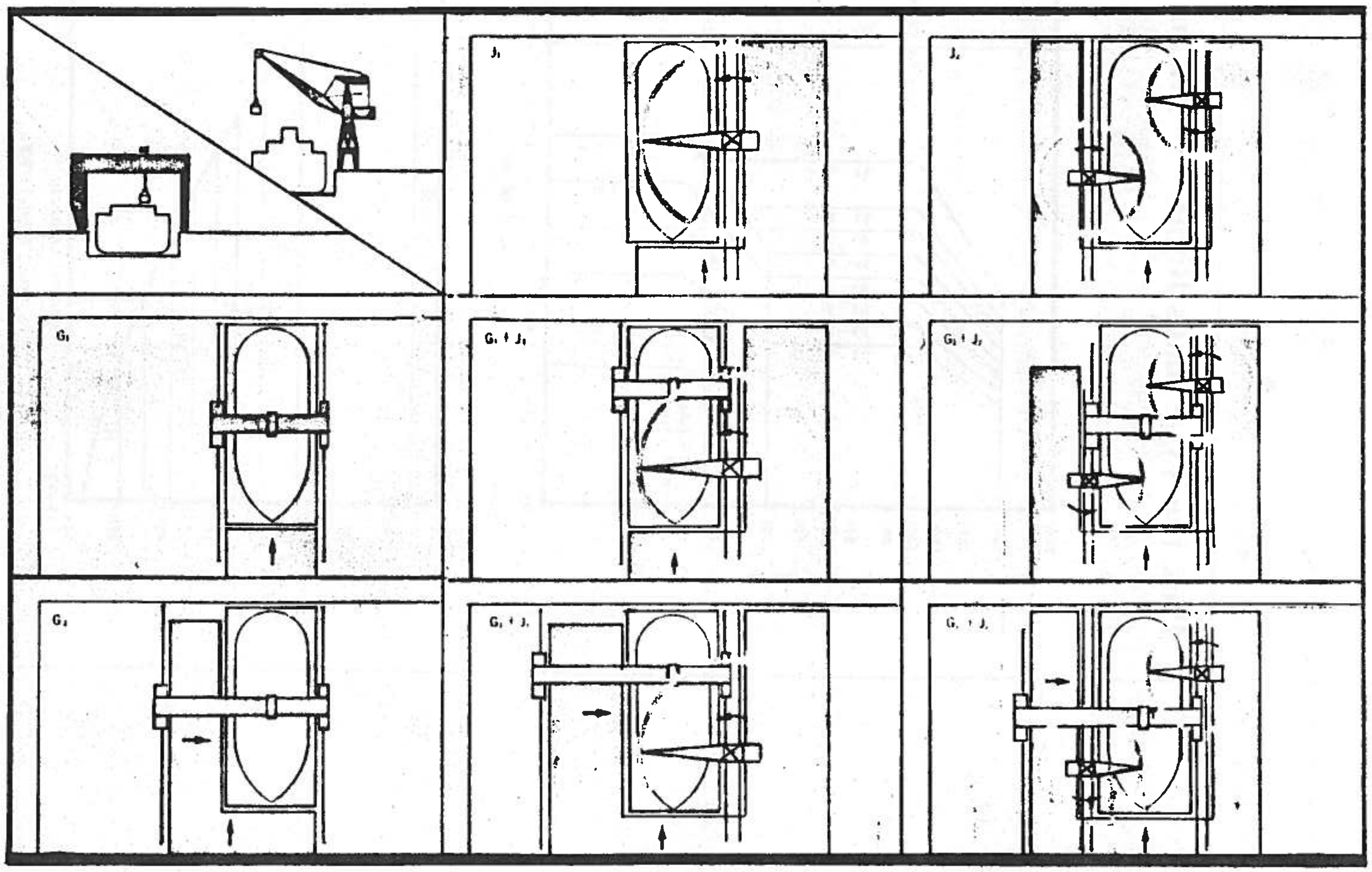
Jib Crane

- Easily manoeuverable and versatile
- Wide range of applications
- Many capacity advantages
- Excellent layout flexibility

