5-YEAR PORT IMPROVEMENT PLAN

IN

ETHIOPIA

SEPTEMBER 1973

OVERSEAS TECHNICAL COOPERATION AGENCY

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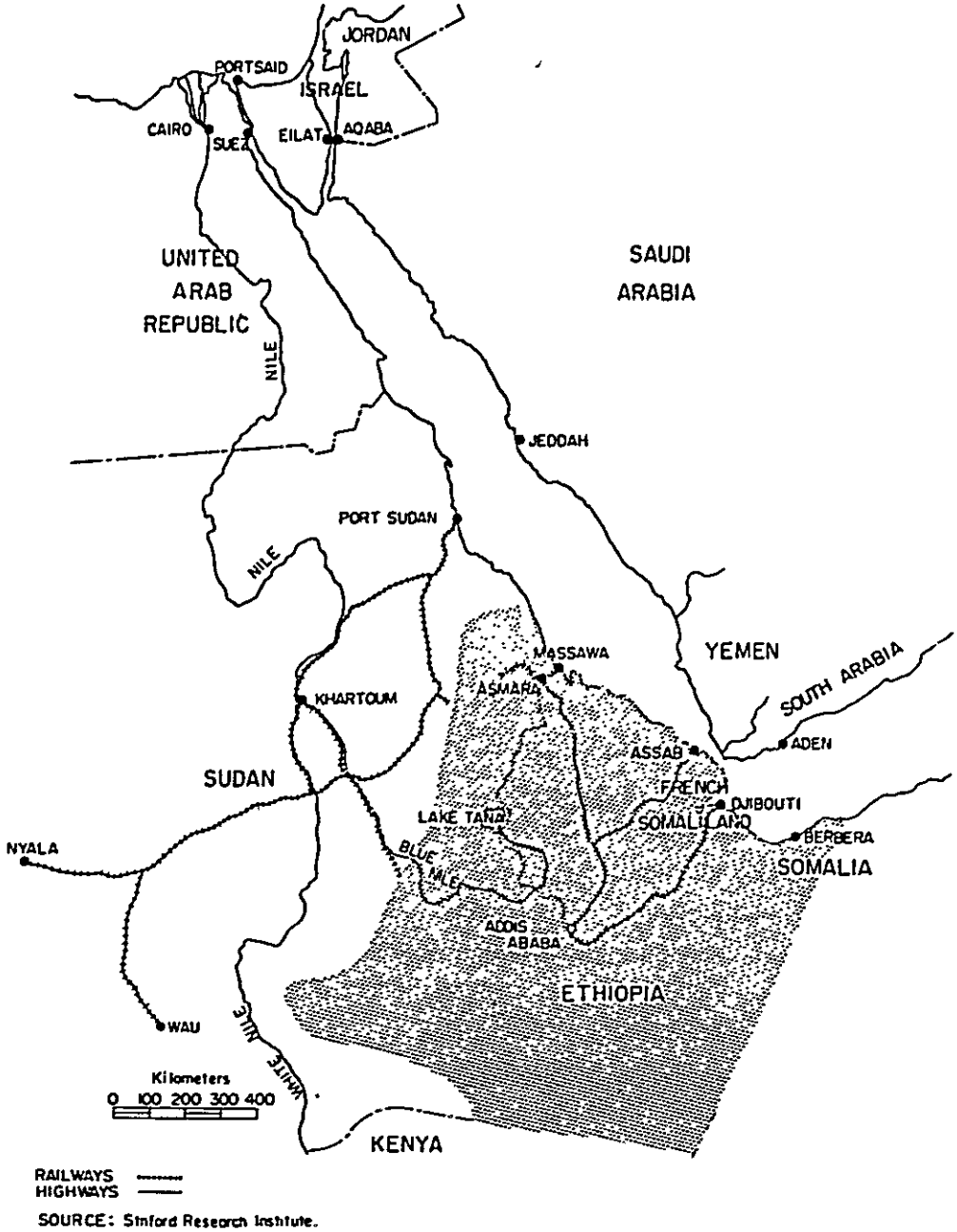
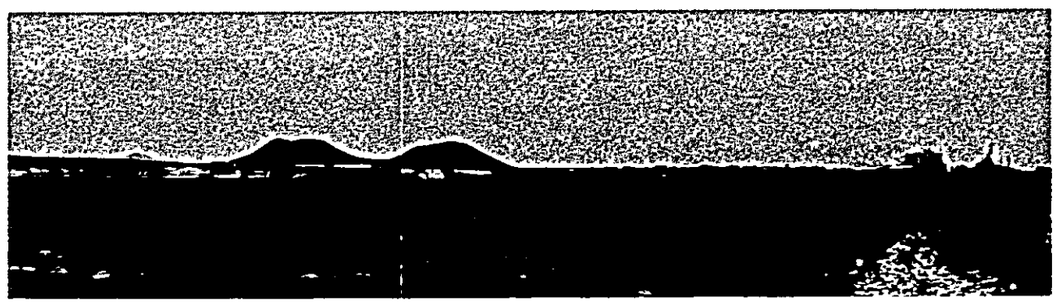
LOCATION MAP



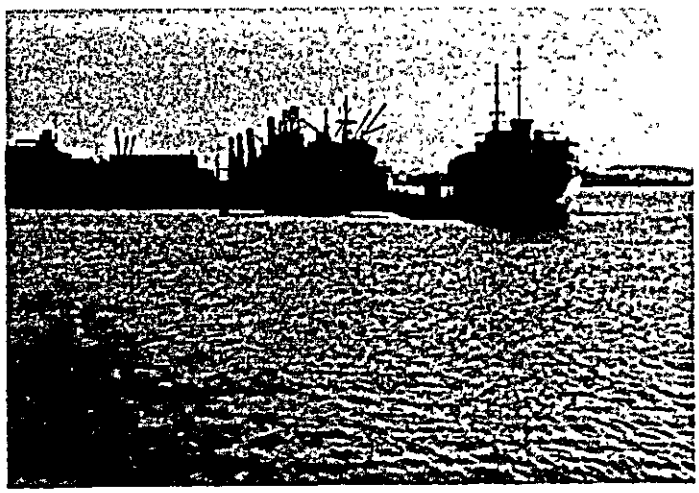
SOURCE: Stnford Research Institute.

C O N T E N T S

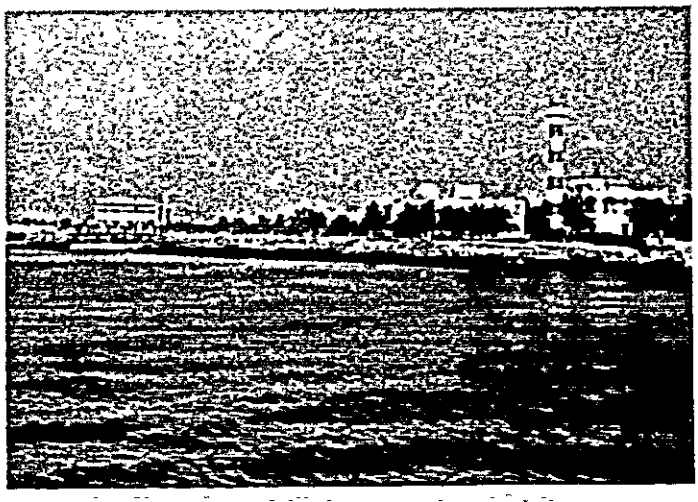
Port of Assab



Recommerded Construction Site for New Berths
Port of Assab



No. 6 Berth to be expanded and reclaimed
Port of Massawa



Recommended Construction Site for New Berths
Port of Massawa

PREFACE

In compliance with the request of the Imperial Ethiopian Government for a technical survey for its port improvement project, the Government of Japan entrusted the implementation of the survey to the Overseas Technical Cooperation Agency.

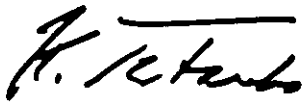
In view of the fact that the improvement and expansion of Port of Massawa and Port of Assab will greatly contribute to the development of the economy in Ethiopia, the Overseas Technical Cooperation Agency has previously sent a survey mission to that country on two occasions, in August 1972 and March 1973, to work out a master plan for the port improvement project. The primary aim of the 3 Delegation of the survey mission sent on this occasion was to formulate a detailed 5-year port improvement plan on the basis of this master plan in cooperation with the Ethiopian authorities.

The Delegation, after exchanging views with officials concerned of the Ethiopian Government and making various studies in both technical and financial aspects, has finally completed the drafting of the 5-year Port Improvement Plan and the report on it is ready for presentation to the Ethiopian Government.

I shall be most pleased if this report proves useful to the improvement of ports in Ethiopia and to the promotion of economic exchange as well as friendly relations between the two countries.

Finally, I would like to take this opportunity to express my deep appreciation to the staff of the Japanese Embassy in Addis Ababa for their assistance in the execution of the survey at the site and to the Ministry of Foreign Affairs, Ministry of Transports and other government agencies for their cooperation in orgaizing the survey mission.

September 1973



Keiichi Tatsuke
Director General
Overseas Technical Cooperation Agency

I . SUMMARY

I. SUMMARY

The primary object of the 3rd Delegation of the Japanese Survey Team for the Port Project in Ethiopia, following the 1st and 2nd Delegations sent in August-September 1972 and in March 1973, respectively, is to recommend the Ethiopian authorities on the port improvement plan to be included in the 4th 5-year Development Plan worked out by the Imperial Ethiopian Government, while the purpose of the 1st and 2nd Delegations was to formulate a long-term master plan for the improvement of ports in Ethiopia. Therefore, the implementation and follow-up of the interim report presented by the 1st and 2nd Delegations and a final preparation of the master plan are not the aim of this Delegation.

In summary, the following are the scope of works-

(1) Forecast of the volume of import and export cargo in 1979, the last year of the 4th 5-year Development Plan, through macroscopic analysis.

(2) An examination of the consistency between the forecast of sectorical cargo volume and the macroscopic analysis.

(3) Distribution of import and export cargo volume among the 3 ports, Massawa, Assab and Djibouti.

(4) Recommendations on the improvement plan for Massawa and Assab to cater for the increasing export and import cargoes during the coming 5 years.

(5) Annual investment plans for Massawa and Assab.

Through several meetings with the authorities, it was apparent that the authorities, more or less, already had in mind its own guideline along which the ports will be improved for the coming 5 years. The Delegation thoroughly studied the situation to make recommendations as the conclusion by collecting as much information as available and by making fact-finding surveys at Massawa and Assab for about a week. In order to successfully implement the plan, however, it is imperative that fundamental surveys and investigations be carried out on continuous base as suggested in the recommendations.

II. CONCLUSIONS AND RECOMMENDATIONS

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The volume of cargo to be handled in Ports of Massawa and Assab in 1971 E. C., the target year of this 5-year Port Improvement Plan, is estimated at 481,000 tons and 520,000 tons, respectively.

It is recommended, therefore, that the Imperial Ethiopian Government take the following measures to cope with the anticipated increase in the volume of cargo.

1. Improvement for Maximum Utilization of Existing Loading/Unloading Capacity.

(1) Expansion of Port Facilities for Separation of Apron Area Loading/Unloadings, Stacking Area and Storage Area

Place	Massawa	Assab
Apron	Extension of No. 6 berth Reclamation of water area behind No. 6 berth for construction of aprons.	
Stacking area	Construction of a transit shed behind No. 6 berth. Pavement of the area behind No. 5 and 6 berths.	Pavement of jetties.
Storage area	Construction of a warehouse behind No. 6 berth.	Construction of 5 warehouses in the expanded port area.
Port area (bonded area)		Expansion of port area to the south.

(2) Amendment of Port Regulations

(i) Prohibition of storage of cargo in the apron area.

(ii) Revision of tariff for use of stacking yard and transit shed:

(a) For the first 3 or 5 days after arrival of the cargoes.....free or low tariff.

(b) For the period exceeding the above.....as high tariff as possible, which will be increased in proportion to the length of storage.

(c) The tariff should be based on the "ton" measurement. For this purpose, a strict "check system" is to be enforced.

(iii) Review of tariff for storage yard and warehouse:

(a) Abolition of the tariff that has a penalty character. (However, the present penalty system to confiscate the cargoes that have been stored over 6 months should be maintained.)

(b) Adoption of the tariff system principally based on "square meter" measurement, in parallel with the tariff system based on "ton" measurement which applies to owners of minor cargo.

(c) Adoption of a special rental system for storage facilities for certain bulky cargoes handled regularly and in large quanties.

2. Construction of New Berths

Immediately after the implementation of the improvement measures recommended in the preceding Section 2 berths with a depth of -10m capable of handling 15,000 D/W ton ships should be constructed in Massawa and Assab, respectively, and related port facilities including transit sheds, warehouses, cargo handling equipments, tugboats and access roads and so on, should also be provided so that the whole port facilities may operate in harmony with an increased capacity.

3. Budget for Investment

The total investment required to implement the above-mentioned improvement measures is estimated, for the budgetary purpose, at Eth. $17,773,000 for the Port of Massawa, and Eth. $16,830,000 for the Port of Assab.

III. PURPOSE AND SCOPE OF STUDY MADE BY THIS DELEGATION

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The Imperial Ethiopian Government has been promoting vigorously its nation-wide social and economic development under the 25-year longrange development plan, starting from 1957 year in 5 successive stages, with each stage having its own detailed development program set up through appraisal of the performance and results of the preceding 5-year development plan and by taking into consideration the outlook of the situation in the coming 5 years. This year is the third year of the Third 5-year Development Plan ending in September 1974. The 3rd Delegation was sent to Ethiopia at the request of the Imperial Ethiopian Government to carry out a study and make recommendations necessary for the inclusion of the Port Improvement Plan in the Fourth 5-year Development Plan starting from 1974.

As mentioned previously, the 1st and 2nd Delegations were despatched to make a study necessary for setting up the long-term master plan for the improvement of port facilities and an interim report was presented in Sept. 1972. As already mentioned, short term plans should not be treated individually. but should be integrated into a long-term planning. In this sense, the study and recommendations made by this Delegation had to be related closely with the long-term master plan which is to be completed by the subsequent survey team, by taking into account the findings obtained by the previous delegations with some adjustments.

The following is the outline of the contacts made between both Governments on the technical assistance on Ethiopian port planning and related surveys.

+ September 1971: The Imperial Ethiopian Government asked the Japanese Government to prepare the master plan for the development of Ethiopian ports. Presentation "Terms of Reference".

+ March 1972: The Imperial Ethiopian Government requested the Japanese Government to send port experts to Ethiopia.

+ April 1972: The Japanese Government gave a reply accepting the request.

+ May 1972: H. E. Ato Negash Garedew, Vice Minister of Marine Department, Ministry of Communications visited Japan to exchange views on what Ethiopian side wishes to be studied and how Japanese side can assist. It was agreed upon that in sending the Japanese experts, investigations should be made as regards Paragraph C (exclusive of Item 8 and 13) of "The Terms of Reference" and Ethiopian side assured all possible assistance and co-operation shall be rendered to Japanese experts to help their works in Ethiopia including the collection of data and information and so on.

+ August 1972: H. E. Lij Endalkatchew Makonnen, Minister of Communications accompanied by H. E. Ato Negash Garedew came over Japan.

+ August-September 1972: The 1st Delegation of the Japanese Survey Team was sent to Ethiopia.

+ September 1972: The report entitled "Interim Report on Port Development of Ethiopia, Assab and Massawa" was submitted to the Imperial Ethiopian Government.

+ November 1972: The request for sending the 2nd Delegation was made from Ethiopian side.

+ January 1973: The comments on the above Interim Report were given to the Japanese Government by the Steering Committee of the Imperial Ethiopian Government.

+ March 1973: The 2nd Delegation was despatched. The Interim Report was modified a little and submitted to Marine Department. The co-ordinative discussions were held between the two parties particularly on the economic figures such as a traffic volume and so forth, and suggestions were given by the Japanese Delegation as to the modifications on "the Terms of Reference". Later on, additional data were presented to Japanese side by Ethiopian side.

+ May 1973: The request for sending the 3rd Delegation was made by the Ethiopian side.

+ June 1973: The 3rd Delegation has come to Ethiopia.

As mentioned above, the Interim Report submitted by the 1st Delegation represents the most fundamental port plan by making recommendations for expansion of berthing facilities. However, the two Governments differed in opinion on the following 2 basic problems on which the said recommendations were based:-

(1) Forecast of the increase in cargo volume

(2) Distribution ratio of the cargoes among three ports, Massawa, Assab and Djibouti.

