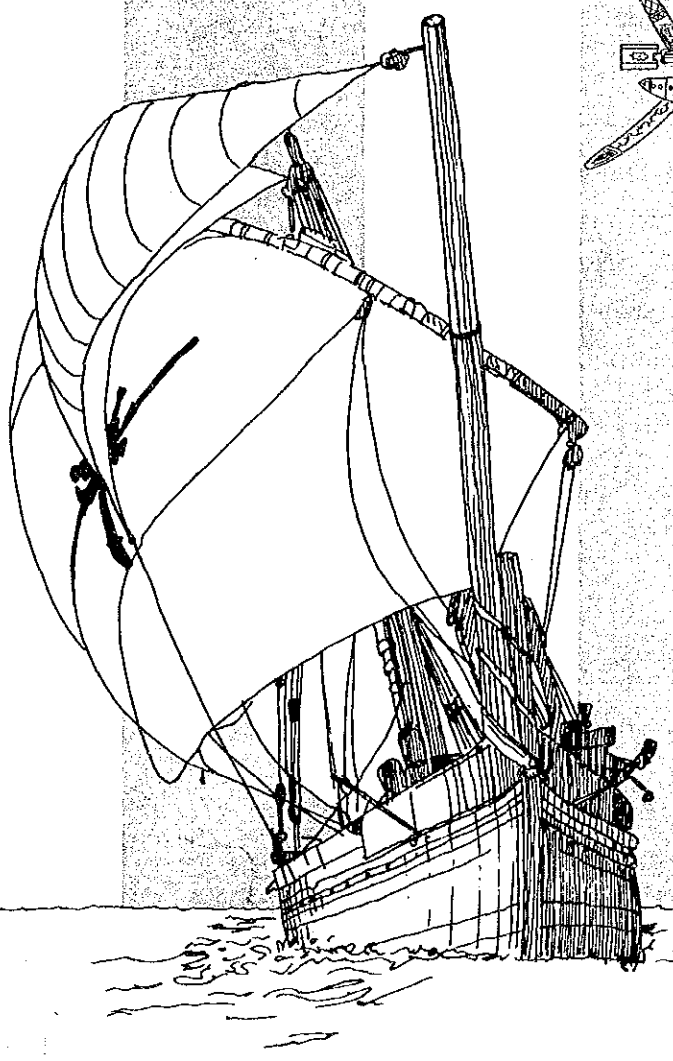
社会開発調査部報告書

FINAL REPORT

THE STUDY ON THE PORT DEVELOPMENT FOR NORTHERN OMAN

SUMMARY

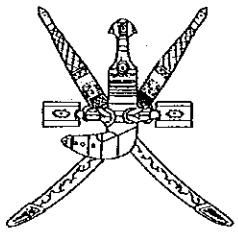


OCTOBER 1990

JAPAN INTERNATIONAL COOPERATION AGENCY

FINAL REPORT

THE STUDY ON THE PORT DEVELOPMENT FOR NORTHERN OMAN



SUMMARY

OCTOBER 1990

PREFACE

In response to a request from the Government of the Sultanate of Oman, the Japanese Government decided to conduct a study on Port Development in Northern Oman and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Oman a survey team, headed by Mr. Hideaki Sagara, and composed of members from the Overseas Coastal Development Institute of Japan and Nippon Koie Co.Ltd., four times between September 1989 and September 1990.

The team held discussions with officials concerned of the Government of the Sultanate of Oman, and conducted field surveys. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Sultanate of Oman for their close cooperation extended to the team.

1990

Kensuke Yanagiya

Kensuke Yanagiya
Presdident
Japan International Cooperation Agency

LETTER OF TRANSMITTAL

October 1990

Mr. Kensuke Yanagiya
President
Japan International Cooperation Agency
Dear Mr. Yanagiya :

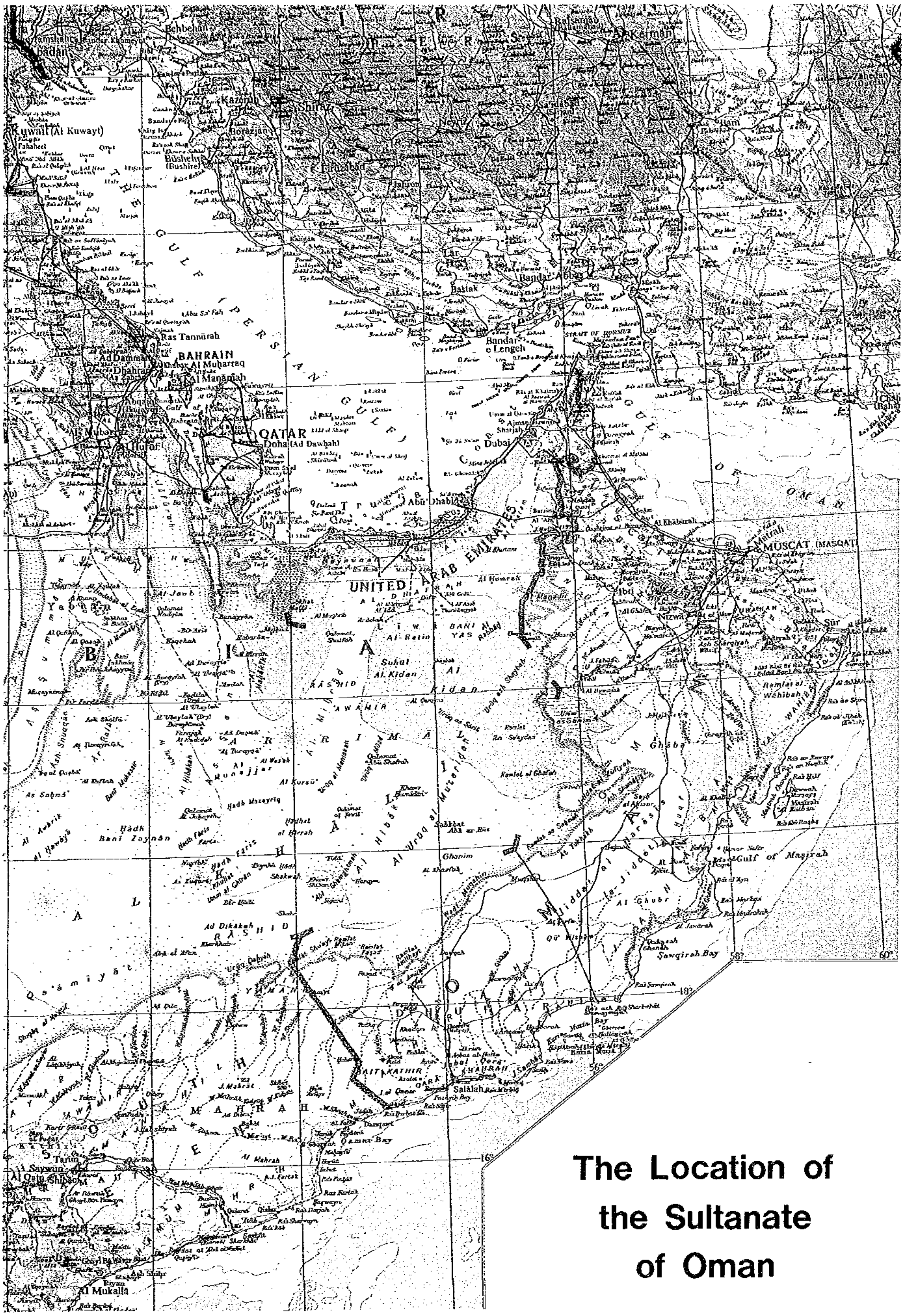
It is may pleasure to submit herewith the Final Report for the Study on the Port Development for the Northern Oman.

The team's acknowledgments to the relevant persons in the Sultanate of Oman appear in the foreword of the volume 1 of the main report, and I wish to take this opportunity to express my sincere gratitude to the Japan International Cooperation Agency, the Ministry of Foreign Affairs, the Ministry of Transport and the Japanese Embassy in Oman for their support.