Gantry Crane

- High loading capacity
- Wide span
- Easy operation





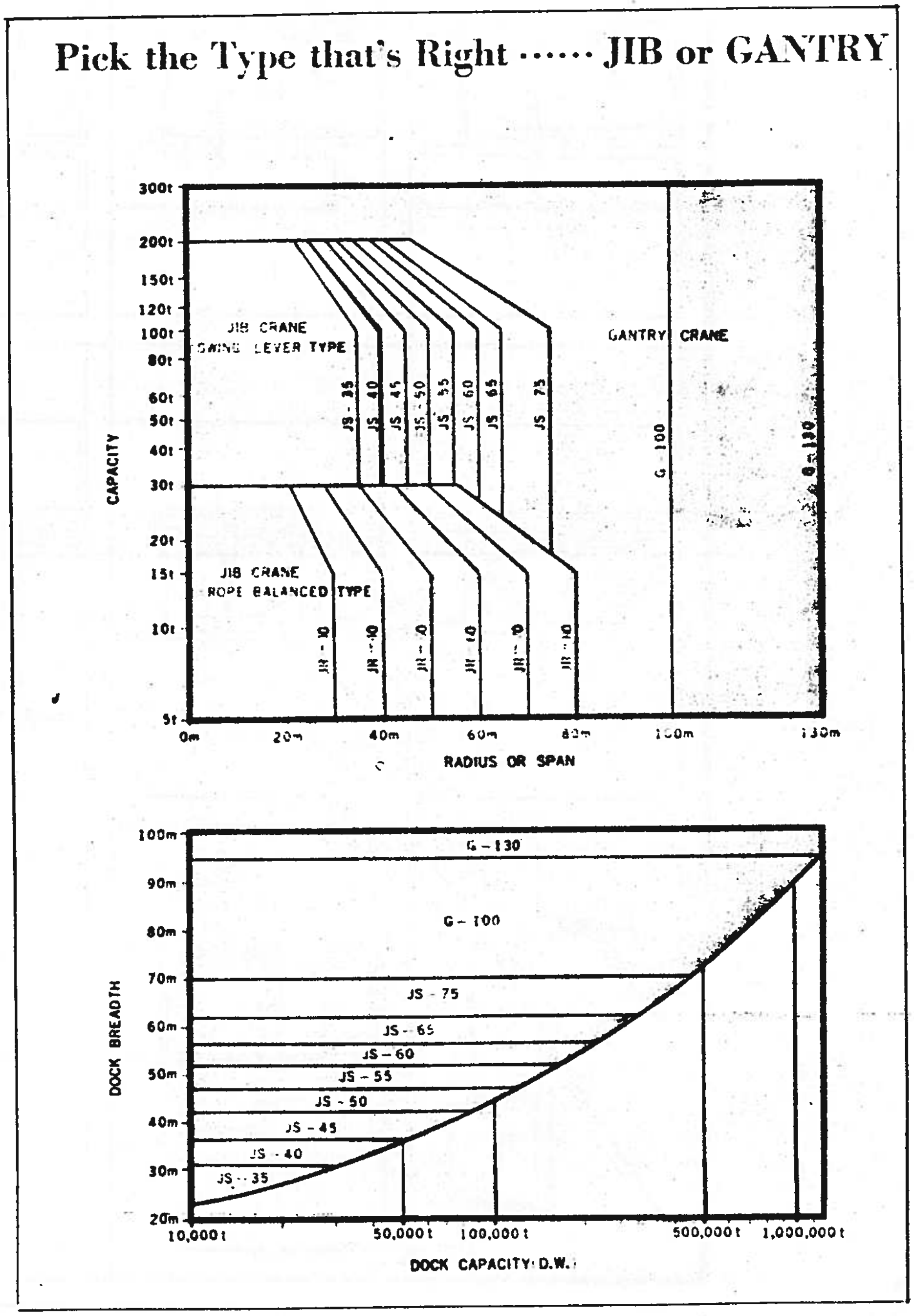


Fig. 14 Capacities of Shipyard Cranes

The engine and modern fishing gear are imported from the United States; steel plates and other construction materials come from Spain. (15)

In tropical waters, fouling of the ship's hull requires annual docking. In an effort to reduce this cost, some pilot vessels have been constructed using an aluminum or a copper hull. While the initial cost is relatively higher than that of steel, the anti-fouling properties of these materials and lightweight construction can offset this over the lifetime of the ship.

CONCLUSION

This report has presented recent developments in the maritime picture of Colombia, Ecuador, and Peru. It was written with the intent of giving the reader interested in ship design enough data to make a good preliminary design with features useful in trading along the northwest Pacific coast of South America.