Therefore, the first task of the 3rd Delegation was to adjust opinions with Ethiopian authorities on these points, though it was admitted that the arguments were mainly due to inadequacy of data and information available. For this reason, both figures of the forecast for the year 1979, the last year of the coming 5-year Development Plan, were reviewed through a joint study with Marine Department experts on the basis of additional data and information obtained from the Planning Commission and other sources.

Needless to say, the equal footing and basically the same point of view between the Marine Department and the Planning Commission on the forecast of these fundamental figures is very important factor to finalize a future plan, whether a long or short one, as the Government policy.

Though the recommendations made on the basis of such a reestimation is for a rather short term plan with 1979 as the target year, a further study and review should be made to forecast as accurately as posible these fundamental figures for setting up a long term master plan.

With regards to the opinion of Marine Department on the advisability of absorbing the increase of traffic volume through improvement of port management and expansion of facilities on the land for the time being, the Delegation paid more attention to this probability and made recommendations along this line. As mentioned previously, however, the recommendations made by the Delegation are only for the coming 5-year period and a closer study and appraisal should be made by the Ethiopian authorities and more long sighted recommendations should be made for setting up a long term port plan, including the improvement of port administration.

IV. SURROUNDING SITUATION

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1. Foreign Trade

Foreign trade in Ethiopia is steadily increasing at a high growth rate in recent years. Main export commodities are coffee, to begin with, oil seeds, hides and skins, other agricultural products and salt. Recently, petroleum products refined in an oil refinery in Assab have also been added to the above commodities. Main import items are crude oil destined to the above-mentioned refinery in Assab, followed by machinery, textiles and other general commodities. According to the estimation on the increase rate of foreign trade in the future made by experts of the Imperial Ethiopian Government in connection with the formulation of the coming 5-year Development Plan, the annual growth rate will be between 4-5% at the minimum and 8-8.5% at the maximum. However, the pattern of foreign trade will not change greatly, and will center on export of agricultural products and import of industrial goods, except the inclusion of a few items like copper for export and fertilizer for import. From the above estimation, a considerable expansion of the economic activities will be realized in the hinterland of the ports during the coming five years.

2. Sharing Functions among Three Ports

Ethiopia has two major ports, Port of Massawa and Port of Assab, both facing the Red Sea in the northern boundaries. Commodities produced in the eastern area bordering on Somali go through Port of Djibouti in French Territory of Afars et Issas which was the only outlet of Ethiopia until Eritrea province was amalgamated into Ethiopia. It is generally believed that all export and import cargoes are approximately equally shared by these 3 ports in recent years. However, while Massawa has its own hinterland, Assab and Djibouti share the same hinterland. In this sense, Assab and Djibouti may be said to be in a competitive or supplementary position with each other in functioning as major ports of Ethiopia, and such relationship will be to much extent affected by inland transportation which each port can utilize.

Inland transportation connecting Assab to Addis Ababa will be much improved by the construction of Awash-Tendaho Highway which will be completed very soon, while a road construction project connecting Djibouti to Awash is reportedly schemed to put Djibouti in more advantageous position in competition with Assab despite the existence of railway between Djibouti and Addis Ababa already. Thus, the competitition between Assab and Djibouti will depend on or will be decided by the superiority of port services and the dependability of inland transportation facilities, apart from the relevant policy of the Government concerned.

V. ESTIMATION OF CARGO VOLUME TO BE HANDLED IN THE PORTS

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1. Estimated Foreign Trade Volume of Ethiopia

(1) Microscopic Analysis

The estimated growth rate of foreign trade in terms of monetary value, as announced by the Department of Economic Analysis is as follows:

Minimum	4-5%
Maximum	8.0-8.5%

Since the statistics of the past show almost no change in the average unit price of export and import, the above growth rate in terms of monetary value may also be applied to the growth rate of cargo volume for foreign trade.

(2) Estimated Volumes of Export and Import Cargoes by Commodities

(a) Export

(a)-1 Major Agricultural Products

The volume of major agricultural products for export was estimated by 2 experts of the Department of Agriculture (Planning Commission Office) and their estimation was used for this study.

Commodities	1967-69 G.C. (1,000 M.T.)	Assumed growth rate per annum (%)	Projected export volumes 1979 E.C. (1,000 M.T.)
Coffee	81	3.0	112
Oil seeds & cakes	84	6.5	149
Pulses	73	8.0	170
Hide & skins	11	11.0	34
Meat & meat products	5	10.0	15
Banana	16	5.9	30
Sugar	--	0 up to 1979	10
Molasses	--	--	40
Cotton	--	--	5
Cereals	3	--	10

(a)-2 Salt

According to the information obtained from the Government, export of salt is estimated at 250,000 tons in 1968 - 1971 E.C. So the export in 1979 G.C. will be 250,000 tons.

(a)-3 Potash

According to the information obtained from the Government, exports of potash, if any, will start in 1979 or 1980.

The feasibility is still being studied. It is assumed, however, that there will be no export in 1979.

(a)-4 Petroleum and Products

The amount of petroleum products exported in 1971 was 130,000 tons. According to the information obtained from the oil refinary, 200,000-250,000 tons of petroleum products will be exported in 1980. Therefore, a growth rate of 6% can be expected for this period. With this growth rate, export of petroleum products in 1979 is estimated at 212,000 tons.

(a)-5 Copper

Exploitation of copper mine in Asmara area will reach the stage of export before 1979. A tentative plan made by Ethio-Nippon Mining Share Co., with some modifications, was used for this study. The export volume in 1979 is estimated at 78,000 tons.

(a)-6 Others

As for other commodities, their export volumes are too small to estimate for individual items. It is assumed, therefore, that the growth rate of their export volumes will be the same as that of major agricultural commodities.

Export volume of major agricultural products during 1967-69

273,000 M.T.

Export volume of major agricultural products in 1979 (from (a)-1)

575,000 M.T.

Export of major agricultural product will grow from 273,000 M.T. in 1967-69 to 571,000 M.T. in 1979, a growth of 2.11 times. The export volume of other commodities than major agricultural products, salt and petroleum products in 1979 will be:

$$47,000 \times 2.11 = 99,000 \text{ M.T.}$$

(b) Import

(b)-1 Fertilizer

The import volume of fertilizer has also been estimated as in the case of major agricultural products, by 2 experts of the Department of Agriculture (Planning Commission Office). Their estimation was used for this study.

	1967-69	1979 (M.T.)
Fertilizer	0	189,000

(b)-2 Crude Oil

As for the import volume of crude oil, the estimate made by the Government, or 1,362,000 M.T. in 1979, was used for this study.

(b)-3 Petroleum Products

The import volume of petroleum products has shown a rapid decrease since the establishment of an oil refinery in this country. The import volume of petroleum products in the future is expected to be almost the same as the average volume imported in these three years.

(b)-4 Others

As for other commodities, the import volume in 1979 is estimated to 2.11

times greater than the volume for 1967-69 as in the case of (a)-6.

Import volume of other commodities in 1967-69 --- 256,000 t

Import volume of other commodities in 1967

256,000 M.T. × 2.11 = 540,000 t

(c) Summing-up of Cargoes by Commodities

The total volume of export and import obtained from the External Trade Statistics and the future values calculated by (a) and (b) is shown in Table V-1. According to this table, the export volume in 1979 will be 1,214,000 t and the import volume in the same year will be 2,151,000 t, for a total of 3,365,000 t.

Table V-1 External Export & Import in Ethiopia
- Statistics & Forecast -

(1,000 M.T.)

	1966	1967	1968	1969	1970	1979 (Forecast)
Export	462	459	473	618	586(311)	1,214(758)
Coffee	74	74	80	88	71 (71)	192(112)
Oil seeds & cakes	85	89	76	87	82 (82)	149(149)
Pulses	68	68	74	77	51 (51)	170(170)
Hides & skins	15	11	9	12	11 (11)	34 (34)
Meat & meat products	8	6	6	4	5 (5)	15 (15)
Bananas	15	18	16	14	10 (10)	30 (30)
Sugar	-	-	1	3	12 (12)	10 (10)
Molasses	-	-	-	-	-	40 (40)
Cotton	-	-	-	-	2 (2)	5 (5)
Cereals	-	4	1	4	4 (4)	10 (10)
Salt	166	156	160	178	141 (3)	250 (6)
Potash	-	-	-	-	-	-
Copper	-	-	-	-	-	78 (78)
Petroleum & products	-	-	-	93	137	212
Others	31	33	51	58	60 (60)	99 (99)
Import	580	523	923	773	950(344)	2,151(729)
Fertilizer	-	-	-	-	-	189(189)
Crude oil	-	-	605	484	559	1,362
Petroleum & products	279	251	57	53	47	60
Others	301	272	261	236	344(344)	540
Total	1,042	982	1,396	1,391	1,536(655)	3,365(148)

Source: for statistics, Annual External Trade of Statistics

Note: ( ) shows cargo to be handled through public berths.

This is approximately 2.19 times greater than the cargo volume in 1970, or 1,536,000 t, showing an average annual growth rate of 9.1% with 1970 as a base year. As compared with the macroscopic figures given in (1), or the maximum annual growth rate of 8-8.5%, this seems a little higher. In this case, however, fertilizer and copper, which had not been included, are included. If the volume of fertilizer and copper is subtracted from the above volume of export and import, the following may be obtained.

1970	1979
1,536,000 tons	3,098,000 tons

Thus, an average annual growth rate of 8.1% is expected for the period from 1970 to 1979.

Therefore, in view of the continuous increase in the volume of cargoes, it may be said that the estimate made by the Delegation comes close to the target set by the Department of Economic Analysis.

Cargoes to be handled at public berths will be:

Export: General cargoes (major agricultural products, and salt exported Via Port of Djibouti) and copper.

Import: General cargoes (fertilizer and others.)

Note: Copper is included in the cargoes to be handled at the public berths for the following reasons:

1) The estimated amount of copper to be exported in 1979 is not sufficient enough for exclusive use of private berth.
2) The copper to be exported through Port of Massawa will be handled like other general cargoes in the backets prepared and used exclusively by the cargo owner.

Accordingly, the figures for cargoes to be handled at public berths will be:

	1970 (A) (1,000 t)	1979 (B) (1,000 t)	(B)/(A)
Export:	311	758	2.44
Import:	344	729	2.12
Total:	655	1,487	2.27
			(9.5% per annum)

2. Estimated Volume of Cargoes to Be Handled at Port of Massawa and Assab

(1) Distribution of Public Cargo Volume

For the distribution of public cargo, the distribution ratio of 1971 E.C. which was based on the record of actual cargoes handled at Ports of Massawa, Assab and Djibouti was adopted. Needless to say it is desirable in this case to use the method of determining the cargo distribution ratio, while taking into account such factors as production amount, routing, transportation cost, etc. The present estimate, however, was derived from the estimate for 1971 E.C., which is made by the simplified trend extension method.

Table V-2 Statistics of Public Cargo Volume & the Share by Port

	Cargo Volume (1,000 M.T.)					Share (%)				
	1960 E.C.	1961	1962	1963	1964	1960 E.C.	1961	1962	1963	1964
Imports										
Massawa	97	114	124	126	107	31.8	37.5	38.6	38.1	32.7
Assab	99	83	85	104	89	32.3	27.2	26.3	26.2	27.2
Djibouti	111	108	113	166	131	35.9	35.3	35.1	42.0	40.1
Total	307	305	322	396	327	100.0	100.0	100.0	100.0	100.0
Exports										
Massawa	108	144	119	151	137	34.0	41.1	34.3	40.7	35.0
Assab	134	115	110	127	159	41.9	32.8	31.7	34.2	40.4
Djibouti	77	92	119	94	97	24.1	26.1	34.0	25.1	24.6
Total	319	351	348	372	393	100.0	100.0	100.0	100.0	100.0
Imports & Exports										
Massawa	205	258	243	276	244	32.9	39.4	36.4	36.2	34.0
Assab	223	198	195	231	248	37.2	30.2	29.1	30.0	34.4
Djibouti	188	200	232	260	228	29.9	30.4	34.5	33.8	31.6
Total	626	656	670	767	720	100.0	100.0	100.0	100.0	100.0

Source: Ethiopian Government

Table V-3 Estimated Share of Public Cargo to Be Handled in Port of Massawa, Assab and Djibouti

Export or Import	Port	1964 E.C.	1971 E.C.		
			Estimation from 4 Year Data 1961-64 E.C.	Estimation from 5 Year Data 1960-64 E.C.	Average $\frac{(A)+(B)}{2}$
		%	(A) %	(B) %	%
Export	Massawa	35.0	34	39	36
	Assab	40.4	51	36	44
	Djibouti	24.6	15	25	20
Import	Massawa	32.7	21	33	27
	Assab	27.2	29	21	25
	Djibouti	40.1	50	46	48

Table V-4 Cargo to Be Hnadled in the Public Berths in Each Port

(1,000 M.T.)

Export or Import	Port	1964 E.C.	1971 E.C.		
			Public Cargo	Copper	Total
Export	Massawa	137	245	78	323
	Assab	159	299	-	299
	Djibouti	97	136	-	136
	Sub-total	393	680	78	753
Import	Massawa	107	197	-	197
	Assab	89	182	-	182
	Djibouti	131	350	-	350
	Sub-total	327	729	-	729
Total	Massawa	244	442	78	520
	Assab	248	481	-	481
	Djibouti	228	486	-	486
	Total	720	1,409	78	1,487

Table V-2 shows actual results and shares of the three ports according to the statistics prepared by the Government. The actual results for Ports of Massawa and Assab were derived from the port statistics prepared by the respective port offices, while the actual results for Port of Djibouti were estimated from the transportation statistics of Franco-Ethiopian Railway.

Table V-3 represents the shares of public cargoes in the three ports in 1971 E.C. derived from the trends in the past 4 years, the shares of public cargoes in 1971 E.C. as derived from the trends in the past 5 years, and the average values taken from these shares are shown in Table V-4.

For the total volume of cargoes for the three ports, the figure estimated for 1979 G.C. is used for 1971 E.C., but, only a small error will be expected.

(2) Other Cargoes

(a) Export

(a)-1 Salt

Each port will have its share in salt according to the actual share in 1964 E.C. The share of Port of Djibouti, however, has already been added up in item (1).

(a)-2 Copper

The whole copper cargo will be handled at Port of Massawa according to the plan shown by the Ethio-Nippon Mining Share Co.

(a)-3 Petroleum and Products

Petroleum and products will be handled only at Port of Assab where an oil refinery is located.

(b) Home Trade and Transshipment

As for the volume of home trade, the status quo is expected to continue because no factors for the growth are conceivable. In respect of transshipment, the status quo will also be maintained, as no specific reasons for changes are conceivable.

3. Total Volume of Cargoes to Be Handled at Port of Massab and Assab.

As shown in Table V-5. the volumes of cargo to be handled in these ports in 1971 E.C. are estimated (totaling 1 and 2) at 824,000 t for Port of Massawa, of which 520,000 t will be handled at public berths, and 2,309,000 t for Port of Assab, of which 481,000 t will be handled at public berths.

Table V-5 Estimated Cargo to Be Handled in Port of Massawa and Assab

(1,000 M. T.)

Commodities	Massawa		Assab	
	1964 E.C.	1971 E.C.	1964 E.C.	1971 E.C.
Export	210	458	517	746
Public cargo	137	245	159	299
Salt	67	129	60	115
Copper	-	78	-	-
Petroleum and products	-	-	179	212
Home trade	6	6	120	120
Import	264	366	715	1,563
Public cargo	107	197	89	182
Crude oil	-	-	612	1,362
Petroleum and products	33	45	10	15
Home trade	123	123	3	3
Transhipment	1	1	1	1
Total	474	824	1,232	2,309
Cargo to be handled at public berths	244	520	248	481

VI. BASIC CONSIDERATION FOR FORMULATING 5-YEAR PORT IMPROVEMENT PLAN

VI. BASIC CONSIDERATION FOR FORMULATING 5-YEAR PORT IMPROVEMENT PLAN

1. Basic Consideration

The economic situation of Ethiopia reflects a population of 25, 820, 000 and personal income per capita of ETH. $165. The present stage of the economic development of Ethiopia is considered the society before "Take-off Stage" under the "Rostow's Theory", still needing the development of the industrial and social capital.

In the general picture where various kinds of infrastructural investments are urgently necessitated in all aspects for a nation-wide development, improvements, modernization and development of port facilities should be one of the most important national schemes. In planning such infrastructure as the port improvement, except the case of the construction of industrial ports which does not require much public capital, the public investment should be decided by giving due consideration to the financial standing of the Government and be given priority among many other national schemes and should be planned so that the scheme can activate and inspire other integrated investments and schemes, thus, as a whole, the maximum utilization of the national economic resources including manpower and capitals is effectuated.