Yours faithfully,

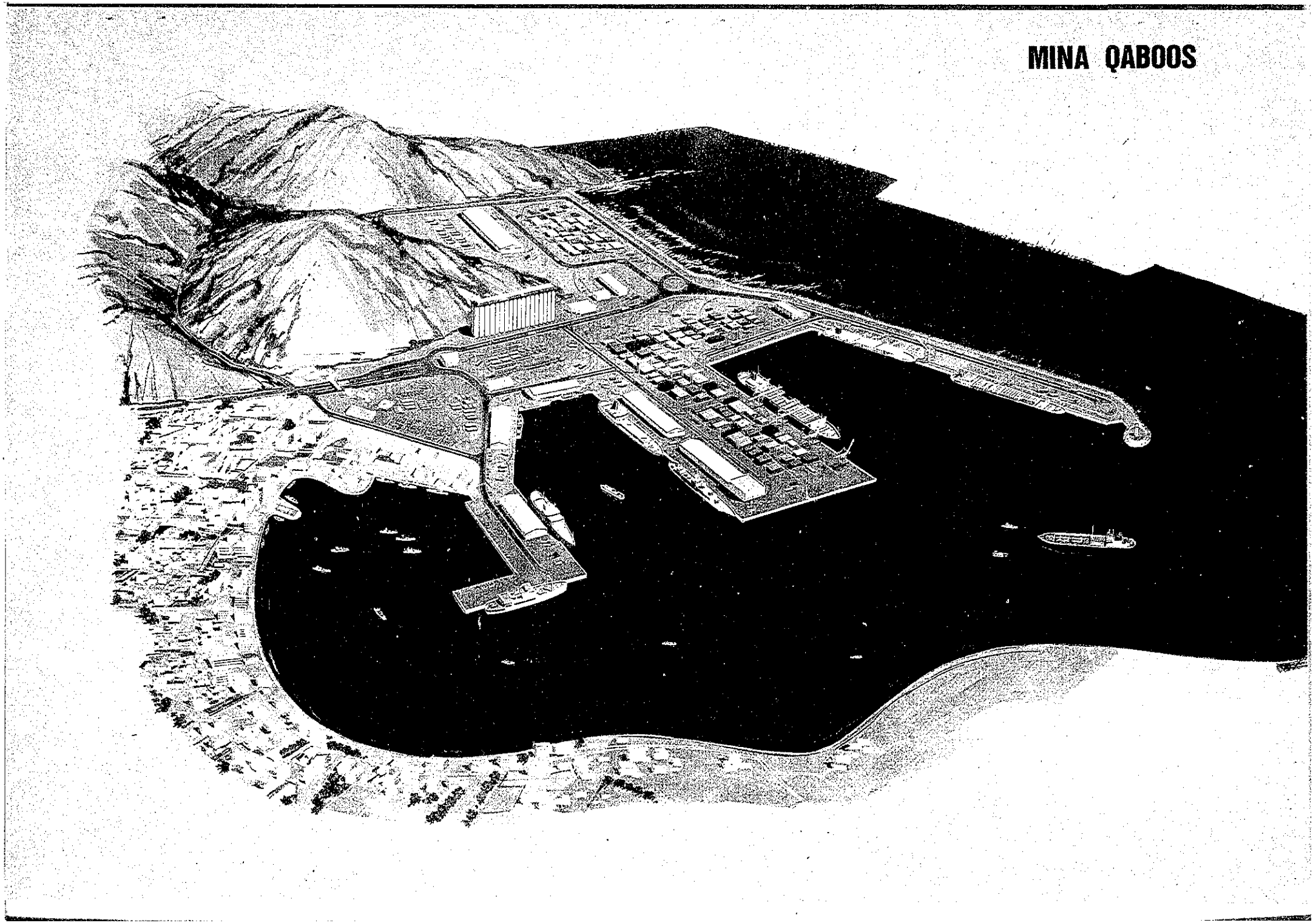
Hideaki Sagara

SAGARA Hideaki
Leader
Japanese Study Team for
the Study on the Port Development
for Northern Oman
(Senior Executive Director,
the Overseas Coastal Area
Development Institute of Japan)

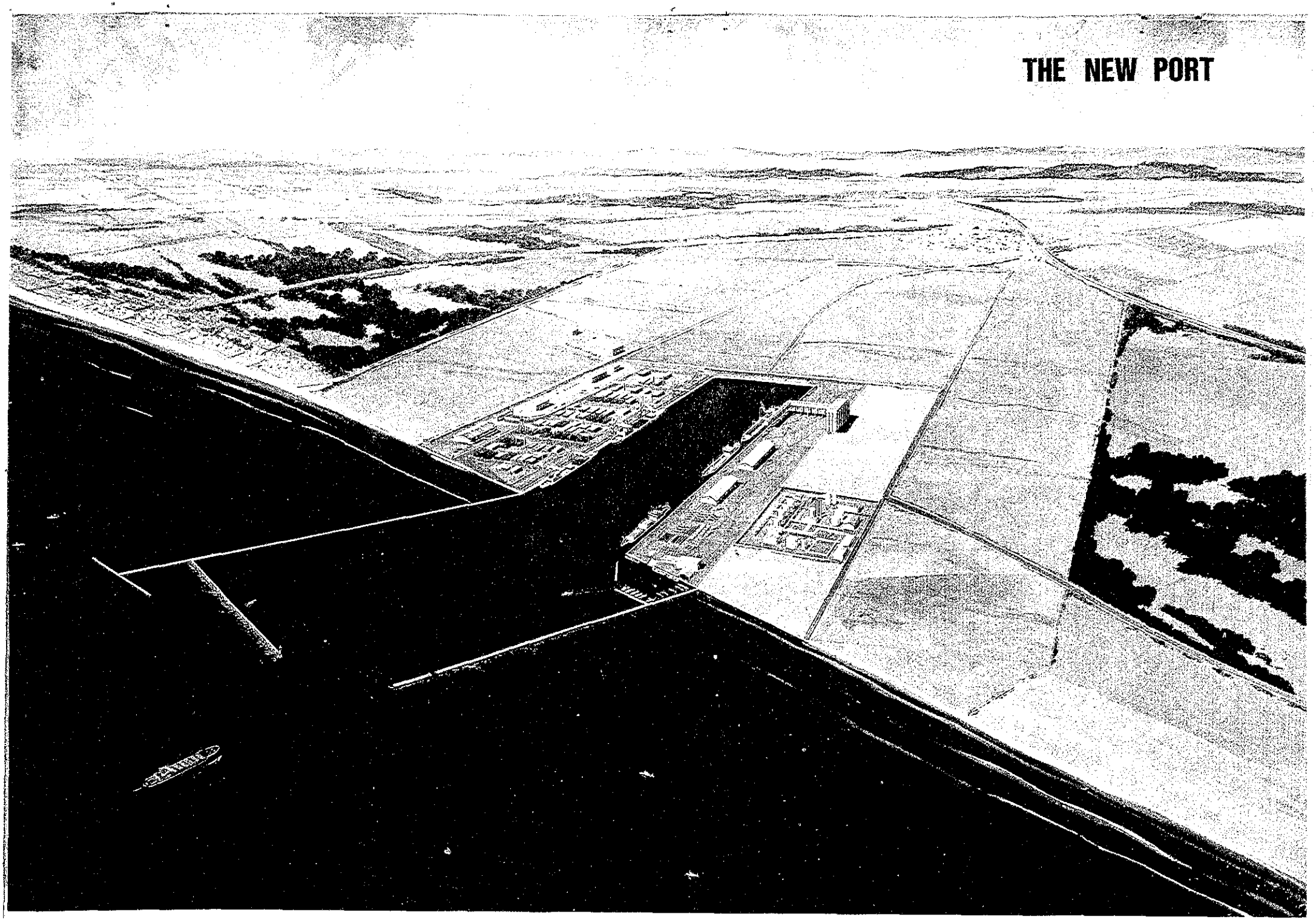


The Location of the Sultanate of Oman

MINA QABOOS



THE NEW PORT



THE STUDY ON THE DEVELOPMENT

FOR NORTHERN OMAN

VOLUME I THE STUDY ON THE DEVELOPMENT FOR NORTHERN OMAN

VOLUME II MINA QABOOS DEVELOPMENT PLAN

VOLUME III NEW PORT DEVELOPMENT PLAN IN SOHAR

SUMMARY

ABBREVIATIONS

CA	Capital Area
CD	Chart Datum
CES	Consulting Engineering Service (India) Private Limited
CFS	Container Freight Station
CMA	Compagnie Maritime d'Affretement
CRT	Cathode Ray Tube
CY	Container Yard
DC	The Development Council
DL	Datum Water Level
DWT	Dead Weight Tonnage
FCL	Full Container Load
FTZ	Free Trade Zone
G.C.	General Cargo
GCC	The Gulf Co-operation Council
GDP	Gross Domestic Product
GDP(R)	GDP for Regression Analysis
GNP	Gross National Product
G.S.	Ground Spot
G/T, GRT	Gross Tonnage
H	Wave Height
Ho	Deep Water Wave Height
H1/3	Significant Wave Height
IBRD	International Bank for Development and Reconstruction
IMO	International Maritime Organization
JAFZ	Jebel Ali Free Zone
JICA	The Japan International Cooperation Agency
J¥	Japanese Yen
L	Wave Length
LAT	Low Astronomical Tide
LCL	Less Than Container Load
LNG	Liquid Natural Gas
L.W.L.	Low Water Level
MAF	Ministry of Agriculture and Fishery
M.H.W.L.	Mean High Water Level
MMSCF	Million Standard Cubic Feet

MMSCFD	Million Standard Cubic Feet per Day
M.L.W.L.	Mean Low Water Level
MOC	The Ministry of Communications
MRO	Million Omani Rial
M.S.L.	Mean Sea Level
MT	Empty Container
MTBE	Methyl Tertial Butyl Ether
MTD	Metric Tonnes per Day
MTPA	Metric Tonnes per Annum
MW	Mega Watt
NYK	Nippon Yusn Kabushikigaisha
OBAF	The Oman Bank for Agriculture and Fisheries
OCDI	The Overseas Coastal Area Development Institute of Japan
ORC	Oman Refinery Company
PAMAP	The Public Authority for Marketing Agricultural Produce
PMB	Port Management Body
PSC	The Port Services Corporation
R.O	Omani Rial
Ro/Ro	Roll on/Roll off
SMDS	Shell Middle Distillate Synthesis
SPT	Standard Penetration Test
TEU	Twenty-foot Equivalent Unit
TRS	Transshipment
UAE	The United Arab Emirates
US$	The United States Dollars
ϕ	Angle of Internal Friction

CONTENT (SUMMARY)

FOREWORD

Foreword

1. The objectives of the study, which appear in "the Scope of Work for the Study on the Port Development for Northern Oman" agreed upon by the Government of Japan and the Government of the Sultanate of Oman, are:

(1) to review and evalute the intermediate development plan of Mina Qaboos,

(2) to recommend a port development strategy for northern Oman,

(3) to formulate a master plan for a new port in northern Oman considering the following:

(i) Reviewing the completed study for a proposed new port at Quriat,

(ii) Reviewing a major extension of Mina Qaboos into Shutaify Bay,

(iii) Examining the present situation at Mina Qaboos, including the recommendations for improvement/development made by the Indian Consultant.