Material dealing with shipbuilding has also been presented and discussed to give some impressions of what in involved in considering a shipyard for this study region.

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Appendix 1

OCEAN TRANSPORTATION

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From Professor John Devanney III's presentation
CONFERENCE RATE MAKING AND THE WEST COAST OF SOUTH AMERICA

This presentation describes a study we have undertaken of the effects of conference rate making on the trade of the West Coast of South America. This effort included a fairly detailed look at the present situation, an analysis of what an efficient liner service for this trade would look like and the implications for developing countries with respect to:

a) support or non-support of the conference system
b) investment in domestic merchant marine
c) formation and organization of shipper's councils

Basic results so far:

(1) The conferences are charging little more than the marginal costs of efficient service on the trade that actually moves Northbound. These are generally large consignment goods (copper, coffee, fishmeal) for which the potential of chartering is a real threat. At least, on this route, the claim that the conference system discriminates uneconomically against traditional exports does not in fact appear to be true. It is still quite possible that losses in real income result from the fact that conference rates on manufactured exports (e.g. copper products), which presently do not travel, are well above marginal costs.

(2) The conference lines' total costs are a little over twice the total costs of the most efficient system we would devise (type and number of ships).

(3) This loss is made up on the Southbound trip where rates are two or three times the average cost of an efficient service.

(4) The developing country pays the bulk of the freight rate both ways due to the shapes of the supply and demand curves in both the export and import trades. Thus, the greater part of the above loss in real world income is borne by the developing country.

(5) Conversely, the bulk of the increase in world income of going to an efficient system would end up in the developing country. However, it would manifest itself in the form of lower cif prices for imports which would necessitate some disruption of the domestic import competing industries.

After examining the standard arguments for the necessity of the conference system, the report concludes:

(1) Liner services could viably be provided by a competitive market if cartelization could be prevented and that it would certainly be in the developing countries interest to initiate steps in this direction.

(2) It is inconsistent for a developing country to desire both to be a shipowner and to reduce rates to efficient levels. The conference system promotes a persistent oversupply of vessels. If the system is altered, a good many present shipowners are going to go broke. A high cost developing country fleet will require massive real wealth-reducing subsidiaries in the face of reduced rates.

(3) It appears at least possible that a strong policy on the part of the government of a developing country could have some effect on rates. Necessary ingredients of such a policy are:

a) no national fleet to worry about
b) organizing importers as well as exporters into shippers councils
c) willingness to purchase chartered shipping to carry the council's trade

In at least the trade that we analyzed, the principle benefits would be obtained on the import side, so one can expect intense opposition to such policies from import competing industries.

TABLE I

Year	Commodity	Origin	Destination	Percentage of Total Trade in Commodity	
1968	All Trade	Chile	U.S.	22%	[67a]
"	"	"	Japan	13.3%	[67a]
"		"	Western Europe	65%	[67a]
"	"	Colombia	U.S.	40%	[67a]
"	"	"	Japan	1.5%	[67a]
"	"	"	Western Europe	36.4%	[67a]
"	"	Ecuador	U.S.	41.5%	[67a]
"	"	"	Japan	10%	[67a]
"	"	"	Western Europe	18%	[67a]
1967	"	Peru	U.S.	39.4%	[67a]
"	"	"	Japan	15%	[67a]
"	"	"	Western Europe	25.8%	[67a]
1967	Iron Ore	Peru	Japan	80%	[57]
"	Fish meal	"	Western Europe	40%	[57]
"	Cotton	"	U.S.	69%	[57]
1969	Coffee	Colombia	U.S.	80%	[122]
"	Sugar	"	U.S.	90%	[122]
"	Bananas	Ecuador	U.S.	60%	[57]
1967	Bananas	Colombia	Western Europe	80%	[120]