Through discussions with Ethiopian authorities on several occasions, the Delegation has formulated the following basic consideration on the basis of which the Delegation has made recommendations:

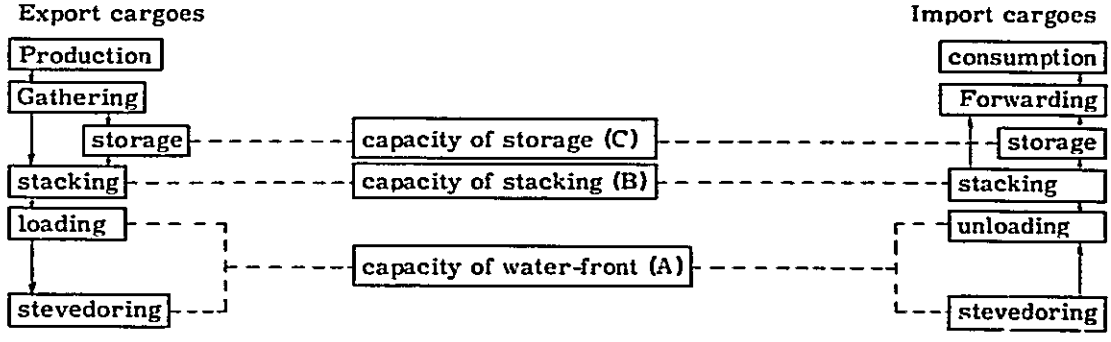
(1) In view of the basic character of Port of Massawa and Assab as commercial ports, the plan should be made in accordance with the anticipated increase of commercial cargoes by avoiding un-necessary pre-investment.

(2) The plan should be directed to the maximum utilization of the existing port facilities under minimum financial burden and investment. If necessary, the plan should be made so as to make the maximum utilization of the existing facilities for the maximum efficiency of financing.

2. Basic Formula for the Plan

The following is the cargo-handling process in the port like Massawa and Assab, where many liner ships are regularly calling from different origins and going to different destinations carrying various kinds of general cargoes with different type of packing and cargo owners:

Fig. VI-1 Cargo Handling Process



The volume of cargoes handled in the port (X) is determined within the capacity of each of the above (A) (B) (C) upto the maximum capacity of each stage:

$X = A \qquad X \leq B \qquad X \leq C$

Needless to say, if there is a difference in the maximum capacity between the above (A) (B) (C), the smallest capacity is the ceiling capacity of the cargo handling as a whole:

$X = \text{Min. } (A, B, C)$

Each of the capacities of (A) (B) (C) shall be determined as follows:-

(Water-front capacity) (A)=F (d, l, c, q, w, p, etc)

- d: depth of berth
- l: length of berth
- c: capacity of crane
- q: quality of labourer
- w: width of apron (quay surface)
- p: capacity of handling machine

(Stacking capacity) (B)=F (st, q, p, etc.)

- st: width of stacking yard
- q: quality of labourer
- p: capacity of handling machine

(Storage capacity) (C)=F (so, etc.)

- so: width of storage yard

The cargo volume handled in Massawa and Assab in 1964 E.C. (X_{64}) is as per Table VI-1 hereunder which shows that (X_{64}) is still considerably below the cargo-handling capacity at water-front (A_{73}):

(1,000MT)

	1964 E.C. X_{64}	Cap. (A)	Diff. (A-X_{64})	Forecast in 1971 E.C.
Massawa	244	328	84	520
Assab	248	323	75	481

Notwithstanding the above, what the Delegation heard from the port people in charge of this fact-finding survey in both ports was something different from the above; there is considerable congestion both in Massawa and Assab.

This is assumed due to the following reasons:

(1) Small capacity of stacking and storage yards (B and/or C)

(2) While the water-front capacity is determined mainly by apron width and actual apron width in both ports is sufficient enough, the efficiency of the apron is much hampered by stacking or temporary storage on the apron, and the capacity of water-front is not utilized to the fullest extent. Particularly in Massawa, the railway and quay cranes are adversely affecting the maximum utilization of the water-front.

On the other hand, the cargo-handling volume in 1971 E.C. are forecasted 520,000 tons in Massawa and 481,000 tons in Assab, which far exceed the existing capacity of water-

front in both ports (A). As described in the previous paragraph 1, the counter-measure for a possible shortage of the capacity resulting from the increasing cargo volume whould be to provide a minimum necessary investment for ancillary facilities to that the existing berth can be utilized to the maximum extent while avoiding the construction of new berths which requires a tremendous amount of investment.

The countermeasures and steps necessary for the enhancement of handling capacity will be:

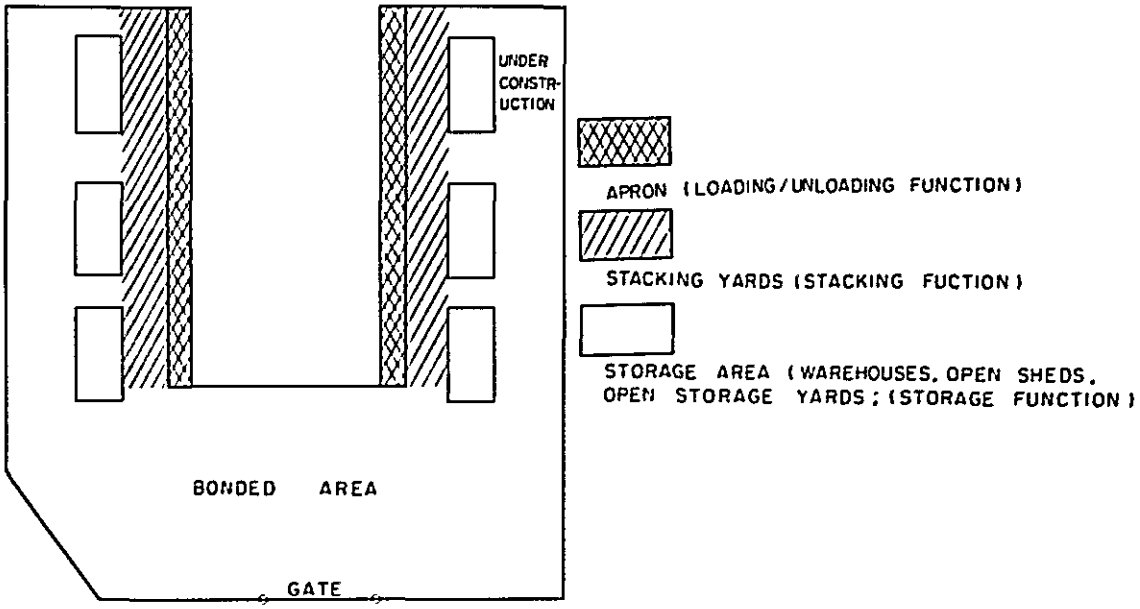
(1) To increase the capacities of stacking (B) and storage (C) to that of water-front (A) so that cargo handling may be brought to the level equivalent to the maximum capacity of water-front.

(2) To increase the capacity of water-front itself and others accordingly.

Proposal for the improvement of the cargo-handling capacity Step 1.

The following are for Assab, but will also apply to Massawa automatically.

Fig. VI-2 Model fo Present Utilization of Port of Assab

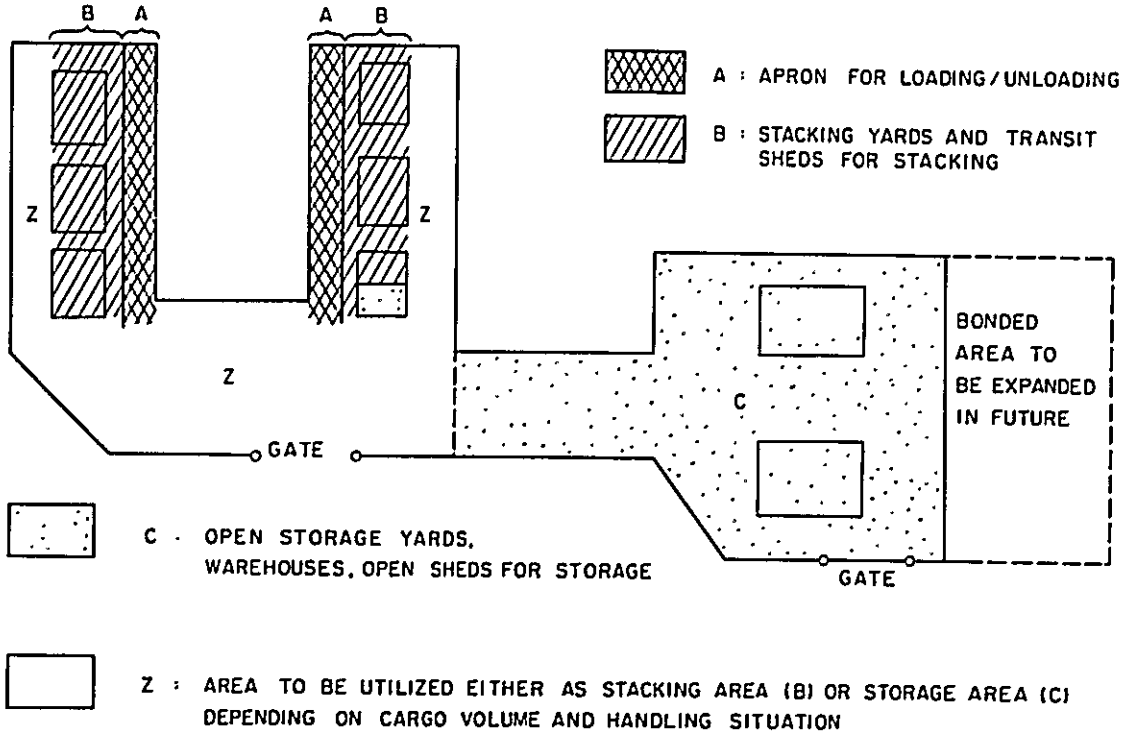


As Fig. VI-2 shows, while the Port of Assab has a comparatively wide area as a whole, stacking yard is provided only in the wharf-front area which extends far upto the water-front, which should be reserve as aprons only for loading/unloading function and should not be mixed with stacking function. Other area are used for storage purposes such as warehouse, open shed and open storage yard, in general. A large volume of cargoes which have not finished customs clearance is stockpiled in warehouse, open shed and even in open storage yard for a long period time, thus affecting to much extent the smoothness and efficiency of stacking function as well as loading/unloading function by limiting the space of stacking area and the apron unnecessarily. Functions of the apron will be taken up again in the section for the capacity of water-front.

It is considered quite difficult to get all imported cargoes forwarded out of the bonded area

(the whole area of the port is the bonded area) immediately after unloading because of high customs rate, and considerable accumulation of a considerably large volume of imported cargoes in the port area (the bonded area) will be unavoidable. In order to improve the stacking and storage functions under the existing customs practice, while allowing an accumulation of cargoes for a certain period, it is necessary to relocate the existing storage function to another area to allow the use of the existing port area specially for stacking function so that the both the stacking and storage areas will have enough spaces for their respective purposes.

Fig. VI-3 Model of Modified Utilization of Port of Assab



The above Fig. VI-3 outlines the proposal made by the Delegation. As the Figure indicates, while the total area including the expansion will be maintained as the bonded area with the imported cargoes being given the same benefit of customs treatment as they are enjoying at present, A, B and C areas will be used only for loading/unloading, stacking and storage functions, respectively. Z areas shall be utilized either as stacking area (B) or storage area (C) depending on cargo volume and handling situation.

Thus, the stacking capacity (B) depends on st, q, p, etc.

$$B=F(st, q, p, etc.)$$

therefore, the stacking capacity will increase as much as the capacity of st increases.

Under the proposal, the existing warehouses and open sheds in the wharf shall be utilized as transit sheds while the existing cold storage may be used as it is.

In the new expansion area intended for storage function, several warehouses and a large number of open sheds shall be provided because less of rainfall in the district.

Additional warehouses will be needed to cope with the increasing cargo volume, especially in export cargoes which require more spaces for efficient loading and which are transported over a long distance between the port and producing centers.

Additional warehouses for export cargoes are needed because they require more space for storage while waiting for ships after being transported from a distant producing center in the hinterland. For the promotion of export trade, more public warehouses should be provided by the public fund.

For better management of the port, the existing charge system should be amended by adopting a high penalty tariff for cargoes over staying in the stacking area to clear them out as quickly as possible, while the tariff with little difference from the existing tariff should be applied to the cargoes in the storage area.

For better utilization of storage facilities, a special rental system and a special charge system on the basis of square meter instead of ton, should be considered for owners of bulky cargo or for a specific storage area.

With the above countermeasures, the condition of $B \geq A$, $C \geq A$ will be maintained and cargo volume to be handled in the existing berths (X) will increase remarkably.

Proposal for the improvement of the capacity of water front Step 2.

In order to further improve the handling capacity following countermeasures should be adopted to increase the capacity of water-front (A);

Repeating again $A=F(d, l, c, q, w, p, \text{etc.})$

In the case of Massawa, completion of No. 6 berth (increase of 1 in the above formula) and the replacement of the existing quay cranes will greatly increase (A). Though the reservation of a proper apron width by separation of apron area from stacking area and storage area as recommended will no doubt increase (A), such an increase will be offset in the case of Massawa by the presence of railway and quay cranes in wharf-front area with the decrease in the efficiency of labourers. Therefore, there will be only a little increase in w or it will be difficult to maintain the original w. For this reason, only a little improvement can be expected in A as follows:

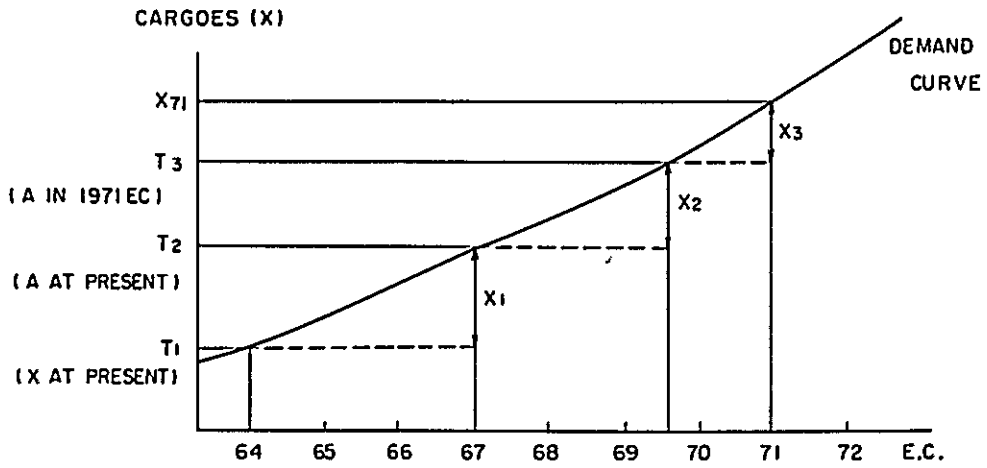
$$A_{\uparrow} = F(\overline{d}, l_{\uparrow}, c_{\uparrow}, \overline{q}, \overline{w} \text{ (or a little}_{\uparrow}) \overline{p}, \text{ etc.})$$

In the case of Assab (as far as the present berthing facilities are concerned), there is no quay crane in the apron except No. 10 berth and d, l and c remain constant. Therefore;

$$A_{\uparrow} = F(\overline{d}, \overline{l}, \overline{c}, \overline{q}, w_{\uparrow}, \overline{p}, \text{ etc.})$$

and an increase of capacity of water-front can be expected from the improvement of only apron function. Only after increasing the efficiency of the existing berthing facilities in this way, construction of the additional berths ($d_{\uparrow}$, $l_{\uparrow}$) should be considered. See Fig. VI-4.

Fig. VI-4 Basic consideration for 5-year Port Improvement Plan



T_1 : CARGO HANDLING VOLUME IN 1964 E.C. = A at present ≒ C at present

T_2 : WATER-FRONT CAPACITY IN 1964 E.C. = A at present ≠ B in 1971 E.C. ≒ C in 1971 E.C.

T_3 WATER-FRONT CAPACITY IN 1971 E C = A in 1971 E.C. ≠ B in 1971 E.C. ≒ C in 1971 E.C.