2. Until the midway point of the whole project, the study was carried out by dividing into two parts, i.e., Mina Qaboos and a new port, because the timing of development as well as the contents of the studies are different. However, in the later stage, the study was carried out such that an overall picture of port development in northern Oman could be emerged.

At the outset of the work, the Inception Report was submitted by the team to the Ministry of Communications, the counterpart of the team, on 5th Nov. 1989 at the occasion of the teams' first visit to Oman. Following to the report, five reports, viz. Progress Report (I), Progress Report (II), Interim Report (I), Interim Report (II) and Draft Final were submitted based on the team's findings through discussions, interviews, field reconnaissance of possible new port sites, preliminary investigation of natural conditions and studies of collected data. Of which reports, Progress Report (I) and Interim Report (I) deal with the development of Mina Qaboos, while on the other hand, Progress Report (II) and Interim Report (II) describe the development of a new port.

The Draft Final Report, submitted on 24th August, 1990 consists of three volumes. In Volume I, the team tried to formulate a comprehensive picture of port development policy form now until the year 2015, by amalgamating both Mina Qaboos and a new port aspect. Volumes II and III

deal with the expansion of Mina Qaboos and development of a new port, respectively. And these volumes are to a large extent the same as the first and second interim reports with some alterations or additions in the light of discussions or studies thereafter. The reason why the report is presented in this form is that the Volume I quickly describes the whole concept of port development policy in northern Oman, while detailed analyses of each port are left to Volumes II and III, and in this way readers are free to take any of these Volumes according to their needs instead of having to deal with one voluminous report.

3. The substance of the Final Report is virtually same as the Draft Final Report, except insofar as it is amended in accordance with the outcome of meetings at the team's last visit between 23rd Aug. and 4th Sept. 1990. The composition of The Final Report also follows suit, however, for the convenience of users, it is supplemented by the summary of Volume I of the Final Report. Followings are the main content of each volume.

Volume I: Comprehensive strategy for port development of Northern Oman including both Mina Qaboos and a new port.

Volume II: Composite scheme of the development of Mina Qaboos.

Volume III: Master plan for the new Port including its site selection and the short term plan.

Summary of Volume I

4. Launching a new port is a challenging task and expanding Mina Qaboos also involves much difficult work. Although the team tried to pave the way for formulating a development scheme for ports in northern Oman corresponding to the country's stage of economic development, there is still a lot of work to be done before full materialization of the scheme.

The team hopes that this study proves to be a contribution to the development of ports and finally growth of the economy and progress of welfare of the Sultanate of Oman.

5. Acknowledgments

Acknowledgment is made to H.E.Salim Bin Ali Bin Nasser As Siyabi, Undersecretary of Ministry of Communications; Mr. Engr. Moh'd Bin Rajab Ba-Omar, Director General of Finance and Administration, MOC; and the Committee chaired by Mr. Engr. Salim Bin Hameed Al Ghassani, Director

General of Ports and Public Transport, MOC, the members of which are from MOC and the Port Service Corporation (Mina Qaboos), for holding fruitful discussions and making many productive suggestions.

Acknowledgment is also made to Mr. Engr. Majid Bin Saeed Al-Rawahi, Superintendent General, Planning and Studies; Mr. Abbas Bin Khudadat Dostein and his division; and in particular to Mr. Engr. Shahid Hussain Mirza for providing us for useful advice and information.

The members of the team are very grateful to H.E.Awadh Bin Salim Al Shanfari, President of the Port Service Corporation (Mina Qaboos); Mr.Saud Bin Ahmed Al Nahari, Operation Manager; Capt. Ahmed Bin Said Bu-Saidy, Harbour Master; Mr. Hamid Bin Abdul Rehman Al Khadi, Chief Engineer; Mr. M.M. Shipchandler, Financial Controller; Mr. Engr. Said Bin Salim Al Shanfari; Mr. Ahamed Bin Nasser Al Riyami and the officials of the PSC for providing us for an enormous volume of date and information.

The team wishes to express its gratitude to H.E. Mohammed Bin Moosa Al-Yousuf, Secretary General of Development Council for holding enlightening discussions with the team.

Acknowledgment is made to Mr. Omar Bin Mohamed Bin Jaber Al Jabri, the ex-Director General of Follow-up, DC; Mr. Ahamed Al Mamri, Director General of Follow-up and his Directorate; and also Mr. Donald Ritson, Advisor, Supreme Committee for Town Planning and Mr. Ali Abdul Rahim, Advisor, Directorate of Follow-up for assisting in collecting information and data. Various forms of cooperation were also extended by officials of the Technical Secretariat, DC, in particular, Ali M. Hassan, Acting Director General of National Statistics.

The study team thanks the Royal Oman Police, Ministry of Agriculture and Fisheries, Ministry of Commerce and Industry, Ministry of Housing, Ministry of Electricity and Water and Ministry of Petroleum and Minerals for providing useful information.

The study team conducted many interviews with private companies in various fields such as shipping agents, mining firms, manufacturers, contractors and consultants, and these interviews were very informative.

The study team wishes to mention the assistance of WS Atkins International Ltd., Nortech Surveys Inc. and Swiss Boring Overseas Corporation Ltd.

Finally, the study team gratefully acknowledges the various services provided by Mr. Engr. Moh'd Bin Rajab Ba-Omar, Director General of Finance

and Administration and Mr. Ali Bin Moh'd Bin Ali Al-Tiwany, Director, Services and Public Relations, as well as the Embassy of Japan in Oman.

6. List of the Team Members

Mr. SAGARA Hideaki	leader
Mr. SASAJIMA Hiroshi	co-leader
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Mr. KAWAKITA Hirokazu	
Mr. OHNO Hiroshi	
Mr. MASUNAGA Kunio	
Mr. INOUE Toshihisa	
Mr. MURAI Noboru	
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Mr. TERASHIMA Takuro	
Mr. EBATA Shizuo	
Mr. LIAN, Fawzi L.,	

H.SAGARA
The Team Leader

CONCLUSION AND RECOMMENDATIONS

Conclusion (Brief)

While detailed conclusion appears in Chapter 12, its brief is as follows:

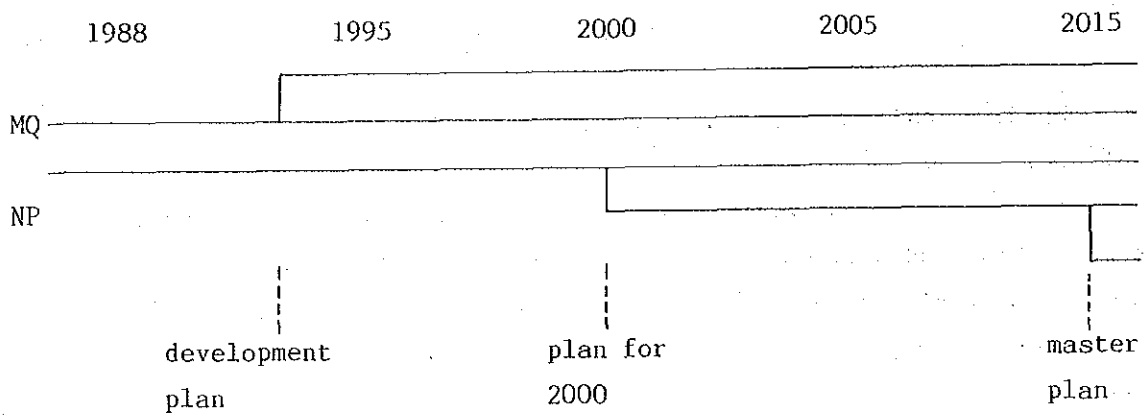
It is widely recognized that Mina Qaboos, which is the only gateway port to Oman and will continue to play an important role in various aspects of the country's economic life, cannot properly adapt itself to the present increasing cargo demand and the technological progress of relevant industries.

In order to meet these circumstances the development work at Mina Qaboos should be expedited. Speedy construction work is also required with a view to saving on financial costs as well as minimizing the unfavourable effects on day-to-day port operations during the construction period.

As far as development of a new port is concerned, the economic internal rate of return (EIRR) based on a cost-benefit analysis is 5.0%. The figure is below the level that is generally considered to be economically feasible in terms of construction of infrastructure.

According to the financial analysis using the financial internal rate of return (FIRR), the project is financially viable in terms of a port management body on the assumption that about 80% of the funds necessary for the project are borne by the government on an interest-free and no-repayment basis. These terms seems to be attainable, because they are similar to the funding arrangement of Mina Qaboos.

There are some other concern regarding the new port project. The Sultanate of Oman attaches great importance on the preservation of the environment. In this regard, at the site selection and actual planning at the selected site, the highest priority is given to keeping the impact of the port development to a minimum. After consideration of alternatives in terms of port development, and taking into account favourable effects of a new port upon the nation's economy, regional development and other factors such as environmenfal aspects, the team came to the conclusion that a new port should be constructed in the vicinity of Sohar. Following figure are the tentative action plan:



Notes: MQ-Mina Qaboos; NP-New Port;
Width of the bars does not indicate cargo handling capacity.

However, the circumstance where the factors for future demand is not entirely clear, the timing of the new port construction should carefully be examined, with the budgetary codition of the time and the progress of relevant development schemes in mind.

Recommendations

(1) The wave conditions have been observed by using marine buoys since 1988. It is desirable to continue this observation because the natural conditions of the Port are important to daily port administration and development.

(2) Due to their lack of length, Berths Nos.1, 1A & 2, Nos.4 & 5, Nos.7 & 8 cannot be considered sets of two independent berths. Therefore, berth allocation should be done carefully in order to maximize the port's capacity. Regarding port capacity, it should be also noted that berth occupancy by non-commercial users is to be expected to some extent even in the future. Port capacity should thus be evaluated considering these factors.