TABLE II

U.S. TO CHILE

	Freight Rate per Ton	Tonnage	Freight Bill ($ × 10⁶)
Dairy Products & Eggs	$140	12,500	1.75
Cereals	-	(455,000)	-
Fruits and Vegetables	220	600	.13
Miscellaneous Food	100	6,800	.68
Tobacco	136.80	2,850	.39
Rubber	100	3,450	.34
Pulp & Waste Paper	100	13,500	1.35
Raw Textile Fibers	90	1,200	.10
Crude Fertilizers		(115,000)	-
Ferrous Ores & Scrap	44	1,400	.06
Crude Animal & Vegetable Materials	50	850	.04
Animal Oils and Fats	-	-	-
Vegetable Oils	95	30,700	2.95
Chemicals	-	(64,100)	-
Chemical Mfg. Products	120	61,200	7.34
Chemical Fertilizers	-	(315,000)	-
Manufactures by Material	160	250,000	40.00
Machinery	80	113,000	9.04
Misc. Manufactures	250	6,150	1.54
Total Conference Cargo		504,200	
2/3 from East Coast U.S.	130.30	336,000	43.8

TABLE III

CHILE TO U.S.

	Freight Rate per Ton	Tonnage $(\times 10^3)$	Freight Bill $(\$ \times 10^6)$
Fish	$90	3.2	.27
Cereals	-	-	-
Fruits & Vegetables	60	56.1	3.36
Sugar	22	.4	.01
Coffee & Cocoa	55	-	6.93
Animal Feed	[illegible]	126.	-
Beverages	69	1.2	.01
Tobacco	-	-	-
Crude Materials (hides, furs, textile fibers, metal scrap, animal and vegetable material)	68	2.0	.01
Wood and Cork	45	16.4	.74
Chemical Products	22	113.	2.49
Leather Mfg.	-	-	-
Wood Mfg.	-	-	-
Paper Mfg.	30	3.6	.01
Textile Products & Yarn	-	-	-
Metal Mfg. (mostly iron & steel)	50	.8	.04
Non-Ferrous Metals	36	250.	9.0
Machinery	180	.06	.01
Miscellaneous Mfg.	-	-	
Total Conference Cargo		572,760	
2/3 to East Coast U.S.	39.80	382,000	15.2

SYNCROLIFT®
DRYDOCKS AND TRANSFER SYSTEMS

Phone: 305/271-5721
Cable: SYNCROLIFT, MIAMI, FLORIDA
Telex: 051-9340 SYNCROLIFT MIA

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Address Reply to:
PEARLSON ENGINEERING COMPANY, INC.
P.O. BOX 8
MIAMI, FLORIDA 33156, USA

Appendix 2

DATE 21 December 1971
JOB NO. XXX XXX
CAPACITY 4200 Tons
HOISTS 38 - 180/15

PROPOSAL FOR A SYNCROLIFT DRYDOCK FOR

R. LATORRE

FOREWORD

Please note that the proposal is such that only the hoisting equipment, special wire rope assemblies and the electrical controls need be purchased from us. Design drawings for the complete Syncrolift drydock (excluding civil works) along with full details of the platform steel and transfer cradles will be furnished at no additional cost so that fabrication and installation of the complete Syncrolift and transfer system can be done by your staff or the contractor of your choice.

At an opportune time to you, we will gladly send one of our engineers to your offices for further discussion and assist in your initial planning. This will be done at no cost or obligation to your Company.

PEARLSON ENGINEERING COMPANY, INC.

PROPOSAL NO. xxxxxx

Date 21 December 1971

1. **DESCRIPTION**

Syncrolift Rated Capacity 4200 Long Tons (Ship weight/normal docking conditions)

Maximum Lifting Capacity 5735 Long Tons (Evenly distributed load on all hoists)

Allowable Load Per/Ft. 16.5 Long Tons (Maximum concentrated loads)

Platform Length 350 ft. Width 82 ft. Approx. depth of main beams 8 ft.

Lifting Speed 1.0 ft./min. Allowable vertical travel 36 ft.

Approx. KVA required 802

2. **MATERIALS SUPPLIED BY PEARLSON ENGINEERING COMPANY, INC.**

A.	38 Hoists assembled with components ready for installation	$ 733,514.00
B.	Electrical control center completely wired internally with safety devices ----------	$ 54,188.00
C.	Wire Rope Assemblies ----------	$ 27,208.00
D.	Services of Pearlson Engineering Company engineer to check-out complete Syncrolift installation and instruct personnel (See Page 10) ----------	INCLUDED
E.	Design Plans for complete installation (except civil works) and Instruction Manuals covering operation and maintenance procedures (See Pages 11, 12 & 13) ----------	INCLUDED
	TOTAL PRICE EX-FACTORY ----------	$ 814,910.00
F.	Insurance and Freight charges for above materials delivered to Not Determined (See Page 13)	--- ---
G.	Export packing for above materials---------- (See Page 13)	--- ---
	TOTAL C.I.F. PRICE PEARLSON FURNISHED MATERIALS & SERVICES	--- ---

NOTE: 1) Prices quoted are valid until 1 March 1972.