X_1 : INCREASE OF CARGO HANDLING VOLUME BY IMPROVEMENT OF STACKING AND STORAGE SYSTEM

X_2 : INCREASE OF CARGO HANDLING VOLUME BY INCREASE OF WATER FRONT CAPACITY

X_3 : INCREASE OF CARGO HANDLING VOLUME BY THE CONSTRUCTION OF NEW BERTHS

VII. 5-YEAR IMPROVEMENT PLAN FOR PORT OF MASSAWA

VII. 5-YEAR IMPROVEMENT PLAN FOR PORT OF MASSAWA

1. Outline

Port of Massawa has long been playing an important role as infrastructural function for the economic and social development of its hinterland, where Asmara, the 2nd largest city of Ethiopia, is situated.

The development and improvement of Massawa, therefore, should be planned with the additional capital investment in conformity with the development of its hinterland while avoiding hasty and un-necessary pre-investment.

As a result of evaluations of all available data and information collected from various sources, the cargo volume to be handled at Massawa in 1971 E.C. is estimated at 824,000 t as shown in Table V-5, of which cargoes to be handled at the public berths is estimated at 520,000 t, which is the target volume on which the plan is set up. First of all, the improvement should be directed to re-adjustment and better management of the port by strengthening the existing port facilities centering on water front area and secondly, construction or expansion of berthing facilities should be aimed if the existing facilities become unable to cater to the increase in the demand.

2. Existing Port Facilities

The main existing port facilities with some comments are shown in Table VII-1, VII-2 and VII-3.

Table VII-1 Existing Berths in Port of Massawa

Berth	Length	Depth	Remarks
Commercial Harbor	m	ft	
No. 1	176	16.5	Constructed in 1935 G.C.
No. 2	150	24.5	
No. 3	137	28.5	"in 1885 — Having quay cranes
No. 4	137	28.0	"in 1941 — Having quay cranes
No. 5	137	27.0	"in 1941 — Having quay cranes
No. 6	170	30.0	"in 1929 — Partly lacking in apron
Salt Berth		Max. 32.0	
Oil Terminals			
AGIP Terminal		28.5	
Mobile Terminal		30.0	
Cement Berth		Max. 18.0	
American Jetty		Max. 18.0	Having partly ruined floor but still available bollards

Table VII-2 Existing Storage and Stacking Area in Port of Massawa

(1) Quantity and capacity by the authorized publication

Items	Quantity	Capacity
Warehouse	6	75,921 m^3
Open shed	1	2,616 m^3
Stacking area		33,555 m^2

(2) Evaluation of available area by the Team

Items	Place and Quantity		
Building available as transit shed	Behind No. 1 berth,	300 m^2 300 m^2	600 m^2
	Behind No. 4 berth,	2,800 m^2 1,800 m^2	4,600 m^2
	Total		5,200 m^2
Building available as warehouse	Behind No. 4 berth	1,100 m^2 800 m^2 1,500 m^2 3,500 m^2 2,000 m^2	
	Total		8,900 m^2
Area available as open stacking yard			Not sufficient
Area available as open storage			Sufficient

Tabel VII-3 Existing Port Equipments in Port of Massawa

(1) General

No.	Description	No. of Existing Equipment	Condition
1	Forklift	8	4 in working condition
2	Quay Cranes	6 going to be replaced by another 6 new ones.	All of them work but reduced their lifting capacity from 7 to 2-3 tons. Lifting capacity of new ones may be 5 tons.
3	Mobile Cranes	5	New ones
4	Tug boats	3	2 × 350HP 1 × 1,000HP working but higher H. P. is required.
5	Pilot boats	2	in working condition
6	Workshop machineries	Few	Require more and modern types
7	Vehicles	One bus, 2 trucks 1 V. W.	Require Landrover, dumping truck and V. W.
8	Fire fighting	Truck 1	Coming soon

(2) Forklift trucks

Item No.	Description	Capacity	Price	Date of Purchase	Country Purchase
1	Matboro Forklift truck	3 1/2 ton	$23,044	1960	England
2	Montgomery	1 ton	10,500	1960	"
3	Indos vd 2500	2 1/2 ton	7,350 US	1960	Yugoslavia
4	Litostroj V5d	5 ton	14,062 US	1965	"
5	4 Hyster forklift trucks	3 ton each	25,006.80	1973	England

REMARKS

1. MATBRO FORKLIFT TRUCKS

   Remained idle repeatedly the whole year due to lack of adequate spare parts.

2. LITOSTROJ V5d

   Now in working condition, but this forklift truck also remained idle repeatedly due to lack of adequate spare parts.

3. INDOS Vd 2500

   It is idle also due to lack of spare parts. The engine was overhauled so many times and was repaired in Asmara Workshops. To make this forklift in working condition, complete spare parts for the engine, all drums, cylinder head, tilting ram cylinders, pistons and seals for hoist cylinder have to be replaced.

4. MONTGOMERY

   Not in working condition since it came from Assab, due to lack of spare batteries which can not be found here. The running expense is high and the batteries have to be recharged every 4 hrs.

5. HYSTER

   All of them are in good working condition.

(3) QUAY CRANES

There are two pilot boats in the port which are at present in good condition.

Description	Date of Purchase	Country Purchase
Lord Grey	1952	Great Britain
Fetan	1971	Great Britain

(4) TUGBOATS

Item	Description	Horse Power	Date of Purchase	Country Purchase
1	Shegew	350	1956	Holland
2	Auraris	350	1956	"
3	Khaleb	1,000	1965/66	Yugoslavia

3. Selection of Site for Construction of a New Port

(1) Method of Selection

The existing cargo handling capacity will not be sufficient to handle the estimated cargo volume in 1971 E.C. Therefore, 2 additional berths sould be constructed in another location due to technical difficulty involved in the construction on the extension line of the existing wharf. These 2 berths should be so designed that they not only cater for the foreseeable increase in demand but also function as an integral

part of the new port which will be constructed at a later stage under a long-term master plan to be formulated.

The new port should be equipped with a sufficient space for loading/unloading, stacking and storage areas, a wide and calm basin, and extensive berthing facilities along the water area deep enough for mooring ocean-going vessels, and all other necessary qualifications for the gateway of foreign trade of the country.

Keeping in mind these considerations for the selection of a site for the new port, the most suitable sites would be south of Massawa Island and "Khor Dakliyat". The final selection between these two proposed sites will be preceded by analytical comparisons of several subjects on which significant difference will occur under the plans shown in Fig. VII-1 and Fig. VII-2.

Fig. VII-1 Alternative Plan of Port of Masswa
(South of Massawa Island)

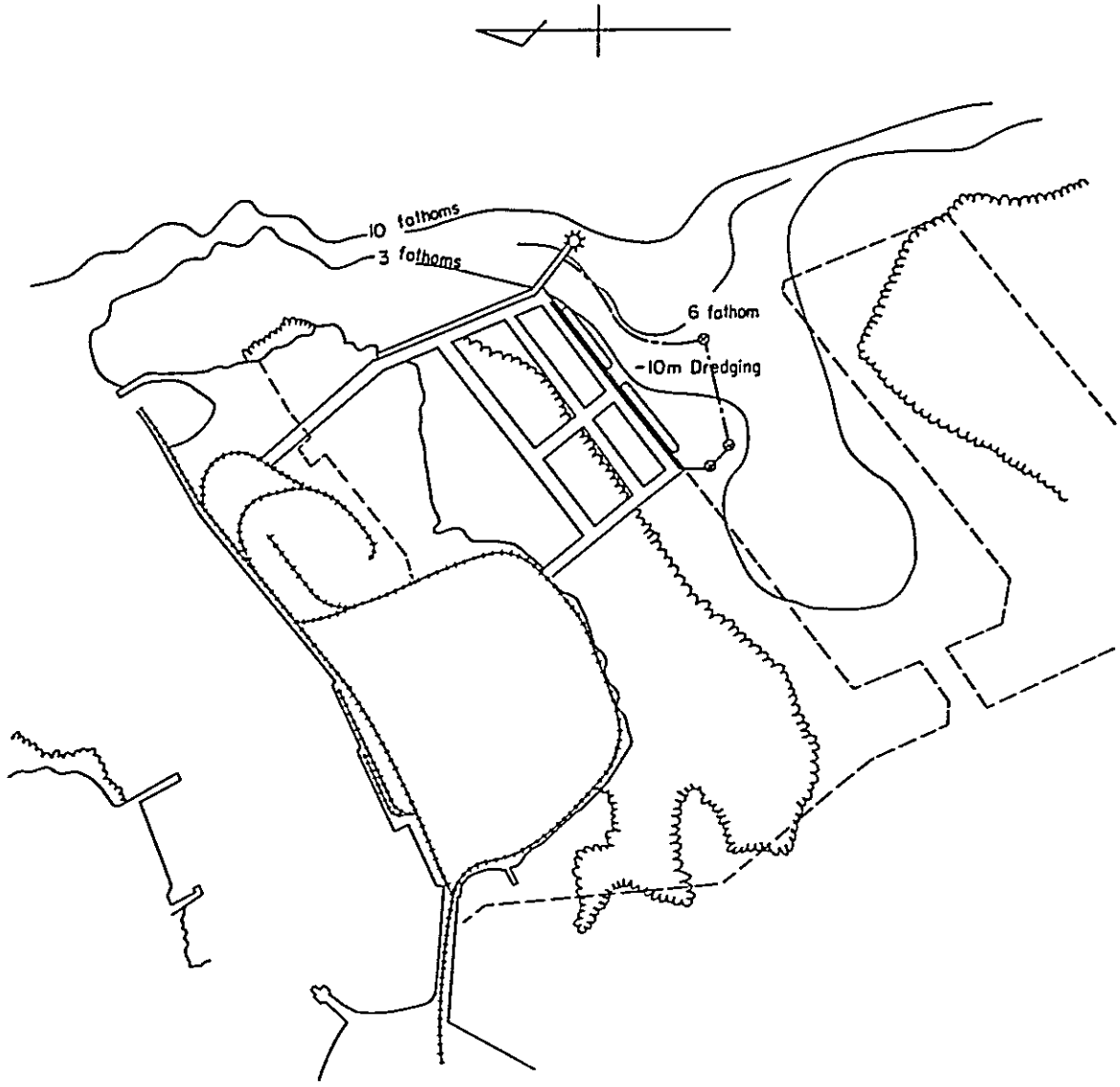
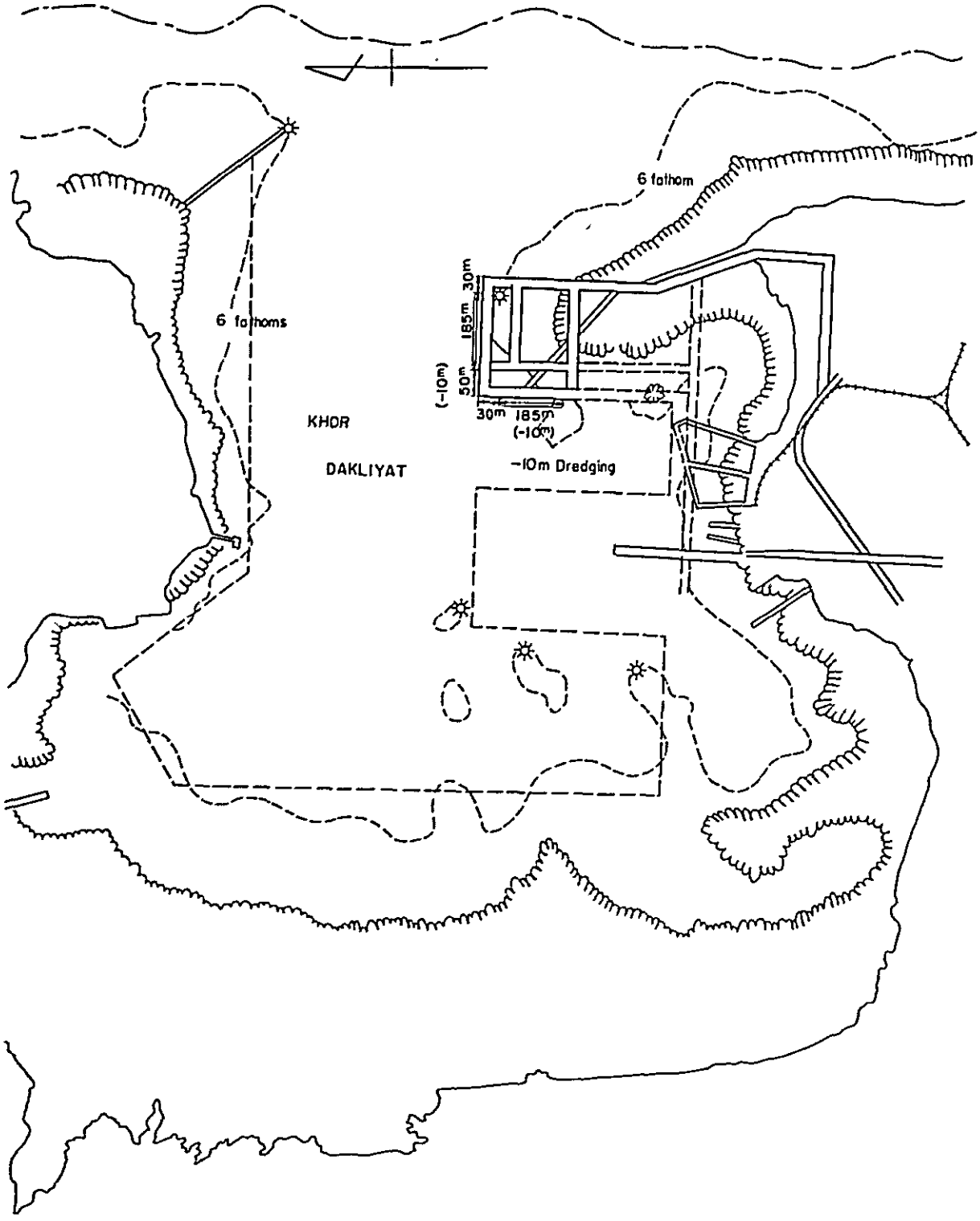


Fig. VII-2 Alternative Plan of Port of Massawa
(Khor Dakliyat)



(2) Comparison

Table VII-4 shows a comparison of main subjects between these 2 proposed sites. According to this comparison table, south of Massawa Island is considered superior to the other, though costly, for integration with the existing port and for access to the city, including the availability of manucipality function. For this reason, it is recommended that South of Massawa Island should be chosen as a site of the new port, particularly from a view point of easier administration and operation of the port for a long period of time.

The improvement plan for port facilities of Port of Assab is shown in Fig. VII-3.

Table VII-4 Comparison of the Proposed Sites in Massawa

	Items	South of Massawa Island (S)	Khor Dakliyat (K)	Comments
(1)	Integration with the existing port	A	C	(S) 1 single bonded area to cover both new and existing ports can be set up. (K) 2 bonded areas inevitable. Road distance between the two is 4km.
(2)	Combination with municipality function	A	C	(S) Banks, shipping agents, forwarders etc. located in the same area. (K) Isolated from such manucipality function.
(3)	Access to inland transportation facilities	A	A	(S) and (K) both easy access
(4)	Freedom from the conflict with existing activities	B	B	(S) The distance between the existing water front line and the city is very close. (K) Oil jetty may be buried in reclaimed land. Area is near to Naval Base.
(4)	Economics of the construction (in case of master plan)	B	A	Soil quantity to be dredged in (S) is bigger than that in (K).

(Note) Above evaluation is graded into A, B and C.