(3) It should be emphasized that the proposed Mina Qaboos development plan is based upon adequate cargo allocation with a new port in the year 2000, and delay in the new port development schedule will bring about a serious shortage of cargo-handling capacity at Mina Qaboos. Hence the development schedule of Mina Qaboos and the new port should be controlled carefully.

(4) In this project, development of multipurpose berth, dredging of water basin and reclamation of Shutaify Bay are very closely related to each other. Therefore, for the efficient use of the multipurpose berth, dredging of the water basin should be implemented at an early stage after completion of the multipurpose berth.

(5) The transfer crane system should be adopted to accommodate the rapidly increasing amount of container traffic in Mina Qaboos. Effective land utilization can be expected only with this system because it enables higher stacking of containers, and a smaller area is needed for containers. The new system requires an appropriate number of tractor-trailer, top lifters and other equipment.

(6) The number of gangs needed for handling conventional cargoes and containers and at CFS is to be increased. At the same time, the productivity of handling cargo is to be improved by mechanization, using

appropriate equipment, training of gang members and recruiting younger labourers.

(7) Computerization should be speeded up to match the new handling system. The new handling system can maintain its function with appropriate support from the integrated computer system. Application of the following systems is indispensable for the introduction of new handling system:

i) Terminal control system
   Marshalling yard control program
   Gate control program
ii) Terminal planning system
   Loading schedule program
   Discharging schedule program
iii) Program for optimum handling equipment procedure
iv) Documentation

(8) Facility design and evaluation are carried out based on the sub-soil surveys and the existing bore hole data. But more sub-soil surveys should be carried out in the implementation stage, because there are many different sub-soil characteristics in each section of the port area.

(9) Construction work such as dredging, erection of container cranes. etc., should be executed without interfering with regular port activities by ensuring coordination among the administration and operation sections and port users in order to maintain smooth port operations.
Alternative space for normal port operations should be provided during the construction period.

(10) Considering the expandable space of Mina Qaboos and the future demand forecast of cargoes, a new port should be constructed in northern Oman.

(11) The new port should be in Majis, considering the various factors such as space availability, ground surface conditions, locational relation to the existing towns, construction costs and the potential functions of the new port.

(12) With regard to preservation of the environment, the highest priority

is given to minimizing the impact on the environment during both site selection and actual planning of the new port at the selected site. The environmental aspects of the project should be kept in mind in the detailed design and construction stages.

(13) The transfer crane system should be adopted at the container terminal in the new port as well as at Mina Qaboos due to ease of maintenance of equipment, such as obtaining the parts for the equipment, and of operator training.

(14) The management body of the new port may be a corporation, a large portion of the capital of which will be owned by the government but independent from the existing PSC. This is because a large part of investment should be borne by the government, and the PSC cannot bear the huge deficit envisaged at its initial stage, although the body will be self sustaining in the long term.

(15) For the new port, in order to carry out these enormous tasks which have to be done along with the construction, a detailed study of recruitment and training should be carried out. Where difficulty is envisaged in recruiting a sufficient number of experts for higher-ranking officials of the PMB, it may be advisable to hire foreign experts with much port management experience, preferably including a general manager, with a view to assisting in the smooth operation of the port and also to transfer port management expertise in the inauguration period.

(16) The new port should make an intensive effort to "sell" the port. For new comers it is absolutely true that without such efforts the port will not survive. However, it should be emphasized that publicity can only do a little on its own. Reputation accompanied by substance is more effective. Form the customers' viewpoint the best substance is sure and speed cargo movement. To attain this, quick customs, immigration and quarantine (CIQ) procedures are also vital.

(17) The new port and Mina Qaboos should cooperate with each other and coordinate their activities in many fields. It may be advisable to establish a national port council under the Ministry of Communications

consisting of exectives of the PSC (Mina Qaboos) and of the port managing body of the new port with a small secretariat.

(18) Some means of linking all the relevant bodies should be developed. Relevant bodies include municipalities, regional branches of central organizations dealing with housing, education, energy, customs, quarantine and immigration, the industrial estate authority, the governing body of the free trade zone and the petro-chemical factory.

(19) Another study, which may be named as the study for preparation for the new port at Sohar, will be useful in finding solutions to some of the questions including fixing exact timing based upon economic indices forecasts and information regarding related projects at the time. Also, detailed plans of ancillary services and plans for recruitment and training structure may well be a part of the study. Taking into account the time schedule for the new port construction, the study should be concluded by 1997.

SUMMARY

Chapter 1 NATURAL CONDITIONS

1.1 Seismicity of the Area

The interior of the Arabian Peninsula is comparatively stable, its rigidity being determined by the Pre-Cambrian basement, and the influence of this dominates the seismicity of Oman.

The regulations in current use make no reference to design earthquakes. Consultants working in the Capital Region indicate however that no special allowance is normally made for earthquakes in the design of major structures.

1.2 Geology

1) Mina Qaboos

Generally the material encountered in boreholes Nos.1 and 2 at -10, -11m depths is similar, contrary to the material found in borehole No.3 at -5m depth.

In boreholes Nos.1 and 2, the material is an intercalation of medium dense and dense granular material of silty fine to coarse sand with some shells and some corals down to the level of -16.5m from Chart Datum. The SPT value varies in general between N=10 and N=30 and exceeds the value of N=30 in some areas.

The material found in borehole No.3 down to the level of -9.6m is medium dense silty sand gravel with some cobbles.

2) New Port

At the drilled off-shore boreholes, a layer of 3.0m to 6.0m thickness of very loose silty fine sand with some shells is noted below the sea-bed (SPT Value is around zero).

It is underlain by an intercalation of non-cemented, weakly cemented and cemented beds of granular material. This strata is constituted predominantly of sand and silt with some clay, gravel and some shells or a mixture of these in different composition and degree of cementation. The SPT value is found to vary between N=10 and N=30 and the strata could be considered, in general, as medium dense, though in some locations the SPT value is found to be higher than 30 (N>30).

1.3 Hydrography

(1) Tides

The predicted tidal levels for Muscat and Majis are as follows:

	Muscat	Majis
Highest astronomical Tide	+ 3.1	--
Mean high water spring	+ 2.7	+ 2.4
Mean high water Neap	+ 2.4	+ 1.9
Mean sea level	+ 1.9	+ 1.5
Mean low water Neap	+ 1.6	+ 1.1
Mean low water spring	+ 0.8	+ 0.9
Lowest astronomical tide	0	--

(2) Waves

1) Mina Qaboos

Design Waves

Wave Depth	: h	= 12.7m(10m + 2.7m)
Significant Wave Height	: Ho	= 5.8m
Maximum Wave Height	: Hmax	= 9.5m

2) New Port

Design Depth	: h	= 9.9 m (7.5m + 2.4m)
Significant Wave Height	: H1/3	= 5.2 m
Maximum Wave Height	: Hmax	= 7.7 m

(3) Coastal Sediment Aspect

At new port location, the net littoral drift would be fully trapped by any solid structure likely to be contemplated. The waterline would advance about 100-200m seaward after 50 years.

It was estimated that the maximum recession after 50 years could be 20-30m, At sheltered basins, or dredged areas, finer-grained sediment deposits are likely to be so dispersed that they are not likely to necessitate significant or frequent maintenance.

Chapter 2 PRESENT CONDITIONS OF MINA QABOOS

2.1 Port Facilities

The existing port facilities at Mina Qaboos are as foloows:

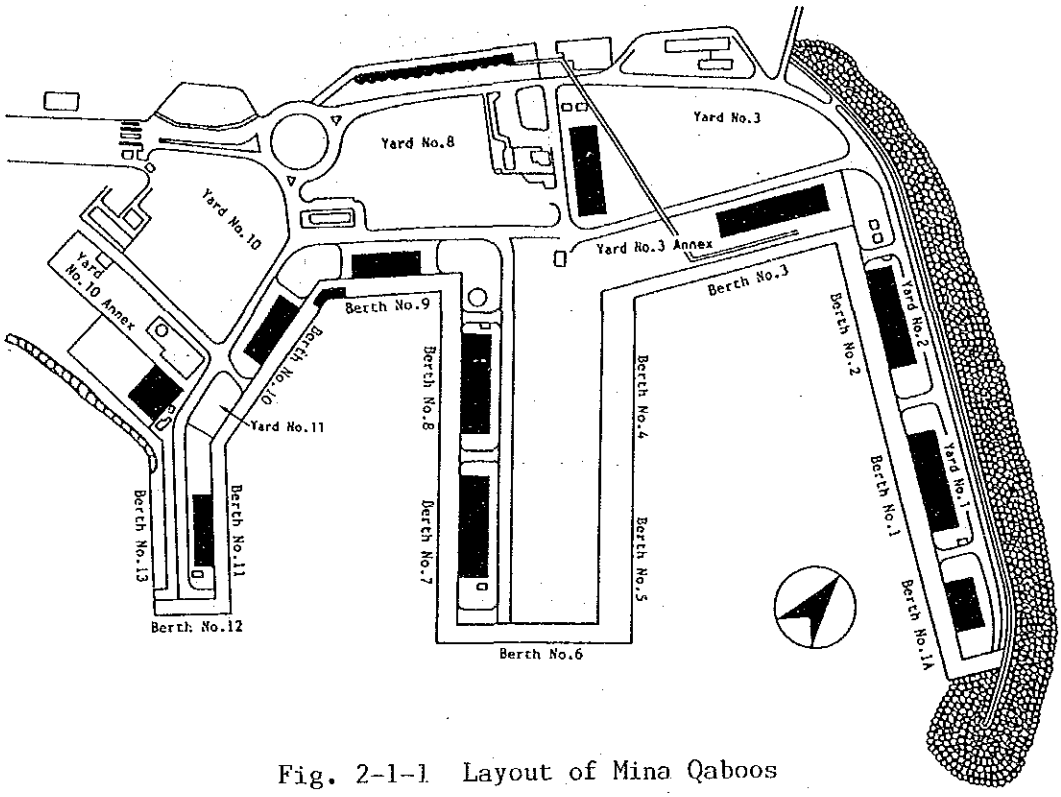


Fig. 2-1-1 Layout of Mina Qaboos

Table 2-1-1 Length of and Draft at Berths

Berth No.	Length (m)	Available Depth below CD (m)	Declared Draft (m)	Remarks
1A	91.5	13.0	10.4	Ro/Ro, Convention
1	183	13.0	10.4	Ro/Ro, Convention
2	183	13.0	10.4	Ro/Ro, Convention
3	228	11.0	9.8	Bulk Grain, Rice
4	183	9.5	9.1	Container
5	183	9.5	9.1	Container
6	198	9.5	9.1	Royal Support Yacht, Convention
7	183	9.5	9.1	Convention, Naval Vessel
8	183	9.5	9.1	Convention, Bitumen
9	122	5.0	4.0	Port Service
10	183	5.0	4.0	Naval, Police Vessel
11	183	9.5	4.0	His Majesty's Vessel
12	76	3.5	3.0	His Majesty's Vessel
13	152	2.5	2.2	Coast Guard Launch

Table 2-1-2 Dimensions of Transit Shed

No.	Dimension	Area	Cargo by traffic mode
No. 1A	55 X 30.5m	1,678 m^2	Conventional
No. 1	110 X 30.5m	3,355 m^2	Conventional
No. 2	110 X 30.5m	3,355 m^2	Conventional
No. 3	131 X 30.5m	3,996 m^2	Conventional
No. 4	95 X 30.5m	2,898 m^2	Container (CFS)
No. 7	110 X 30.5m	3,355 m^2	Conventional
No. 8	110 X 30.5m	3,355 m^2	Conventional
No. 9	76 X 24.0m	1,824 m^2	Container (CFS)
No.10	76 X 24.0m	1,824 m^2	Government use
No.11	76 X 24.0m	1,824 m^2	His Majesty's use
Total		27,462 m^2	

- Covered storage for conventional cargo: 19,094 m^2
- Covered storage for LCL cargo (CFS): 4,722 m^2
- Covered storage for government use : 3,648 m^2

Table 2-1-3 Dimensions of Open Storage Yard

No.	Area	Cargo by traffic mode
No. 1A	2,200 m^2	Conventional
No. 1	2,000 m^2	Conventional
No. 2	2,020 m^2	Conventional
No. 3	28,430 m^2	Conventional/Container
No. 3A	7,180 m^2	Container
No. 4/5	36,900 m^2	Container
No. 8	18,030 m^2	Container
No. 9	1,225 m^2	Conventional
No.10	20,000 m^2	Conventional/Container/Ro/Ro
No.10A	5,250 m^2	Ro/Ro
No.11	2,100 m^2	Container
Total:	125,335 m^2	

- Storage yard for conventional cargo: 39,910 m^2
- Storage yard for containers: 87,425 m^2

Note: Open yard allocation by comodity is illustrated in Fig. 3-1-4.

2.2 Handling Equipment

The existing cargo handling equipment at Mina Qaboos are as follows:

Container crane : 2 machines at berth No.2, No.5
Pneumatic Unloader and Chain Conveyer : 1 " " No.3
Forklift Trucks (Heavy Type) : 8 trucks

2.3 Labour Force and Work Hours

The labour force and their constitution and work hours are as follows:

(1) Gangs for Handling General Cargo

i) Number of gangs:

Gangs for day shift : 7 gangs
Gangs for night shift: 5 gangs

ii) Work hours:

Day shift : 07:00 - 15:00
Night shift: 15:00 - 23:00

iii) Constitution of gangs

Foreman : 1 person
Tindale : 2 persons
Labourers on ship : 8 persons
Labourers on shore: 4 persons

In addition to the gangs, one supervisor is stationed on each vessel.

(2) Gangs for Handling Containers

i) Number of gangs

1) Sea/side for loading/discharging

1st shift: 1 gang
2nd shift: 1 gang
3rd shift: 1 gang

2) Land side for CFS

1 gang is deployed for the day shift

ii) Work hours

1) Sea/side operation

Round the clock service is provided for the sea/side.

2) Land side operation

1st shift: 06:00 - 14:00

2nd shift: 14:00 - 22:00

3rd shift: 22:00 - 06:00

3) CY Operation (Delivery/Receiving)

1st shift: 07:00 - 15:00

2nd shift: 15:00 - 23:00

4) CFS operations

Day shift only: 07:00 - 15:00

As well, ship side gangs can be deployed for CFS operations if the CFS operation is very busy and also if there are no vessels at the berth.

iii) Constitution of gangs

1) Sea side (shipside) gangs

Foreman : 1 person

Winchman : 2 persons

Labourers: 13 persons

In case of 2 cranes being in service, the gang is divided into 2 groups for operations with each crane.

2) CFS gang

Foreman	: 1 person
Tally clerk	: 2 persons
Marker boy	: 1 person
Labourers	: 8 persons
Forklift drivers	: 3 persons

In addition to the above, one supervisor conducts the CFS operation.

Chapter 3 CURRENT MAJOR PROBLEMS IN MINA QABOOS

As a gateway port of the Sultanate of Oman, Mina Qaboos has been playing an important role since 1974. Especially since 1982, Mina Qaboos has served as a container transshipment base to connect European countries with Asian countries due to its geographically favorable location. However, Mina Qaboos faces various kinds of problems.

3.1 Limited Land Area

In Mina Qaboos, the land area is extremely limited and the layout of its facilities and the site are not adequately designed for handling a considerable number of containers. For container handling, dispersed land use should be avoided.

3.2 Dimensions of Berthing Facilities

Insufficient available depth is one of the most serious problems Mina Qaboos faces. Calling ships with arrival drafts of more than 10 meters and 9 meters for Berth No.1, 1A, 2 and No.4, 5 respectively, should be considered as having limited maneuverability to some extent.

3.3 Berth Use Allocation

Berths No.1, 1A and 2 are used primarily for general cargoes, vehicles and livestock; Berth No.3 for grains; Berths No.4 and 5 almost exclusively for containers; Berth 7 and 8 for general cargoes. However, the share of berth occupancy for the other cargo ships is very significant and some countermeasures for this situation should be found.

3.4 Land Use Allocation

While some part of the open storage yard is located apart from the berths, the covered storage area is much larger than that required in the future. Therefore, certain measures, including reallocation of land between the open storage yard and the covered storage area, should be taken in order to accommodate the increased future cargo volume.

The area allocated for container stacking is apparently smaller than that required for increased container traffic. Fundamental measures, including a change in handling system, expansion of new land and so on are crucial.

3.5 Productivity of Cargo Handling

The productivity of handling general cargo is generally less than that normally expected. The rate of container handling is also rather small given the potential of gantry crane and the record achieved in UAE ports. This might be attributable to a wide range of management problems such as improper back up system, insufficient number of forklift trucks, improper back up system, insufficient number of forklift trucks, improper stacking and so on.

The present container stacking system has major demerit for import cargoes, especially in terms of deliveries to consignees, and causes a lot of inefficient handling. Although two top lifters are provided for the land side operation, only one unit is said to be actually available.

The number of top lifters and heavy forklift trucks provided for the operation at the moment is marginal or obviously insufficient, taking into consideration downtime and/or maintenance time.

3.6 Computer System

Present problems of computer system are rather in the yard activity which can be improved with the aids of computer system than computer system itself.

A yard map which is prepared by a yard planner and refers locations and specifications of containers, is not frequently revised or up-dated. Therefore, even when a container is shifted from one place to another so that a specific container stacked under the container can be picked up, the shifted container is put back in the previous location instead of the yard map having to be revised. This practice will be a major problem after the deployment of transfer crane system. Reporting and monitoring of container location could be simplified by establishment of a centralized control room and installation of a yard communication system.

The existence of two focal points in receiving necessary documents from the outside parties presents disadvantage for the port users and thus a simpler, single window system should be used.

Furthermore, standardization and simplification of the operation should be achieved by means of a proper terminal control system and operation control system.

Chapter 4 DEMAND FORECAST

4.1 Socioeconomic Framework

The Study Team adopted a population estimate of 1,500,000 for 1989 and an annual growth rate of 3.5% for the future.

Since no authorized figures are available concerning future GDP, the Study Team has estimated the GDP of Oman in the future as in Table 4-1-1.

Table 4-1-1 Estimated GDP in 1995, 2000 and 2010 (at current prices)

(Unit:Million Rial Omani)

Year	Oil	Agriculture Fisheries	Manufacuturing	Consturction	Trade, Hotels, Restaurants	Real Estate, Banking, etc	Government Services	Others	Total
1995	1,440.9	238.0	240.8	156.0	617.2	373.2	699.3	305.9	4,071.3
2000	1,600.8	395.7	400.3	190.1	870.5	489.4	852.4	391.5	5,190.8
2010	1,899.9	907.0	917.7	282.4	1,731.8	841.6	1,205.9	641.3	8,427.6

4.2 Demand Forecast

In this Study, two methods are used to forecast the local trade cargo (imports/exports): one is the "total demand forecast", which forecasts the total volume of cargo as a whole, and the other is the "commodity-wise demand forecast", which forecasts the volume of each major commodity group individually. Concerning transshipment cargo, only total demand forecast is applied. In both forecasts, the share of ports, i.e., the percentage of cargo that will go through Mina Qaboos and a new port, is assumed to increase to some extent in the future.