2) Shipment of materials will be made within 12 months from date of contract.

3) All prices are $ Dollars U.S. Currency.

3. ESTIMATED COST OF OWNER FURNISHED PLANT & LABOR REQUIRED TO INSTALL MATERIALS SUPPLIED BY PEARLSON ENGINEERING COMPANY.

A. Hoists -	$ 10,530.00
B. Electrical Control Center - - - - - - - - - - - - - - - - -	$ 8,170.00
C. Wire Rope Assemblies -	$ 7,600.00
	$ 26,300.00

4. ESTIMATED COST OF LABOR & MATERIAL TO INSTALL COMPONENTS NOT NORMALLY FURNISHED BY PEARLSON ENGINEERING COMPANY.

A. Platform 950 L.T. Tons of steel sandblasted & painted	$ 641,250.00
B. Wood Decking 85,000 board feet, cut to length - - - -	$ 34,000.00
C. Electric Wire & Conduit between Control Center & Motors	$ 15,890.00
D. Air Compressor, Valves and piping - - - - - - - - - - -	$ 2,550.00
E. Civil Engineering, Piers, Piling, Hoist Foundations - -	$ 402,800.00
F. Keel & Bilge Block System - - - - - - - - - - - - - - - -	$ 28,350.00
	$ 1,124,840.00

G. Transfer System

1. Site Plan indicating number of berths required and size/weight of vessels to be transferred must be submitted to obtain estimate.

5. RECOMMENDED SPARE PARTS - Prices furnished upon request.

A. Spare Wire Rope Assemblies

B. Mechanical Spares (See Page 15)

C. Electrical Spares (See Page 16)

TOTAL ESTIMATE FOR COMPLETE SYNCROLIFT INSTALLATION AS INDICATED (Items 2-3-4) - - -	$ 1,966,050.00

NOTE: All estimates based on current U.S.A. labor & material rates.

Your Syncrolift drydock will utilize special designed hoists with a lifting capacity of 180 tons each. Their standards have been developed by Pearlson Engineering Company for specific application to the Syncrolift system. The hoists and their components all comply to the standards of the American Bureau of Shipping and Lloyd's Register of Shipping. With normal maintenance procedures, the life expectancy of the hoists will be forty (40) years or more.

The Syncrolift hoists and their components have the following characteristics:

Approximate weight of each hoist	=	21,500	lbs.
Shipping size of each hoist on skid	=	720	cubic ft.
Approximate weight of control center	=	7,600	lbs.
Shipping size of control center	=	418	cubic ft.
Approximate weight of each wire rope assembly	=	1,300	lbs.
Shipping size of each wire rope assembly	=	26	cubic ft.

The total weight of Syncrolift equipment in this proposal	=	874,000	lbs.
The total shipping weight for Syncrolift equipment in this proposal	=	28,766	cubic ft.
At 40 cu/ft. per shipping ton	=	719	cubic tons

NOTE: When equipment is export packed, shipping weight will become slightly greater. All weights are subject to confirmation at time of shipping.

1. GENERAL DESCRIPTION OF "SYNCROLIFT"

The Syncrolift is basically an elevator type of drydock. The platform of the Syncrolift is lowered vertically and stopped at a predetermined depth. The vessel to be drydocked is floated over the submerged platform, then raised vertically until the vessel and platform are completely above the water level.

The platform, which supports the vessel during the drydocking operation, is raised and lowered by electrically controlled hoists with wire rope cables. The hoists are supported by fixed structures on both sides of the platform and are normally standard marine piling of concrete, wood or steel.

The electric motors, used to drive the hoists, are designed to operate at a fixed rate of speed regardless of the load variations imposed by the vessel's weight distribution. All the electric motors are interconnected and controlled at one central control point. In the event of malfunction of any one motor, the entire system is automatically stopped.

The platform construction consists of steel structural members and wood planks for decking. Syncrolifts using eight or more hoists have articulated platforms consisting of a series of main transverse lifting beams supported by a hoist at each end. The proper keel support is provided by placing intermediate transverse beams between the main beams. These intermediate beams are supported by longitudinal members held at each end by flexible connections.