4. Improvement Plan for Port Facilities at Massawa

(1) Berthing Facilities

(a) Improvement of the Existing Berths

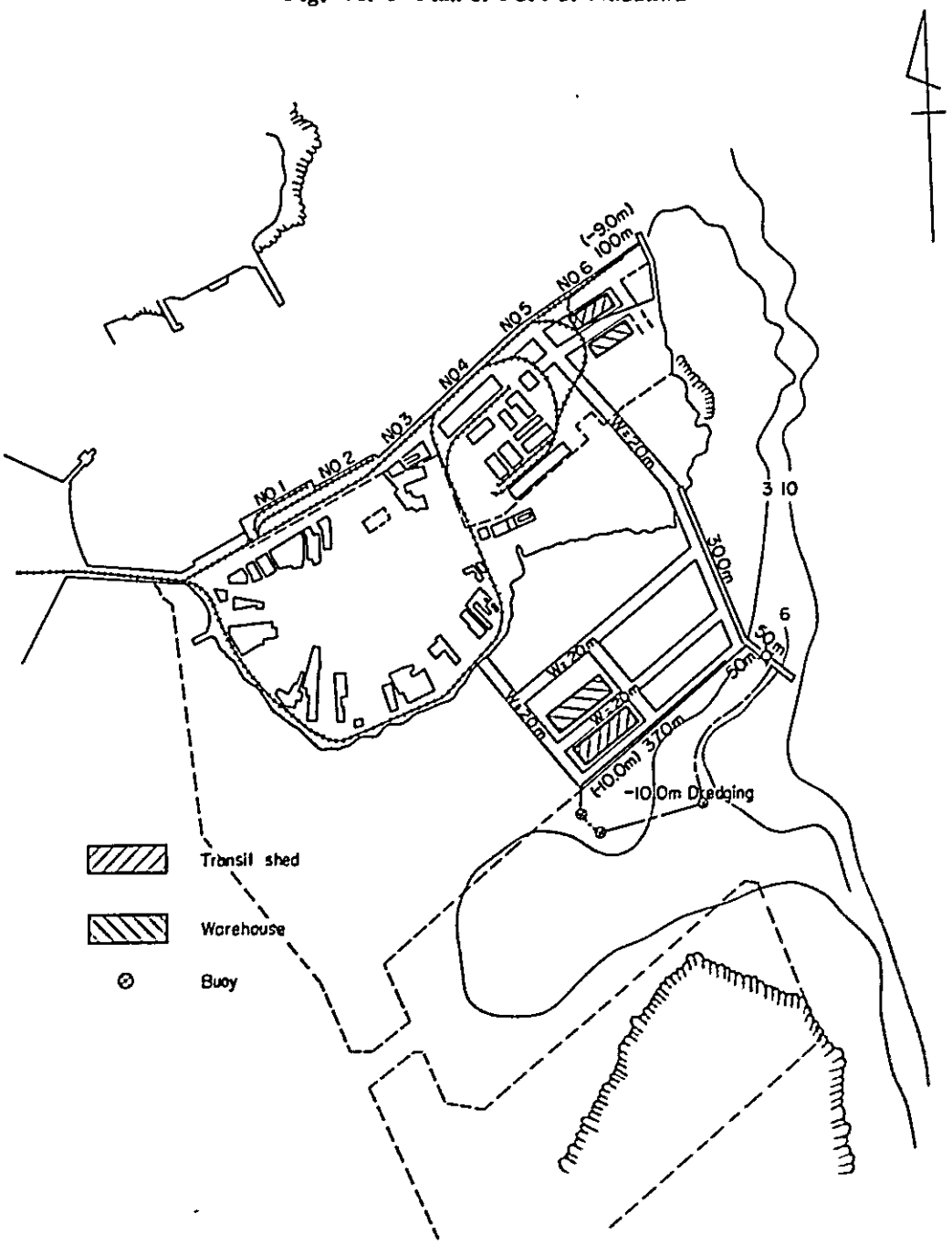
(a)-1 Extension of No. 6 berth

Port of Massawa has 6 berths (No. 1 to No. 6), each having different length and depth of water.

Table VII-5 shows the length, width, depth and draft in full cargo of an ocean-going vessel of the standard type.

Figures in this table should be used as a basis of the determination of dimensions of a standard berth. The length of the berth should be the length

Fig. VII-3 Plan of Port of Massawa



plus the width of the vessel to be moored, assuming the vessel's bow line and stern line extend at 45 degrees. The depth of water should be the draft in full cargo plus an allowance of 0.5m - 1.0m depending upon the type of vessels to be moored.

Table VII-6 shows the length and water depth of a berth suitable for the dead weight tonnage of a vessel of the standard type.

In view of the fact that vessels calling at Massawa are not carrying full cargoes, the length of the berth is a more important factor for evaluation of the berthing capacity of the existing berths. Table VII-7 shows the evaluation of the berthing

Table VII-5 Dimension of Standard Cargo Ship

Tonnage of ship	Length of ship	Width of ship	Depth of ship	Draft in full cargo
D/W	m	m	m	m
700	52	8.3	3.8	3.6
1,000	60	9.3	4.4	4.1
3,000	90	13.1	6.8	5.7
5,000	109	15.3	8.4	6.7
10,000	142	19.0	11.1	8.3
15,000	165	21.6	13.0	9.5
20,000	184	23.6	14.6	10.3

Table VII-6 Dimension of Standard Berth

Tonnage of Ship	Length of Berth	Depth of Berth
D/W	m	m
700	60	4.5
1,000	70	5.0
3,000	105	6.0
5,000	130	7.5
10,000	165	9.0
15,000	185	10.0
20,000	195	11.0

Table VII-7 Evaluation of Existing Berths in Port of Massawa

	Maximum tonnage, evaluated by length of the berth	Maximum tonnage, evaluated by depth of the berth
No. 1	12,000 D/W	700 D/W
No. 2	8,000	5,000
No. 3	5,000	8,000
No. 4	5,000	8,000
No. 5	5,000	7,000
No. 6	10,000	10,000

capacity mainly in accordance with the length of the berth. As the world-wide phenomenon, the tonnage of liners is increasing from the present range of 10,000 D/W to 15,000 D/W and when this trend is taken into consideration, the existing berthing capacity will not be sufficient. The length of No. 6 berth alone can be physically extended and a stacking area can be provided by reclamation. Therefore, the first possible improvement will be the extension of the length of No. 6 berth from the present 170 m to 185 m, and the approach portion of the quaywall, 85 m in length in case of Massawa, should be provided at the end

of the berth from a standpoint of better utilization and coping with structural problem of the quaywall.

(a)-2 Other Improvements

The pavement of the apron should be repaired for smooth traffic of folklifts, truck-cranes, trailors, etc. In particular, the surface of the pavement and the top of rails for wagon and quay-crane should be level with each other.

(b) Construction of Berths

(b)-1 Number of Berths

The existing capacity of Port of Massawa for cargo handling, according to the Interim Report submitted in January 1973 is 302,000 - 353,000 t. Taking 328,000 t/year as an average figure, this figure is obtained from the following:-

A.W.T/A.S.T. =0.15 (Note) A.W.T. means average waiting time per ship and A.S.T. means average days of ship's stay in port.

Berth occupancy = 65%

A.S.T. = 2.17 days/ship

Number of berths = 6

Tonnage loaded and unloaded per ship = 600 MT/ship

Seasonal fluctuation = 20%

Assuming that the execution of the 5-year Port Improvement Plan increases the loading and unloading capacity of the existing berths by 10%, the eventual capacity will be;

328,000 × 1.1 = 361,000 t/6 berths

Therefore, the capacity per berth will be;

361,000 ÷ 6 = 60,000 t/berth

This increase in capacity may be attributed to the shortening of average days of ship's stay.

As the volume of cargoes to be handled at the public berths in Port of Massawa in 1971 E.C. is estimated at 442,000 t, the volume of cargoes to be handled in the new berths should be:

442,000 - 361,000 = 81,000 t

Therefore, the following berths should be newly constructed for handling public cargoes:

81,000 t ÷ 60,000 t/berth = 1.35 berths ---------- (1)

6,500 t of copper is estimated to be handled per month in Port of Massawa in 1971 E.C.

According to the information obtained from Ethio-Nippon Mining Share Co., copper may be carried to ship side in four 2-ton buckets on a 8-ton truck, emptied into the hold by inverting buckets over it with a derick crane equipped on the ship and stored in bulk in the hold of the ship.

Assuming that it takes 10 minutes to load the backets on a truck and 2 hatches are used for copper handling, the time necessary for copper handling per

month will be:

6,500 t/month ÷ (2 t/bucket x 4 buckets/truck x 1 truck/10 min. x 60 min./hr. x 2 hatches) = 68 hrs/month

Assuming that working hours per day are 10 hrs/day, the number of days necessary for copper loading per month will be:

68 ÷ 10 = 7 days

When the berth occupancy is 65%, the number of berths needed for loading copper will be:

$$\frac{7}{30 \times 0.65} = 0.35 \text{ berths} \quad \text{---------- (2)}$$

By adding up (1) and (2), the number of berths to be newly constructed in Port of Massawa will be:

1.35 + 0.35 = 1.70 berths

So, 2 berths should be provided newly in South of Massawa Island in Port of Massawa.

(b)-2 Depth of Water

The depth of water along the berths was determined to be 10 m to accommodate 15,000 D/W vessels.

(b)-3 Apron

The width of apron was determined to be 20 m on the assumption that cargoes may be handled in the same way as in Port of Assab. Railway should not be constructed in the new port area.

(2) Basin

The basin should be dredged to a depth of 10 m for 15,000 D/W liner.

(3) Breakwater

A breakwater should be constructed to prevent running wave.

(4) Transit Shed and Open Stacking Yard

(a) North of Massawa Island

(a)-1 Transit Shed

The cargoes to be handled in North of Massawa Island in 1979 will be:

Export 182,000 t Import 146,000 t Total 328,000 t

Assuming that the cargoes to be directly loaded and unloaded to and from the rail are 55,000 t for export, 55,000 t for import for a total of 110,000 t same as the present, the cargoes utilizing the stacking area will be:

Export 127,000 t Import 91,000 t Total 218,000 t

Then, the stacking area needed will be:

$$A = \frac{W}{\alpha \cdot w}$$

$$W = \frac{Q}{N}$$

(Note) Q = Cargoes to be handled annually: t

A = Stacking area; m^2

W = Measurement of transit shed; t

N = Annual rotation;. /year

α = Utility ratio of the floor

w = Measurement per floor unit; t/m^2

Assuming N = 24,

then, $W = \frac{218}{24} = 9,100$ t

Assuming $\alpha = 0.6$ and $w = 1.0$,

then, $A = \frac{9,100}{0.6 \times 1.0} = 15,000\ m^2$

Judging from the existing situation of cargo stacking in Port of Massawa, 50% of cargo should be stacked in transit shed and 50% in open stacking yard, then the area of transit shed will be:

$15,000\ m^2 \times 1/2 = 7,500\ m^2$

In the meantime, the following are to be utilized as the transit shed out of the existing facilities in Port of Massawa.

No. 1 berth	2 @300 m^2	600 m^2
No. 2 berth		2,800 m^2
		1,800 m^2
	Total	5,200 m^2

Therefore, the area of transit shed to be constructed in North of Massawa Island will be:

$7,500m^2 - 5,200m^2 = 2,300m^2$

In conclusion, construction of 1 transit shed with a floor space of 30m × 80m behind No. 6 berth is recommended.

(a)-2 Open Stacking Yard

The open area connecting to apron area should be used as open stacking yard and should be paved.

(b) South of Massawa Island

(b)-1 Transit Shed

60,000 t/berth of cargo is assumed to be handled in South of Massawa Island in 1971 E.C. The stacking area connecting to 60,000 t berth will be:

Assuming that Q = 60,000, N = 24, $\alpha = 0.6$, w = 1.0

$W = \frac{60,000}{24} = 2,500$ t/berth

$A = \frac{2,500}{0.6 \times 1.0} = 4,200m^2$/berth

which means that a stacking area with space of 40m x 105m is necessary for one berth to handle 60,000 t cargoes.

As for the transit shed, the dimensions of the building should be 40m × 125m including a 10m wide office, store-room, garage, shop etc., at both ends, which should be constructed behind the western berth out of the 2 berths to be provided in the new port, South of Massawa Island.

(b)-2 Open Stakcing Yard

Of the 2 berths to be constructed, the eastern berth will eventually be used for container-vessels in the future and this area, for the time being, should be used as open stacking yard with 50m wide pavement.

(5) Warehouse and Open Storage Yard

The cargo volume to be stored in 1971 E.C., except those direct delivered by rail will be:

Export 190,000 t Import 142,000 t Total 332,000 t

For export cargoes, assuming 1/10 of the above volume is stored in warehouse, the annual cargo storage will be 19,000 t.

As to import cargoes, assuming the half of the volume is stored in the warehouse, the annual cargoes storage will be 71,000 t.

Therefore, Q = 19,000 t + 71,000 t = 90,000 t

As to storage, assumption is made that N = 6, α = 0.7, w = 1.5, therefore,

$$W = \frac{90,000}{6} = 15,000 \text{ t}$$

$$A = \frac{15,000}{0.7 \times 1.5} = 14,400 \text{ m}^2$$

The total floor area of the existing warehouses is 8,900m², and the area to be newly added will be:

14,400 - 8,900 = 5,500m²

which will be shared as follows:

South of Massawa Island	4,200m²
North of Massawa Island	1,300m²

As for the facilities plan, construction of the following is recommended.

One warehouse 40m x 125m (actual storage area = 40m x 105m) in South of Massawa Island,

One warehouse 30m x 80m in North of Massawa Island.

There is a lot of space in Massawa available for open storage yard. Pavement is not considered necessary in view of its rotation 6 times a year. However, the surface of the area where railway tracks are laid should be repaired for smooth traffic of vehicles.

(6) Transport Facilities in and around the Port Area

The existing rail tracks should be extended into the expanded No. 6 berth.

New roads should be built in the new port area of South of Massawa Island and also to connect North of Massawa Island with South of Massawa Island.

(7) Others

Other port facilities such as cargo handling equipments, tugboats and other ancillary equipments should be considered in budget compilement according to their needs.

As regards to water supply to ships, for which demand is expected to increase, this report does not give construction cost for necessary budget, as it is the responsibility of the municipal government. The reason this 5-year Plan does not contain the

procurement of a large number of cargo handling equipments is that the cargo handling system relying more on manpower than upon machinery and equipments will be still appropriate in this country. It is predicted, however, that the introduction of bigger capacity's cargo handling equipments will become necessary to cope with the container system to be adopted upon completion of the execution of this 5-year Port Improvement Plan.

5. Preliminary Design

The following are the preliminary designs and calculations to evaluate an investment amount to be earmarked for the coming 5-year Port Improvement Plan.

Objects of the design are (1) -9.0m quay wall in North of Massawa Island and (2) -10.0m qyay wall, breakwater and seawall in North of Massawa Island.

(1) Quay Wall

(a) Conditions of the Design

(a)-1 Vessels 15,000 D/W

(a)-2 Depth of berth

North of Massawa Island ..... 15,000 D/W berth - 9.0m

South of Massawa Island ..... 15,000 D/W berth - 10.0m

(Note) As the berth in North of Massawa Island is planned as the extension of existing No. 6 berth, the depth of berth will be same as that of No. 6 berth.

(a)-3 Tidal Level

H.W.L. +1.30m

L.W.L. ±0.00m

(Note) Above figures are taken from "the Interim Report"

(a)-4 Crown Height +2.50m

(Note) Above figure is taken from the existing crown height of quay wall.

(a)-5 Surcharge 2.0 t/m²

(a)-6 Earthquake force No consideration

(Note) However, a section is designed so that it will be stable even under design seismic co-efficient k_t=0.05.

(a)-7 Apron Width 20.0 m

(a)-8 Soil Condition under Seabed

Internal friction 30°

Submerged bulk density 1.0 t/m³

(Note) As there is no data on soil condition at the design site, the above figures were assumed on the basis of the following boring data obtained from Taulud Bay where the construction of a fishery base was recently completed by the Ministry of Agriculture, though this location is a little bit far from the design site: The borings were carried out in seabed less than -5.0m deep.

The soil consists of a siltlayer to a depth of -1.0m, -2.0m from the surface, a sandy silt layer with less than 20% of silt and 10-15 N. value

underneath and a rock-layer with 40-50 N. value further below at a depth of approximately -10.0m from the surface.

The soil test reports that sandy silt has:

Submerged bulk density γ_t = 1.80 - 2.10t/m³

Internal friction ϕ = 35 - 40°

Boring tests were carried out by National Boring Company and the soil tests by Materials Research and Testing Department.

(a)-9 Soil Conditions of Backfill

Internal friction	35°
Angle of wall friction	15°
Bulk density above residual water height	1.8t/m³
below residual water height	1.0t/m³

(a)-10 Residual Water Height +0.40m

(b) Evaluation of Construction Type

Block structure would be advisable in view of the fact that the soil condition is assumed to be favorable, the civil works are simple without the need for utilizing any specific construction facilities and construction cost may be economized. See the standard section in Fig. VII-4, VII-5.

(Note) As no boring has been conducted at the site, there is no data available on physical and chemical character of foundation soil. Therefore, the evaluation on the bearing capacity of foundation is not sufficient at this stage. At the time of detailed designing, more detailed soil investigations including boring tests will be necessary, particularly for the confirmation of the rock layer which has already been recognized by the above boring test in the fishery base at the time of construction of the existing Port of Massawa.

(2) Breakwater, Seawall

(a) Conditions of the Design

(a)-1 Wave Height H = 1.6 m

T = 5 sec

(Note) The above figures were taken from "the Interim Report".