In commodity-wise demand forecast the major commodity groups are categorized into the following:

Imports : Rice, Wheat, Other Grains, Sugar, Other Foodstuffs, Timber, Steel, Cement, Other Building Materials, Vehicles, Livestock, Other General Cargo

Exports : Fish, Copper, Chromite, Vehicles, Other General Cargo

The forecast of cargo volume is prepared for the years 1995, 2000, 2010 and 2015, Port traffic between Mina Qaboos and the new port will be allocated later.

The cargo volume is forecast by handling mode as well.

The results of the demand forecast are shown in Fig. 4-2-1 and Table 4-2-1.

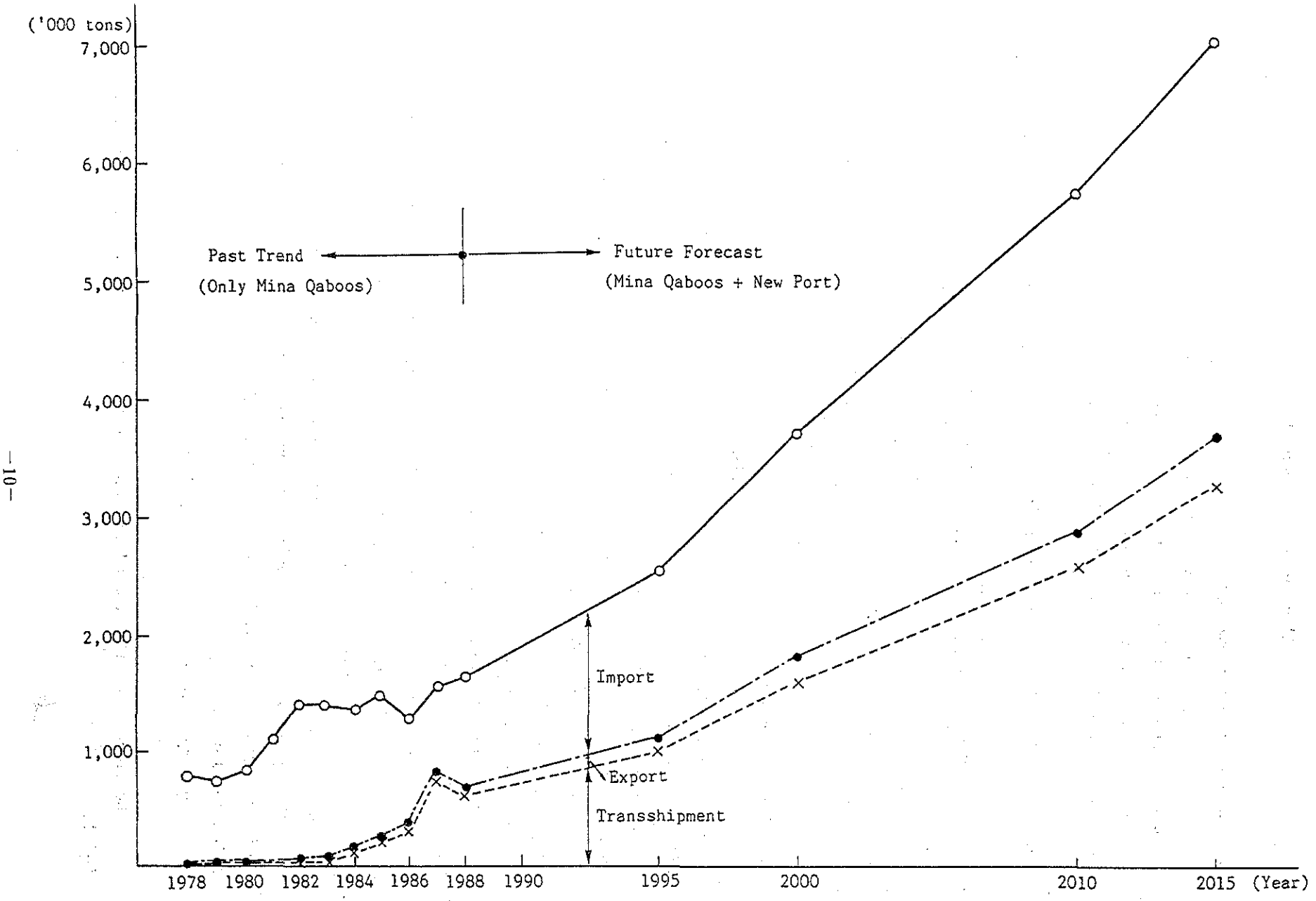


Fig. 4-2-1 Past Trend and Future Forecast of Total Cargo at Mina Qaboos & New Port

Table 4-2-1 Results of Demand Forecast for Mina Qaboos & New Port by Handling Mode

(Unit: '000 tonnes)

	1995	2000	2010	2015
Bulk Grain	204.3	250.3	373.6	456.6
Other Bulk	41.3	89.8	106.0	116.4
Vehicles	66.4	83.7	133.0	167.7
Livestock	17.4	20.8	29.2	34.6
Timber	100.5	124.0	151.1	166.8
Steel & Pipes	230.2	361.4	590.9	755.6
Other Break-bulk	167.4	223.1	324.9	393.2
Containers (Local Cargo)	726.6	982.6	1,438.4	1,745.5
Containers (Transshipment)	977.8	1,560.0	2,541.0	3,243.1
Total	2,531.9	3,695.7	5,688.1	7,079.3
TEUs of Containers	236,604	348,412	542,078	677,352
Boxes of Containers	177,452	261,309	406,559	508,013

Chapter 5 A NEW PORT CONSTRUCTION AND ITS CHARACTERISTICS

5.1 Necessity of a New Port in the Northern Part of Oman

5.1.1 A Supplementary Port of Mina Qaboos

The projected cargo volumes in the Northern Part of Oman are about 3.7 million tons is 2000 and 7.1 million tons in 2015.

The cargo handling capacity of Mina Qaboos is estimated to be about 2.6 million tons in 2000 after the economically feasible expansion and improvement.

Comparing the forecast cargo throughput in 2000 with the capacity of Mina Qaboos in 2000, 1.1 million tons of cargo will overflow from Mina Qaboos.

5.1.2 Spearhead to Develop Industries and Regional Development

The government of Oman is now promoting the development of non-oil industries in order to diversify the sources of national income to augment and eventually replace oil resources which is said to be exhausted within 20 years.

In order to develop new industries a new port in the northern part of Oman is indispensable.

5.2 Timing of New Port Development

In 2000, Mina Qaboos will not be able to handle the forecast cargo volume, accordingly, a new port must be in operation in 2000 at the latest.

5.3 Potential Functions of a New Port

5.3.1 Import Cargo Handling Function

According to the share of import cargoes by point of entry, the import cargo share of Mina Qaboos was only 58.3 percent of Oman's total import cargoes in 1988. The import cargo share by road occupied 29.6 percent in 1988. This suggests that some portion of import cargoes is handled in Dubai Port and transported by road to the northern part of Oman. So the area has good potential for import cargo handling ports.

5.3.2 Transshipment Cargo Handling Function

A new port located at Majis or Haradi in the Batinah coast would have a locational benefit of about 0.5 day for mother vessels compared with

Dubai. Accordingly, there is a possibility of locating a new port on the Batinah coast as a transshipment base.

5.3.3 Industrial Port Function

In order to make the economy of the Sultanate more independent of the oil-based economy, the government of Oman has made efforts to promote non-oil industries for the past two decades.

It is very important to develop a new port in the vicinity of the envisaged new Industrial Estates.

Judging from the government's policies and strategies and the on-going projects in Oman, the industrial sectors which should be studies in the future are found to be as follows:

a. Industries based on indigenous mineral resources
b. Industries based on natural gas resources
c. Agro-related industries
d. Other industries using skilled artisans

5.3.4 Free Trade Zone Function

By introducing free trade zones, the trade potential of export-oriented industries can be expected to increase. The various benefits that are likely to be created in Oman are expected. But introducing FTZs should be handled very carefully in order not to depress the existing domestic industries.

The potential industries in a free trade zone in the northern part of Oman are as follows:

1) Entrepot trade as transshipment, re-export
2) Export processing

The introduction of free trade zones seems to be very beneficial and Oman has good potential in this respect.

5.3.5 Fishery Port Function

The Oman Gulf is abundant in various kinds of fishes.

The Omani fishery industry remains a traditional inshore fishery using small boats. It is necessary to change from traditional fishing to modernized fishing, that is, the introduction of deep-sea fishing would be very beneficial for Oman.

The potential to establish fish processing plants in the Northern Part of Oman seems very high.

5.3.6 Other Functions

We can imagine various other functions for ports.

1) Ship repairing functions should be taken into account in a small scale.
2) Passenger terminals might be possible, considering the close location to Iran, but this function shall be excluded in the master plan.
3) The facilities for working vessels shall be examined.
4) Marine promenades and marine parks shall be treated as part of the environmental aspect of the industrial zone's development.
5) Bunkering facilities and other supply should be taken into consideration.