The wire rope system, which is used on all Syncrolifts, consists of six part reeving. The cable drum is grooved and provides for the maximum amount of travel with a single layer on the drum. Two sheaves mounted on the hoist, together with three sheaves mounted on the main beam, permit reeving the wire rope into a six part support at each hoist. The wire rope is specially constructed for Syncrolift service. The necessary strength is accomplished by special heat treatment and drawing of the component wires. In addition, each individual strand of the wire rope is galvanized to provide the maximum corrosion protection internally as well as externally. The process of galvanizing, followed by the drawing of each strand, assures no loss in flexibility. The net result is a wire rope with the most desirable characteristics for use in a marine environment.

A control center operates the Syncrolift with a minimum number of settings. In the control center, there is an ammeter for each hoist motor. These ammeters indicate the relative loads carried by each hoist during the operation of the Syncrolift. By observing the ammeters, the operator can determine when the ship has grounded on the keel blocks and where the grounding took place. He can also determine the true distribution of loading throughout the ship's length. Safety provisions are incorporated to automatically stop all motors instantaneously if any one motor is overloaded or reaches the designed capacity of the Syncrolift. In this event, the platform can only be operated in the down direction. It is therefore impossible for the Syncrolift or the vessel to be damaged. Provision is also made to automatically stop all motors when the platform reaches the upper or lower limits of travel.

The hoist has two separate and distinct braking systems. The motor has an integral magnetic disc brake that releases when power is applied and engages by spring action when power is disconnected. The wire rope drum has a ratchet and pawl type backstop. An air cylinder actuates the pawl. When the platform is being operated in the down direction, all pawls are automatically withdrawn from the ratchets. Under all other conditions, the air cylinders are automatically vented and the pawls are held in by springs in the cylinders. The ratchet-pawl system also permits removal of the motor-brake unit and intermediate gears with full load on the hoist. An interlock in the control system prevents the platform from being operated in the down direction when any pawl is in place.

Ships are drydocked on the Syncrolift platform using conventional procedures for setting the keel blocks and placing the bilge blocks after grounding. The bilge blocks are moved by a system of chain and pulleys that can position the blocks when the platform is at any elevation in its travel.

Due to the fact that the Syncrolift platform remains level at all times, a transfer system can be readily added to a basic Syncrolift installation. Railroad type rails are installed on the platform and on the adjacent land area. These rails are arranged so that a transfer cradle can be rolled from the platform to the land area when at the yard elevation. An extension on land can develop a transfer system which will permit movement of the cradles in both longitudinal and transverse directions.

Syncrolift drydocks can be expanded with little change to the initial equipment simply by adding additional platform sections and hoists. However, provisions for expansion should be made in the initial design. These provisions will include an increase in width of the platform to allow handling larger vessels and additional controls will be included so that the control center will not have to be rewired when hoists are added.

All electrical and mechanical parts used in a Syncrolift drydock are easily installed, operated, and maintained. The electrical components have been designed and proven in service for climates ranging from tropic to arctic.

3. ESTIMATED COST OF OTHER MATERIALS AND LABOR TO COMPLETE INSTALLATION

The materials and labor to complete the Syncrolift installation shall be provided by the purchaser in accordance with the requirements of the SYNCROLIFT system. Pearlson Engineering Company, Inc. will prepare arrangement plans that will specify the magnitude and location of the hoisting loads and give basic data on anchor bolts, hoist grouting, pier cut-outs, recommended depth of water, and limiting dimensions. Pile arrangements and pier construction shown on these plans are intended for guidance and the detail design shall be provided by the purchaser's engineer to suit local conditions and building codes. All drawings shall be submitted to Pearlson Engineering for approval of arrangement.

The purchaser shall provide electric power as required. The transformer KVA rating specified on Page One is an approximate requirement for the installation served by a high capacity, high voltage distribution system. The actual transformer capacity required depends on the actual characteristics of both the power system and the transformer. Power supply to the SYNCROLIFT must be 3 phase, 3 wire. Frequency may be 50 or 60 cycles.

Preferred voltages are as follows:	Total KVA 50 or less	220, 380, 440, 550
	Total KVA over 50	380, 440, 550

Other voltages available subject to special consideration.

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