(a)-2 Wave Direction NE

(a)-3 Tidal Level

H.W.L.	+1.30m
L.W.L.	±0.00m

(a)-4 Crown Height

Breakwater +2.50m

(Note) C.H. = H.W.L. +0.6H = 1.30 + 0.6 × 1.6 = 2.26 ≒ 2.50

Seawall +3.50m

(Note) C.H. = H.W.L. + 1.25H = 1.30 + 1.25 × 1.6 = 3.3 ≒ 3.50

(a)-5 Rubble

Specific gravity	2.65
Submerged bulk density	1.0t/m³

(b) Evaluation of Construction Type

Rubble mound breakwater and rubble mound seawall like the existing one are recommended for reasons of local availability of the materials, good soil conditions, no need for utilizing any specific construction facilities and the economy of the cost.

See the standard section in Fig. VII-6, VII-7.

6. Program and Cost of Investment

Construction program and annual investment for the construction work are shown in Table VII-8 and VII-9, respectively.

The construction program was made on the basic concept that one of the two berths would begin to ooerate as early as possible.

Unit price of dredging work was estimated on the assumption that N-value, indicator of soil condition, is around 10. Therefore, it may possibly change after detail survey.

Unit price for each item is the summing up of main construction cost and its 30% as indirect cost.

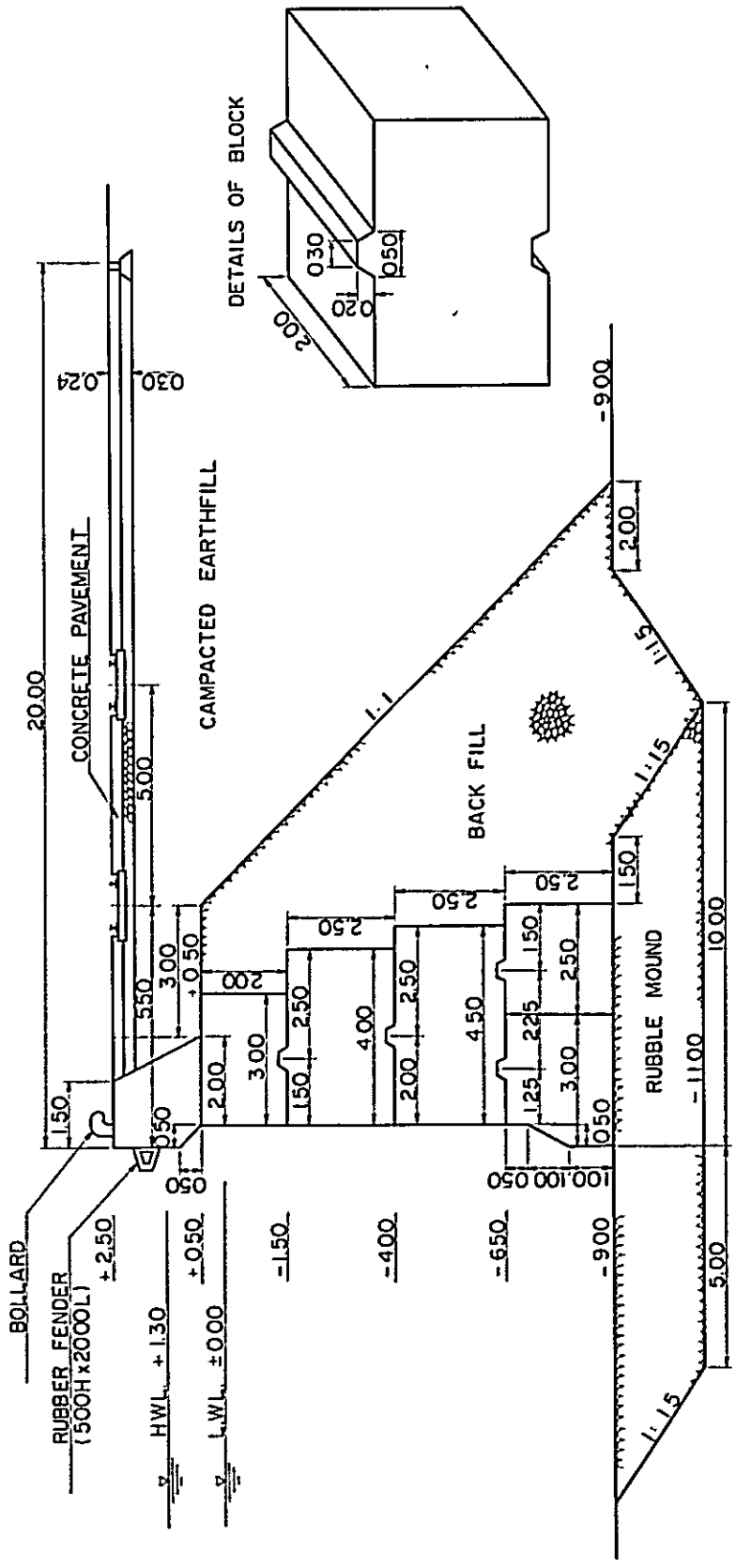


Fig. VII-4 Standard section of -9.0m Quay Wall, Port of Massawa

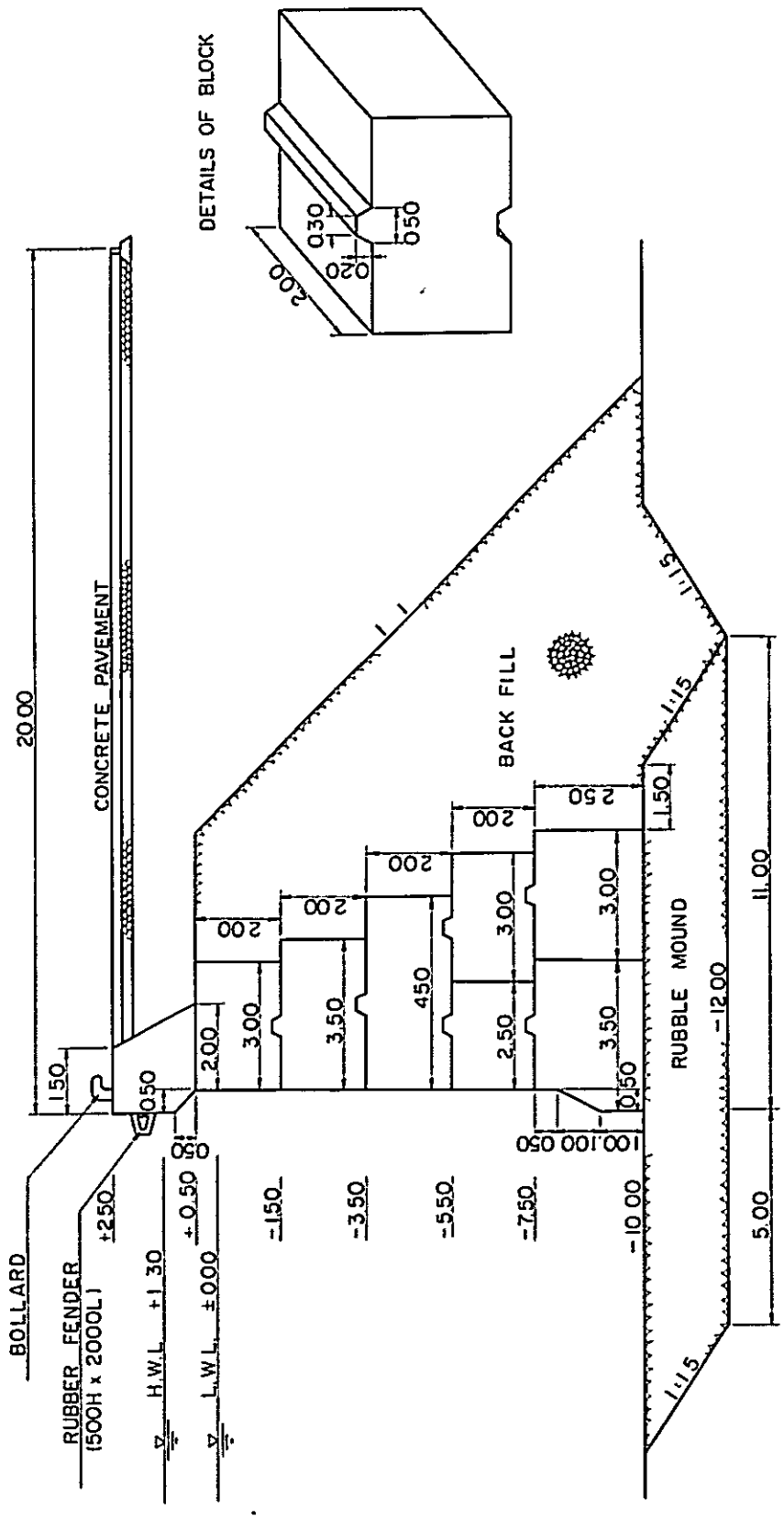


Fig. VII-5 Standard Section of -10.0m Quay Wall

Fig. VII-6 Standard Section of Breakwater

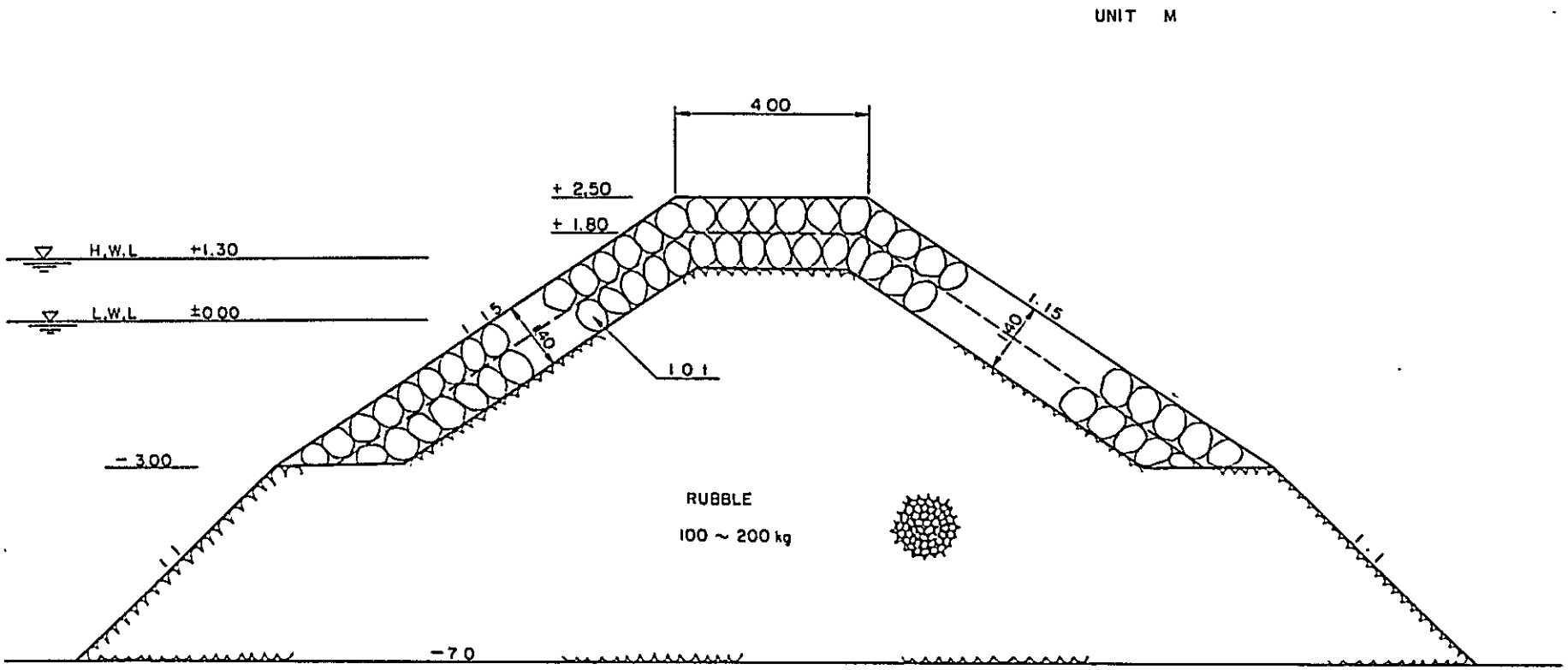
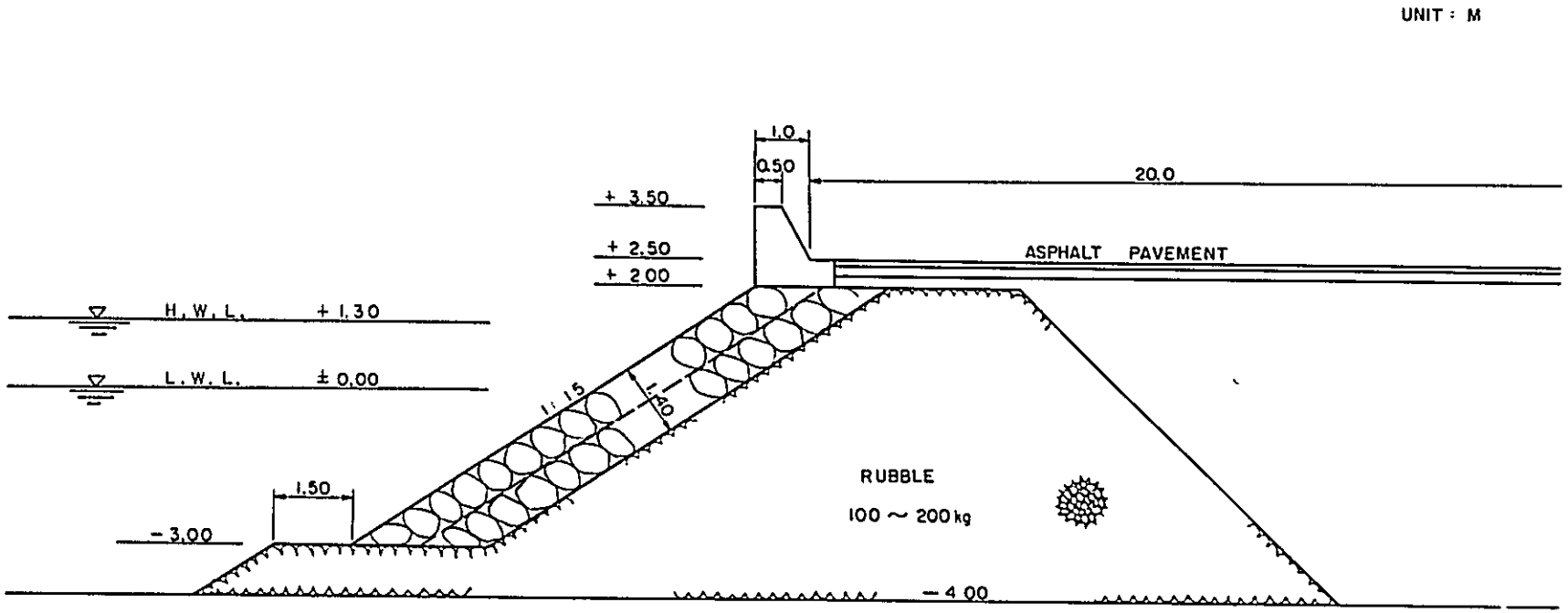


Fig. VII-7 Standard Section of Seawall



Tabel VII-8 Time Schedule of Port Construction, Port of Massawa

Works	Quantity	Fiscal Year				
		1967	1968	1969	1970	1971
Survey & Design (include approach)						
-9.0m Quay Wall (include approach)	100m					
-10m Quay Wall	420m					
Breakwater	50m					
Seawall	300m					
Dredging	195,000m³					
Road	46,600m²					
Railway	200m					
Reclamation (North)	127,000m³					
(South)	531,000m³					
Transit Shed	7,400m²					
Warehouse	7,400m²					
Forklift	4					
Tugboat	1					
Buoy	8					

Table VII-9 Annual Investiment Plan (Port of Massawa)

(Unit: Eth. $1,000)

	Unit	5-Year ('67-'71)		1967		1968		1969		1970		1971	
		Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost
(include approach) -9.0m Quay Wall	m	100	1,230	100	1,230								
(include approach) -10m Quay Wall	m	420	6,140			14.6	214	140.5	2,054	147.3	2,154	117.6	1,718
Breakwater	m	50	230			50	230						
Seawall	m	300	690			300	690						
Dredging	m³	(46,900m²) 195,000	1,500							90,000	692	105,000	808
Road	m²	46,600	2,150					11,660	538	16,670	769	18,270	843
Railway	m	200	123			200	123						
North Reclamation	m³	(25,500m²) 127,000	586	13,400	308	12,100	278						
South Reclamation	m³	(145,000m²) 531,000	2,450			45,500	769	28,600	483	36,400	615	34,500	583
Transit Shed	m²	(30mx80m 40mx125m) 7,400	569	(30mx80m) 2,400	185							(40mx125m) 5,000	384
Warehouse	m²	30mx80m 40mx125m 7,400	569			(30mx80m) 2,400	185					(40mx125m) 5,000	384
Forklift		4	74							2	37	2	37
Tugboat (1,000HP)		1	1,154			0.5	577	0.5	577				
Buoy		8	308	4	154							4	154
Total			17,773		1,877		3,066		3,652		4,267		4,911