5.4 Allocation of functions between Mina Qaboos and a New Port

Functional allocation between Mina Qaboos and the New Port is summarized in the following table:

Table 5-4-1 Functional Allocation between Mina Qavoos and New Port

Functions	Mina Qaboos	New Port
1)Import Cargo Handling		
a. Break Cargo	X	X
b. Container Cargo	X	X
2)Export Cargo Handling		
a. Break Cargo	X	X
b. Container Cargo	X	X
3)Transshipment		
Mainly Container Cargo	X	X
4)Industry Related Cargo		
a. Light Industry	X	X
b. Heavy Industry		X
5)Free Trade Zone Related Cargo		X
6)Bulk Cargo		
a. Wheat	X	X
b. Log/Timber	X	X
c. Steel(Light)	X	X
(Heavy)		X
d. Petrochemicals(Import)	X	X
(Export)		X
e. Fertilizer(Break Bulk)		X
(Bulk)		X
f. Others		X
7)Fishery-Related Cargo		
a. Coastal Fishery	X	X
b. Deep Sea Fishery		X
8)His Majesty's Vessel	X	X
9)Ship Repairing		
a. Small Craft		X
10)Passenger		
a. Passenger Boats	(X)	(X)
b. Ferry Boats		(X)
11)Small Boat		
a. Working Boats	X	X
b. Recreation Boats	(X)	(X)
12)Bunkering Facilities		
a. Bunker Oil	X	X
b. Supply for Vessels	X	X
c. Offshore Supply		(X)
13)Marine Park etc.	X	(X)

Note: Marks in parentheses show that the functions will not be included in the master plan in 2015 and should be planned when the demand of the functions becomes clear.

5.5 New Port Development Policy

Through the analysis of port functions, we have concluded that the new port must be planned by taking account of various functions.

5.6 Site Selection of a New Port

We selected new port development site alternatives at first and chose Majis as the best new port site through the selecting procedure as shown in the following figure.

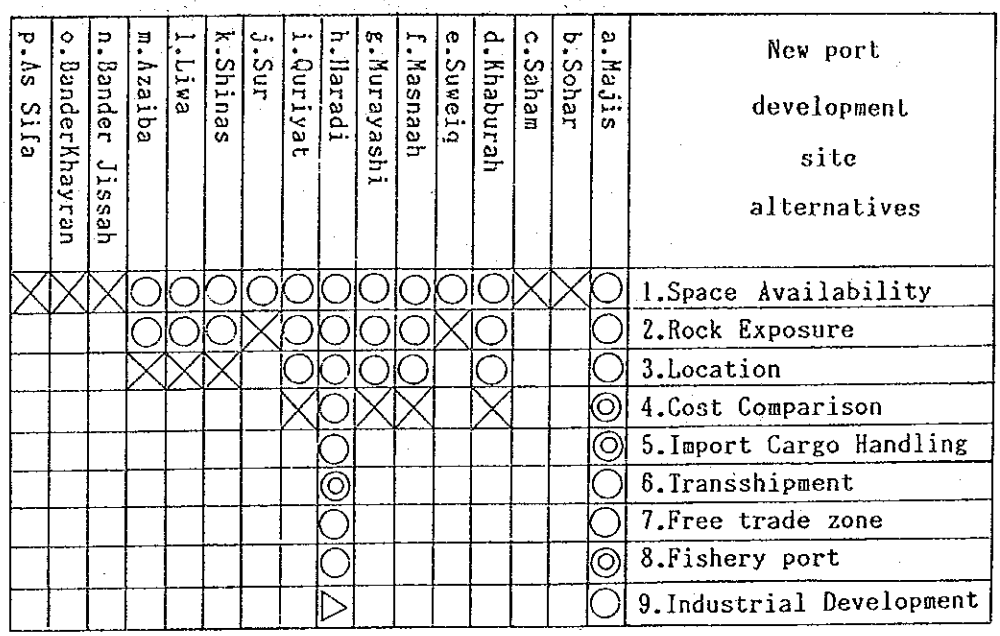


Fig. 5-6-1 Site Selection of a New Port

Chapter 6 FUTURE DEVELOPMENT PLAN OF MINA QABOOS

6.1 Development Strategy

According to the future traffic demand forecast, it is apparent that the existing handling capacity of Mina Qaboos cannot accommodate this demand in the near future. The Mina Qaboos development plan should be an intermediate one which is able to respond to the current situation quickly and efficiently.

6.2 Evaluation of the Existing Development Plan of Mina Qaboos

The existing development plan of Mina Qaboos was proposed by Consulting Engineering Services (CES) through its study in 1988.

Through the review of "Comprehensive Study on Development/Improvement Required in Mina Qaboos", several aspects which require more detail analysis have been noted in the items as follows:

(1) Land use layout
(2) Characteristics of calling ships
(3) Optimum port capacity
(4) Required storage area
(5) Back-up system
(6) Container movement
(7) Dredging method
(8) Revised cost estimate

6.3 Zoning

The port activity zone of Mina Qaboos can be categorized into the following four basic zones:

i) Container zone
ii) Conventional zone
iii) Government use zone
iv) Amenity zone

Fig. 6-3-1 shows the zoning of the port's land area schematically.

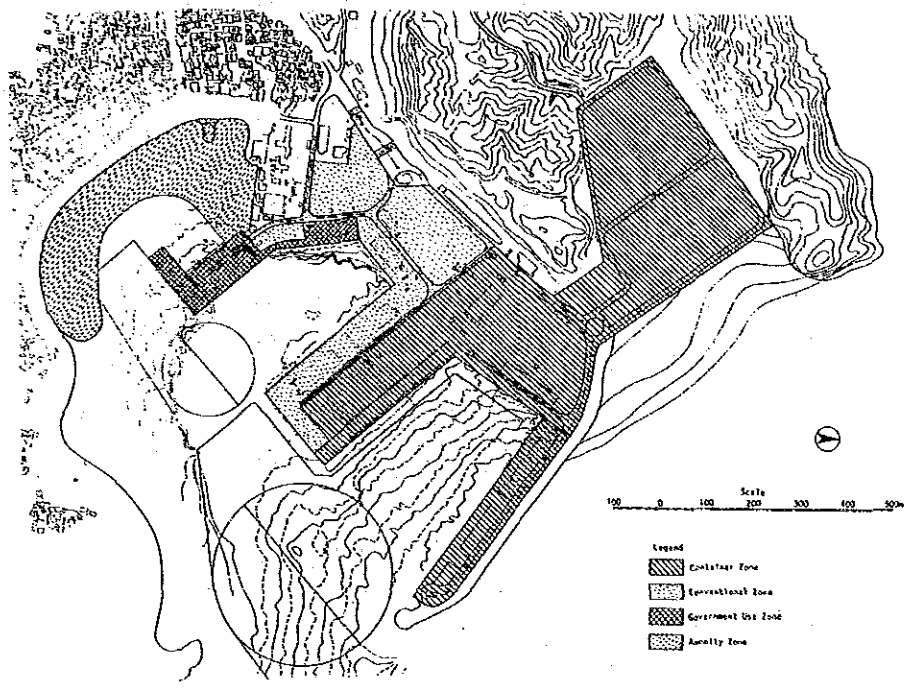


Fig. 6-3-1 Zoning of Mina Qaboos

6.4 Berth Use Plan

6.4.1 Cargo and Berth Characteristics

Considering the cargo and berth characteristics, the concept of berth use allocation can be set as follows:

Berths Nos.1, 1A, 2	.....Converted to multipurpose berths for containers, vehicles, livestock etc.
Berth No.3	.....Bulk grains
Berth No.4,5	.....Containers
Berths No.6,7,8	.....General cargoes, steel, timber etc.
Berth No.9	.....Tugboats, other small boats
Berth No.10,11,12,13	.....Government use

6.4.2 Berth Use Allocation

(a) Cargo Allocation

Cargoes in 1995 and 2000 are allocated to each berth as shown in Tables 6-4-1 and 6-4-2, respectively.

Table 6-4-1 Berth Use Allocation ; (1995)