VIII. 5-YEAR IMPROVEMENT PLAN FOR PORT OF ASSAB

VIII. 5-YEAR IMPROVEMENT PLAN FOR PORT OF ASSAB

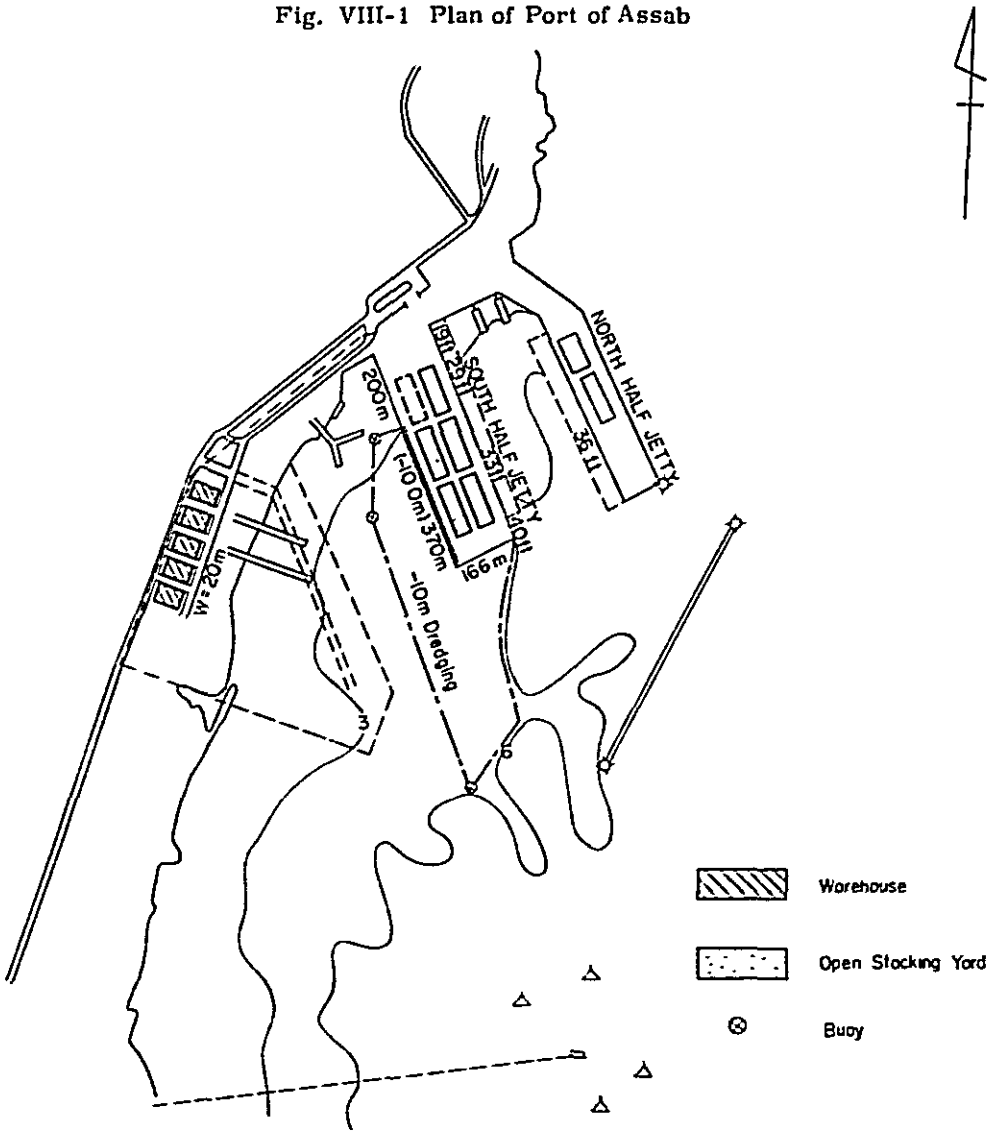
1. Outline

Port of Assab, together with Port of Massawa, is a representative liner port in this country. Having the facilities for unloading of crude oil and loading of oil products, it is also functioning as an industrial port. An oil refinery is located slightly apart from its commercial port area.

A suitable policy is critical for the future of Port of Assab, as it is facing a keen competition with the Port of Djibouti. For the estimation of its cargo volume in 1971 E.C., the trend method was adopted as mentioned in V.

Estimating the volume of cargoes to be handled in the port in 1971 E.C., at 746,000 t for export and 1,563,000 t for import, for a total of 2,309,000 t out of which 299,000 t of export and 182,000 t of import are for public cargoes, the improvement plan has been

Fig. VIII-1 Plan of Port of Assab



laid for the commercial port area paying attention not to affect its function as an industrial port.

The improvement plan for port facilities of in Port of Assab is shown in Fig. VIII-1

2. Existing Port Facilities

The outline of the present port facilities in Port of Assab and some comments on them are shown in Table VIII-1, 2 and 3.

3. Selection of Site for Construction of a New Port

As mentioned in the following paragraph 4 (1), two additional berths are to be constructed in Port of Assab. There are two alternatives for the construction:

Table VIII-1 Existing Berths in Port of Assab

Berth		Length	Depth	Remarks
Commercial Harbor		ft	ft	
The North Half Jetty	1)	1,620	36	• Public berths • Constructed in 1957-61 G.C. • In good working condition
	2)			
	3)			
The South Half Jetty	8)	164	19	
	9)	459	29.5	
	10)	1,115	33.8	
	11)			
Coaster Piers	4)	260	26	
	5)	260	26	
	6)	260	26	
	7)	260	26	
Oil Harbor				
Shell Jetty		Dolphins & Buoys	33	Private berths
Coastal Tanker Jetty			27	
Refinery Terminal			36	
Salt Loading Terminal			33	

Table VIII-2 Existing Storage and Stacking Area in Port of Assab

(1) Quantity and capacity by the authorized publication

Items	Quantity	Capacity
Warehouse	6	2,197,000 ft³
Open shed	1	
Stacking area		1,872,000 ft³
Cold Storage	1	49,000 ft³

(2) Evaluation of available area by the Team

Items	Place and Quantity	
Building available as transit shed	Behind No. 2 berth 120m x 37m = 4,440m No. 4 " 120m x 37m = 4,440 No. 5 " 120m x 37m = 4,440 No. 6 " 120m x 37m = 4,440 Open shed 90m x 40m = 3,600	16,920m (Under construction)
Building available as warehouse	Old warehouse: 45m x 23m = 1,040m 70m x 28m = 1,960m Cold storage: 27m x 11m = 297m	3,000m
Area available as open stacking yard	Behind No. 1 berth No. 3 "	Not sufficient
Area available as open storage	Behind No. 8 berth Along fence In front of garage and shop	18,000m

Table VIII-3 Existing Port Equipments in Port of Assab

(1) Marine Crafts

Item	Equipment	Purchase date	Type/Model	Capacity	Remarks
1.	Metchal tug boat	1955	Crossley engine	670 H.P. Length 23.40m G.R.T. 99.89 displacement 150 ton	Due to long service the engine power is reduced. Assab's rough seas need tugs with 1,000 H.P.
2.	Tatek tug boat	1955	Crossley engine HGN 6	670 HP	Same remarks with Metchal
3.	Addis pilot boat	16.3.71	Perkins T6.354	120 H.P. Length 40ft. weight 16 ton. 8.2 knots.	Good working condition
4.	Abeba pilot boat	26.4.73		Perkins 510U 19652. Length 40ft. depth 5'6". Speed 8.9 knots.	

(2) Cranes

Item	Equipment	Purchase date	Type/Model	Capacity		Remarks
1.	Derrick crane	1957	2nd hand Haulotte	30ton at 15m, 19ton at 25m		The whole structure highly vibrated during operation, clutches burn out rapidly. The general condition of the crane operation is unreliable. It was erected to carry stones during port construction and not suitable for cargo handling.
2.	Mobile crane No. 1	22.2.57	U.A. 832 Wilhag	18ton	10m. extension 4.6m.	Although the crane performance is good, but due to physical life exhaustion, it is the right time for economical reason to replace it.
3.	Mobile crane No. 2	1963	Demag V70nZ	99ton	5m and 3m extension	Good working condition
4.	Mobile crane No. 3	1967	Cokes crane NS 925 neal	20ton	50ft. with extension	Good working condition
5.	Mobile crane No. 4	4.6.73	Jones Crane KL55	5ton	30ft.	

Note: Unless stated on the remarks column the blank space means "In good working condition".

(3) Fork Lifts Qty = 19

Item	Equipment	Purchase date	Type/Model	Capacity	Remarks
1.	Fork lift No. 1	1957	Hyster RT 100	5 ton	This truck have reached maximum economic life and needs replacement.
2.	" No. 2	30.11.62	Hyster H60B	3 ton	No. 3 & 4 have never been utilized because of poor performance - slow speed, hard manueverability, low tyre for working on an asphalted area. Descriminated by agents and operators as well. No. 3 lacks few parts. No. 5 & 7 have better use but they are also in the same situation. For Yugoslave made equipment it is very difficult to get parts in time. These trucks will have to be sold.
3.	" No. 3	"	Indos VD 1.5	1.5 ton	
4.	" No. 4	"	Indos VD 1.5	1.5 ton	
5.	" No. 5	"	Indos VD 2.5	2.5 ton	
6.	" No. 7	"	Indos VD 2.5	2.5 ton	
7.	" No. 8	"	Litostroj VD 5	5 ton	Though, it has some similar characteristics with No. 5 & 7 it has given favorable service life and replacement would be jusitified economically.
8.	" No. 9	1966	Hyster H60C	3 ton	In fair condition but approaching the end of economical life.
9.	" No. 10	1967	Esslingen DC 3.2. R.W.	3 ton	
10.	" No. 11	1967	Matbro Y 70	3 ton	No. 11 & 13 had long down time due to frequent transmission problems. With moderate expenses or cannibalizing system they can give few years of productive service.
11.	" No. 13	1967	Matbro Y 70	3 ton	
12.	" No. 15	1967	Hyster H110	5 ton	Given many years of profitable service working up to 16 hours daily and after a year or two needs replacement.
13.	" No. 16, 17, 18, 19, 20, 21, 22, 23 and 24	20.10.72	Hyster H 0C	5,570 lbs	New, all are of the same made and standard. Good for maintenance and economical purpose. They have never been used on useful job. Used only in workshop for dismounting and mounting engines during over haul.
14.	Electrical fork lifts No. 1	1967	Montgomery lied	1 ton	
	Electrical fork lifts No. 2	1967	Ltd. MR 20	1 ton	

(4) Vehicles

Item	Description	Purchase date	Type/Model	Capacity	Remarks
1.	Land Rover PL. No. 2153	1960	88 Series II	7 persons	Very old, needs replacement.
2.	Land Rover PL. No. 3300		88 Series II	7 persons	Infair condition - Water Supply Section
3.	Land Rover PL. No. 197	1971	109 Series IIA	Truck	In good condition - Water Supply Section
4.	Land Rover	26.4.73	109 Series IIIA	Truck	New.
5.	V. W. PL. No. 1546	1957	113 sedan	5 seats	Very old, needs replacement.
6.	V. W. P. No. 562	1968	110 seats	5 seats	In good condition.
7.	V. W. P. No. 563	1968	231 kombi	12 seats	Working non-stop 24 hrs. over 150,000 km. Kept on service at high maintenance cost.
8.	Commer bus	26.4.73	Commer VCFS 562	30 seats	New
9.	Commer truck	26.4.73	Commer VCFS 441	7 ton	New
10.	Fire fighting truck	1967	UD 43 TI 805 Type IN.	4000 litres	In good condition

(5) Tractors Qty. =17

Item	Equipment	Purchase date	Type/Model	Capacity	Remarks
1.	Tractor No. 2	1964	MTZ 5m	45 H. P.	They are good machine, given long profitable service, but approaching the exhaustion of their physical life. As it is very difficult (U.S.S.R.) to obtain spare parts in time, gradually we have started cannibalizing them.
2.	Tractors No. 3	1964	MTZ 5m	45 H. P.	
3.	Tractors No. 4, 7, 8, 9, 10 and 12	1964	DT 20	20 H. P.	
4.	Tractors No. 13, 14 15 and 17	1967	Esslingen DZ - 10	35 H. P. 2000 Lbs draws bar pull	They are in good working condition but as their economical life is coming to end, maintenance and operation costs increase.
5.	Tractors No. 18, 19 20, 21 and 22	12.10.72	Mercury MD 40 PD	Drawbar pull 4000 lbs.	New and in excellent condition.

(6) Trailers

Item	Description	Purchase date	Type	Dimensions	Qty	Remarks
1.	Solidtyre 3 ton trailer	M64	Blum hardt	240 x 120 x 42cm.	75	Hardly been in use from the bgeinning; better resale them.
2.	5 ton Trailer	1964	Blum hardt	250 x 150 x 75cm.	22	Good working condition.
3.	10 ton Trailer Solid type	1964	Blum hardt	450 x 200 x 60cm.	4	Plat forms distorted, of no use any more.
4.	10 ton Trailer	1964	Blum hardt	450 x 250 x 90cm.	21	In good working condition.
5.	20 ton Trailer			600 x 250 x 100cm.	1	In good working condition.
6.	10 ton New Trailer	28.8.73	Dennis Bro.	450 x 250 x 90cm.	15	Brand new, not yet put in service.
7.	15 ton New Trailer	28.8.73	Dennis Bro.	1,000 x 260 x 80cm.	1	Also new.

(7) Navigational Aids

Item	Description	Date	Type	Characteristics	Optical range	Remarks
1.	Ras Fatuma light house		Flasher-KNDA-130 Burner-ZBFA-130 Burner-901/hr.	3 flashes every 23 sec.	10 miles	New replacement will be installed soon
2.	Ras Gambo light house	1958	Elec. Flasher LKDB 160 Lamp 1000W	1+2+1+11=15 sec.	11 miles	Still giving good service.
3.	Breakwater	1969	Program switch MZY time switch EZC	Red=1 light 2 eclips=3 sc. periods Green=1 light 5 eclips =6 sec. periods Green=0.5 light, 0.5 eclips--1 sec. period	5 miles	All functioning well
4.	New Ras Fatuma	1972	AGA-PRB 12	0.19+2+0.19+2+0.19 +18.43=2 sec.	21 miles 10,000 candles	Not yet installed.
5.	New Ras Gambo	1972	AGA LBEP-220/11	1+1+1+7=10 sec. 1	18 miles 4,000 candles	Not yet installed.
6.	Light Buoy-Bosanquay shoal	1972	AGA B-200/21 7'6" Lbbm-150 H14	0.8+7.2=8 sec.	7 miles	Soon will be installed.

Alternative 1: Extension of the North Half Jetty to the south east

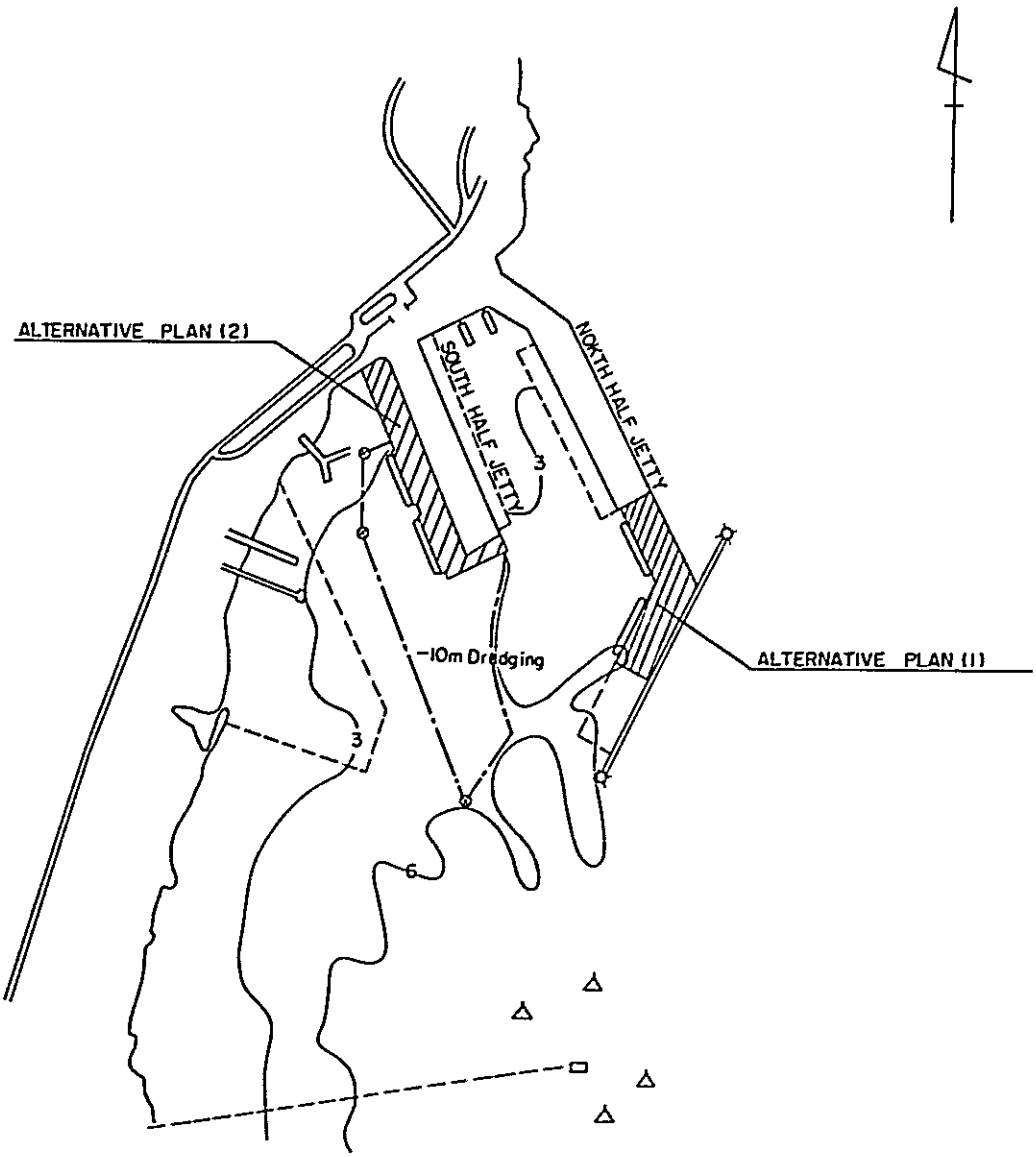
Alternative 2: Expansion of the South Half Jetty to the south.

The two alternative plans are shown in Fig. VIII-2.

The alternative 1 cannot be adopted for reasons that the extension causes the closure of the north port mouth which is very important for ship's operation.

Since the alternative 2 is in line with the general direction of the improvement plan of Port of Assab and as it will not affect the expansion plan of the oil berth, at least within the period of the 4th 5-Year Development Plan, this should be adopted.

Fig. VIII-2 Alternative Plans of Port of Assab



4. Improvement Plan for Port Facilities at Assab

(1) Berthing Facilities

(a) Extension of Berth Nos. 8-11

There are two transit sheds behind berth Nos. 8-11, and another is now under construction behind berth No. 11. As the water-front line here is linear, the length of a berth can be decided easily. The relationship between the transit sheds and berths, however, limits the length of each berth. From this point of view, following figures are given;

Berth No. 8	90m
" 9	150m
" 10	150m
" 11	150m
Total	540m

As a practical plan, however, those figures should be changed as follows by extending the length of the quay by 40m so that the total length will be sufficient to cater for three 15,000 D/W ships at the same time and also by taking into consideration the relationship between the sheds and the berths:

Berth No. 8	40m
9	180m
10	180m
11	180m
Total	580m

(b) Construction of New Berths

(b)-1 Determination of the Number of Berths

According to the Interim Report (January 1973), the present cargo handling capacity of Port of Assab is estimated at 297,000-348,000t per year. Taking an average figure of 323,000t, this is considered to be attributed to the following figures;

A.W.T./A.S.T. = 0.15

Berth Ocupancy = 65%

Average days of ship's stay in port = 1.86 days/ship

Number of berths = 6

Tonnage loaded/unloaded oer ship = 500MT/ship

Seasonal fluctuation = 20%

Assuming that, by the execution of the 5-year Plan, the loading and unloading capacity of the existing berths increases by 10%, the capacity will be;

323,000 x 1.1 = 359,000 t/6 berth

therefore, the capacity oer berth;

359,000 ÷ 6 = 60,000 t/berth

This increase in capacity could be attributed to shortening the average days of ship's stay.

As the volume of cargoes to be handled in the whole Port of Assab in 1971 E. C. is assumed to be 481, 000 t, the volume of cargoes to be handled in the new berths should be;

$$481,000 - 359,000 = 122,000 \text{ t}$$

Therefore, the number of berths to be newly constructed is;

$$122,000 \div 60,000 = 2.0 \text{ berths}$$

(b)-2 Depth of Water

The depth of water along the berths was determined to be 10m to accommodate 15, 000 D/W vessel.

(b)-3 Apron

The width of apron should be 20m, the same width as the existing No. 9-No. 11 berths.

(2) Basin

The basin should be dredged to a depth of 10m to accommodate 15, 000 D/W vessels.

(3) Breakwater

Breakwater in front of the new berths is not considered necessary, as the basin may well be sheltered by the islands situated in front of Port of Assab. However, if no existence of the breakwater seriously affect smoother ship berthing and cargo handling when the new berth starts its operation, construction of a new breakwater should be considered after the execution of the 4th 5-year Plan.

(4) Transit Sheds and Open Stacking Yards

As described in the previous VII 4, (4), (b)-1, a stacking area extending 4, 200m² is necessary for one berth where 60, 000 t cargoes are to be handled. Considering the future demand for utilization of Port of Assab and to cater to the coming container system, one half of the necessary stacking area should be left for open stacking yards. From this point of view, additional transit sheds are not necessary in Port of Assab, and the area behind the water front line should be paved as open stacking yards.

(5) Warehouses and Open Storage Yards

The volume of cargoes to be handled in Port of Assab in 1971 E. C. is estimated as follows;

Export 299, 000 t Import 182, 000 t

Assuming that 1/10 of export cargoes and 1/2 of import cargoes, total of which should be stored in port area, require warehouses;

$$Q = 299,000 \times 1/10 + 182,000 \times 1/2 = 121,000 \text{ t}$$

Assuming that N=6, $\alpha = 0.7$, $w = 1.5$;

$$W = \frac{121,000}{6} = 20,000 \text{ t}$$

Required area of warehouses should be;

$$A = \frac{20,000}{0.7 \times 1.5} = 19,100\text{m}^2$$

The volume of cargoes to be stored in open storage yards is;

$$Q = 182,000 \times 1/2 = 91,000 \text{ t}$$

Applying the same formula of the above warehouses:

$$W = \frac{91,000}{6} \approx 15,000 \text{ t}$$

Required area of open storage yards should be:

$$A = \frac{15,000}{0.7 \times 1.5} = 14,300 \text{ m}$$

In Port of Assab, the space of the buildings available for warehouses is approximately 3,000m² and the yards available for open storage yards may be around 18,000m².
Thus, the floor space of warehouses to be newly constructed should be;

$$19,100 - 3,000 = 16,100\text{m}^2$$

Therefore, it is recommended that the port area should be expanded to the south of the existing port area and warehouses with a floor space of 16,000m² should be constructed in such an expanded area in the south for future development of Assab as a commercial port. The construction of open storage yard is not considered necessary.

(6) Traffic Facilities in and around the Port Area

A road to connect the jetties and the warehouse zone should be constructed.

(7) Others

Other port facilities such as tugboats and other ancillary equipments should be considered in budget compilement according to their needs. The reason this 5-year Port Improvement Plan does not contain the procurement of a large number of cargo handling equipment is that the cargo handling system relying more on man-power than upon machinery and equipments will be still appropriate in this country. It is to be predictable that the introduction of bigger capacity's cargo handling equipments will become necessary to cope with the container system to be adopted upon the completion of the execution of this 5-year Port Improvement Plan.

5. Preliminary Design

The following are the preliminary design and calculation for evaluation of an investment amount to be earmarked in the coming 5-year Port Improvement Plan.
Object of the design is - 11.0m, -10.0m quay wall of South Half Jetty and the type of the extreme point of Jetty will be the same design of -10.0m quay wall.

(1) Quay Wall

(a) Conditions of the Design

(a)-1	Vessel	15,000 D/W
(a)-2	Depth of Berth	15,000 D/W, -10.0m
		15,000 D/W, -11.0m (extended portion)

(Note) The north side of the Jetty is the extension area of the existing quay wall, therefore, the depth of berth is same as the existing one.

(a)-3 Tidal Level

H.W.L.	+1.30m
L.W.L.	±0.00m

(6) (a)-4 Crown Height +2.50m

(a)-5 Surcharge 2.0 t/m²

(a)-6 Earthquake — No consideration

(a)-7 Apron Width — 20.0m

(a)-8 Soil Consition under Seebed

Internal friction — 30°

Submerged bulk density — 1.0 t/m³

(a)-9 Soil Condition of Backfill

Internal friction — 35°

Angle of wall friction — 15°

Bulk density

above residual water height — 1.8 t/m³

below residual water height — 1.0 t/m³

(a)-10 Residual Water Height — +0.40m

(b) Evaluation of Construction Type

Block structure would be suggestible for the same reasons as in Port of Massawa.

See the standard section in Fig. VIII-3, VII-5.

6. Program and Cost of Investment

Construction program and annual investment for the construction work are shown in Table VIII-4 and VIII-5, respectively.

The construction program was made on the basic concept that one of the two berths would begin to operate as early as possible.

Unit price of dredging work was estimated on the assumption that N-value, indicator of soil condition, is around 10. Therefore, it may possibly change after detail survey.

Unit price for each item is the summing up of main construction cost and its 30% as indirect cost.

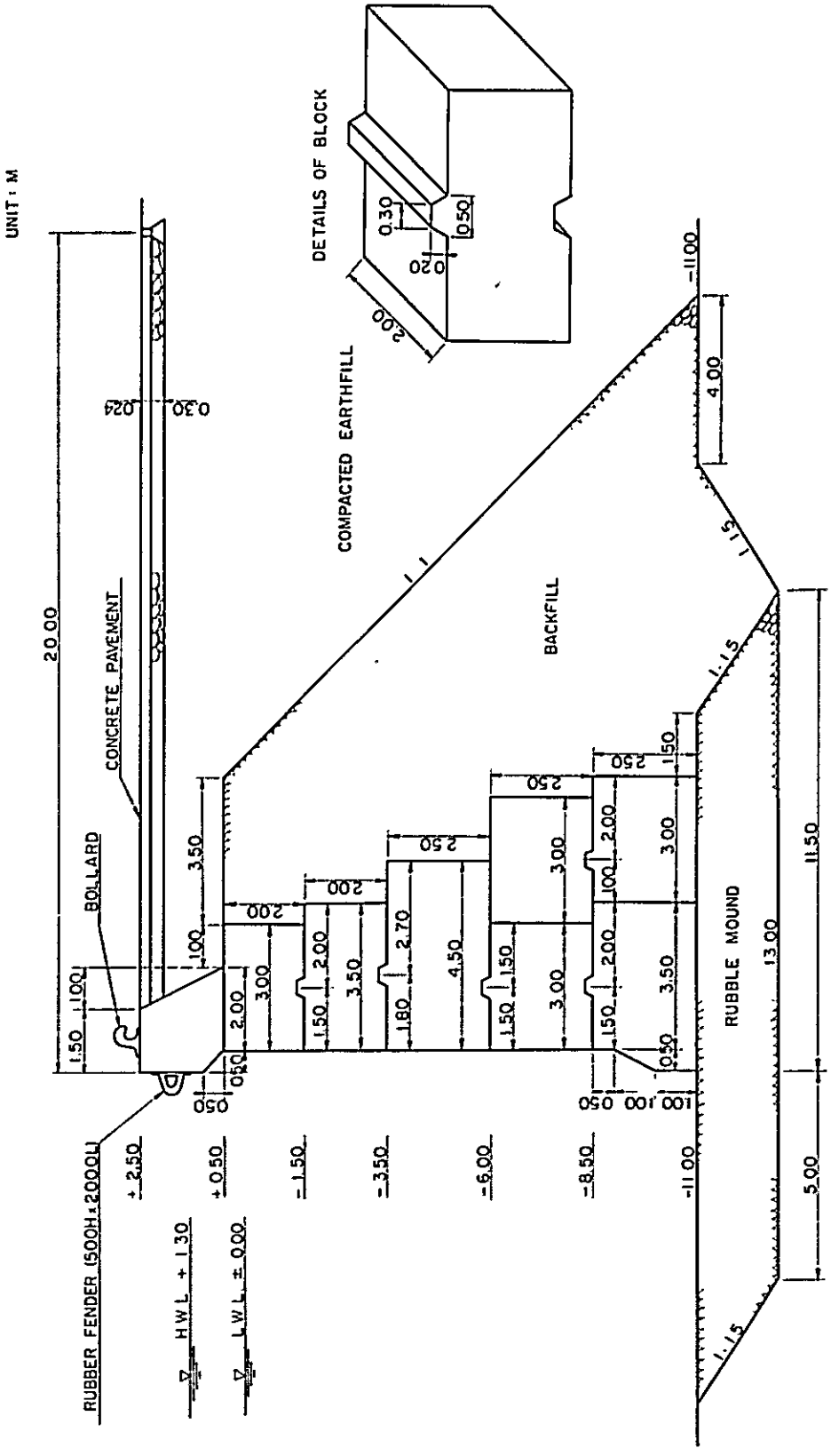


Fig. VIII-3 Standard Section of -11.0m Quay Wall: Port of Assab

Table VIII-4 Time Schedule of Port Construction (Port of Assab)

Works	Quantity	Fiscal Year				
		1967	1968	1969	1970	1971
Survey & Design						
-11m Quay Wall	40m					
-10m Quay Wall	370m					
Revetment	366m					
Dredging	269, 000m^3					
Road	20, 800m^2					
Reclamation	218, 000m^3					
Warehouse	16, 000m^2					
Open Stacking Yard	10, 000m^2					
Tugboat	2					
Buoy	3					

Table VIII-5 Annual Investment Plan (Port of Assab)

(Unit: Eth. $1,000)

	Unit	5-Year('67-'71)		1967		1968		1969		1970		1971	
		Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost
-11m Quay Wall	m	40	677	40	677								
-10m Quay Wall	"	370	5,692			22	338	139.5	2,146	62	954	146.5	2,254
Revetment	"	166	2,554	56	861	110	1,693						
"	"	200	154									200	154
Dredging	m^3	(195,000m^2) 269,000	2,069							200,000	1,538	69,000	531
Road	m^2	20,800	954							10,000	461	10,800	493
Reclamation	m^3	(27,200m^2) 218,000	1,000			50,000	231	67,000	308	67,000	308	34,000	153
Warehouse	"	16,000	1,231			3,200	146	3,200	146	3,200	146	6,400	493
Open Stacking Yard	m^2	10,000	76							5,000	38	5,000	38
Tugboat		2	2,308					0.5	577	0.5	577	1	1,154
Buoy		3	115							1	38	2	77
Total			16,830		1,538		2,508		3,277		4,160		5,347

IX. MEASURES TO BE TAKEN HEREAFTER FOR IMPLEMENTATION OF 5-YEAR PORT IMPROVEMENT PLAN

IX. MEASURES TO BE TAKEN HEREAFTER FOR IMPLEMENTATION OF 5-YEAR PORT IMPROVEMENT PLAN

In order to implement the 5-year Port Improvement Plan successfully, it is inevitable for the Government to execute the following:-

1. To secure funds necessary for the 5-year Port Improvement Plan.

2. To establish a specific organization fully authorized to control and execute the whole program in order to systematically carry out the plan, which includes a lot of construction works.

3. To make the port offices well-organized to cope with the complicated administration and operation, including expansion works with assignment of highly qualified port engineers and labor-forces.

4. To promote the coordination between the head office of Marine Department and its branch organizations.

5. To give trainings and educate port officers to cope with the expansion of port administration: To make them well versed in the good models of the advanced port administration and to make them acquire techniques through the attendance to the training courses held by the foreign institutes etc.

6. To execute detail surveys described below but not limited to before starting the 5-year Port Improvement Plan.
   a) Detailed investigations of the sea area around the construction sites.
   b) Detailed soil surveys around the construction sites.
   c) Survey on whether a large size of rocks bed at the site of foundation works of the proposed new port or not.