Berth	Commodity	Amount of Cargo (Unit/Yr)	Av. Amount of Cargo per Ship (Unit)	No.of Call (Call/Yr)	Productivity (Unit/Hr.G.S.)	Gangs	Shifts	Working HRS (Hr/G.S.D)	Total Productivity (Unit/Ship.D)	Preparation per Ship (Day)	Berthing Time per Ship (Day)	Total Berthing Time (Day)	Working Days (Day)	Berth ※ Occupancy (%)
1	Steel		2,420.0	0	30.0	3	3	8	2,160.0	0.1	1.1	0.0	365	0.0
	Timber		2,000.0	0	30.0	3	3	8	2,160.0	0.1	1.0	0.0	365	0.0
	Vehicle		300.0	0	76.0	1	3	8	1,824.0	0.1	0.2	0.0	365	0.0
	Bulk Grain		13,750.0	0	170.0	1	3	8	4,080.0	0.1	3.4	0.0	365	0.0
	Livestock		460.0	0	61.0	1	3	8	1,464.0	0.1	0.3	0.0	365	0.0
	G. Cargo		950.0	0	25.0	3	3	8	1,800.0	0.1	0.5	0.0	365	0.0
	Container	63,494.0	276.0	230	25.0	2	3	8	1,200.0	0.1	0.2	75.9	365	20.8
	Other Use													0.0
	(Total)													20.8
2	Steel	61,440.0	2,420.0	26	30.0	3	3	8	2,160.0	0.1	1.1	31.2	365	8.5
	Timber	53,500.0	2,000.0	26	30.0	3	3	8	2,160.0	0.1	1.0	27.3	365	7.5
	Vehicle	69,700.0	300.0	229	76.0	1	3	8	1,824.0	0.1	0.2	60.6	365	16.6
	Bulk Grain		13,750.0	0	170.0	1	3	8	4,080.0	0.1	3.4	0.0	365	0.0
	Livestock	17,400.0	460.0	38	61.0	1	3	8	1,464.0	0.1	0.3	15.7	365	4.3
	G. Cargo	29,400.0	950.0	31	25.0	3	3	8	1,800.0	0.1	0.5	19.4	365	5.3
	Container		276.0	0	25.0	2	3	8	1,200.0	0.1	0.2	0.0	365	0.0
	Other Use													0.0
	(Total)													42.2
3	Steel		2,420.0	0	30.0	3	3	8	2,160.0	0.1	1.1	0.0	365	0.0
	Timber		2,000.0	0	30.0	3	3	8	2,160.0	0.1	1.0	0.0	365	0.0
	Vehicle		300.0	0	76.0	1	3	8	1,824.0	0.1	0.2	0.0	365	0.0
	Bulk Grain	204,300.0	13,750.0	15	170.0	1	3	8	4,080.0	0.1	3.4	51.6	365	14.1
	Livestock		460.0	0	61.0	1	3	8	1,464.0	0.1	0.3	0.0	365	0.0
	G. Cargo		950.0	0	25.0	3	3	8	1,800.0	0.1	0.5	0.0	365	0.0
	Container		276.0	0	25.0	2	3	8	1,200.0	0.1	0.2	0.0	365	0.0
	Other Use													30.0
	(Total)													44.1
4	Steel		2,420.0	0	30.0	3	3	8	2,160.0	0.1	1.1	0.0	365	0.0
	Timber		2,000.0	0	30.0	3	3	8	2,160.0	0.1	1.0	0.0	365	0.0
	Vehicle		300.0	0	76.0	1	3	8	1,824.0	0.1	0.2	0.0	365	0.0
	Bulk Grain		13,750.0	0	170.0	1	3	8	4,080.0	0.1	3.4	0.0	365	0.0
	Livestock		460.0	0	61.0	1	3	8	1,464.0	0.1	0.3	0.0	365	0.0
	G. Cargo		950.0	0	25.0	3	3	8	1,800.0	0.1	0.5	0.0	365	0.0
	Container	57,800.0	276.0	207	25.0	1	3	8	600.0	0.1	0.5	115.7	365	31.7
	Other Use													0.0
	(Total)													31.7
5	Steel		2,420.0	0	30.0	3	3	8	2,160.0	0.1	1.1	0.0	365	0.0
	Timber		2,000.0	0	30.0	3	3	8	2,160.0	0.1	1.0	0.0	365	0.0
	Vehicle		300.0	0	76.0	1	3	8	1,824.0	0.1	0.2	0.0	365	0.0
	Bulk Grain		13,750.0	0	170.0	1	3	8	4,080.0	0.1	3.4	0.0	365	0.0
	Livestock		460.0	0	61.0	1	3	8	1,464.0	0.1	0.3	0.0	365	0.0
	G. Cargo		950.0	0	25.0	3	3	8	1,800.0	0.1	0.5	0.0	365	0.0
	Container	57,800.0	276.0	207	25.0	1	3	8	600.0	0.1	0.5	115.7	365	31.7
	Other Use													0.0
	(Total)													31.7
6	Steel	52,400.0	2,420.0	22	30.0	3	3	8	2,160.0	0.1	1.1	26.4	365	7.2
	Timber	15,000.0	2,000.0	7	30.0	3	3	8	2,160.0	0.1	1.0	7.7	365	2.1
	Vehicle		300.0	0	76.0	1	3	8	1,824.0	0.1	0.2	0.0	365	0.0
	Bulk Grain		13,750.0	0	170.0	1	3	8	4,080.0	0.1	3.4	0.0	365	0.0
	Livestock		460.0	0	61.0	1	3	8	1,464.0	0.1	0.3	0.0	365	0.0
	G. Cargo	59,300.0	950.0	62	25.0	3	3	8	1,800.0	0.1	0.5	39.2	365	10.7
	Container		276.0	0	25.0	2	3	8	1,200.0	0.1	0.2	0.0	365	0.0
	Other Use													15.0
	(Total)													35.1
7	Steel	59,000.0	2,420.0	24	30.0	3	3	8	2,160.0	0.1	1.1	29.2	365	8.0
	Timber	16,000.0	2,000.0	8	30.0	3	3	8	2,160.0	0.1	1.0	8.2	365	2.2
	Vehicle		300.0	0	76.0	1	3	8	1,824.0	0.1	0.2	0.0	365	0.0
	Bulk Grain		13,750.0	0	170.0	1	3	8	4,080.0	0.1	3.4	0.0	365	0.0
	Livestock		460.0	0	61.0	1	3	8	1,464.0	0.1	0.3	0.0	365	0.0
	G. Cargo	68,000.0	950.0	63	25.0	3	3	8	1,800.0	0.1	0.5	39.6	365	10.9
	Container		276.0	0	25.0	2	3	8	1,200.0	0.1	0.2	0.0	365	0.0
	Other Use													15.0
	(Total)													36.1
8	Steel	58,000.0	2,420.0	24	30.0	3	3	8	2,160.0	0.1	1.1	29.2	365	8.0
	Timber	16,000.0	2,000.0	8	30.0	3	3	8	2,160.0	0.1	1.0	8.2	365	2.2
	Vehicle		300.0	0	76.0	1	3	8	1,824.0	0.1	0.2	0.0	365	0.0
	Bulk Grain		13,750.0	0	170.0	1	3	8	4,080.0	0.1	3.4	0.0	365	0.0
	Livestock		460.0	0	61.0	1	3	8	1,464.0	0.1	0.3	0.0	365	0.0
	G. Cargo	68,000.0	950.0	63	25.0	3	3	8	1,800.0	0.1	0.5	39.6	365	10.9
	Container		276.0	0	25.0	2	3	8	1,200.0	0.1	0.2	0.0	365	0.0
	Other Use													15.0
	(Total)													36.1
TOTAL	Steel	230,200.0	2,420.0	95	30.0	3	3	8	2,160.0	0.1	1.1	116.1	365	4.0
	Timber	100,500.0	2,000.0	48	30.0	3	3	8	2,160.0	0.1	1.0	51.4	365	1.8
	Vehicle	69,700.0	300.0	229	76.0	1	3	8	1,824.0	0.1	0.2	60.6	365	2.1
	Bulk Grain	204,300.0	13,750.0	15	170.0	1	3	8	4,080.0	0.1	3.4	51.6	365	1.8
	Livestock	17,400.0	460.0	38	61.0	1	3	8	1,464.0	0.1	0.3	15.7	365	0.5
	G. Cargo	309,700.0	950.0	326	25.0	3	3	8	1,800.0	0.1	0.5	137.9	365	4.7
	Container	177494	276.0	643	25.0	2	3	8	1,200.0	0.1	0.2	212.2	365	10.5
	Other Use	0.0												9.4
	(Total)													34.6

※ Only cargo-related berth occupancy is shown.

Table 6-4-2 Berth Use Allocation ; (2000)

Berth	Commodity	Amount of Cargo (Unit/Yr)	Av. Amount of Cargo per Ship (Unit)	No.of Call (Call/Yr)	Productivity (Unit/Hr.G.S.)	Gangs	Shifts	Working HRS (Hr/G.S.D)	Total Productivity (Unit/Ship.D)	Preparation per Ship (Day)	Berthing Time per Ship (Day)	Total Berthing Time (Day)	Working Days (Day)	Berth ※ Occupancy (%)
1	Steel		2,420.0	0	30.0	3	3	8	2,160.0	0.1	1.12	0.0	365	0.0
	Timber		2,080.0	0	30.0	3	3	8	2,160.0	0.1	0.96	0.0	365	0.0
	Vehicle		300.0	0	76.0	1	3	8	1,824.0	0.1	0.16	0.0	365	0.0
	Bulk Grain		13,750.0	0	170.0	1	3	8	4,080.0	0.1	3.37	0.0	365	0.0
	Livestock		460.0	0	61.0	1	3	8	1,464.0	0.1	0.31	0.0	365	0.0
	G. Cargo		950.0	0	25.0	3	3	8	1,800.0	0.1	0.53	0.0	365	0.0
	Container	70,588.0	276.0	256	25.0	2	3	8	1,200.0	0.1	0.23	84.4	365	23.1
	Other Use													0.0
	(Total)													23.1
2	Steel	59,100.0	2,420.0	24	30.0	3	3	8	2,160.0	0.1	1.12	29.8	365	8.2
	Timber	40,600.0	2,080.0	20	30.0	3	3	8	2,160.0	0.1	0.96	20.9	365	5.7
	Vehicle	86,600.0	300.0	289	76.0	1	3	8	1,824.0	0.1	0.16	76.3	365	20.9
	Bulk Grain		13,750.0	0	170.0	1	3	8	4,080.0	0.1	3.37	0.0	365	0.0
	Livestock	20,000.0	460.0	45	61.0	1	3	8	1,464.0	0.1	0.31	18.7	365	5.1
	G. Cargo	25,200.0	950.0	27	25.0	3	3	8	1,800.0	0.1	0.53	16.7	365	4.6
	Container		276.0	0	25.0	2	3	8	1,200.0	0.1	0.23	0.0	365	0.0
	Other Use													0.0
	(Total)													44.5
3	Steel		2,420.0	0	30.0	3	3	8	2,160.0	0.1	1.12	0.0	365	0.0
	Timber		2,080.0	0	30.0	3	3	8	2,160.0	0.1	0.96	0.0	365	0.0
	Vehicle		300.0	0	76.0	1	3	8	1,824.0	0.1	0.16	0.0	365	0.0
	Bulk Grain	258,300.0	13,750.0	18	170.0	1	3	8	4,080.0	0.1	3.37	63.2	365	17.3
	Livestock		460.0	0	61.0	1	3	8	1,464.0	0.1	0.31	0.0	365	0.0
	G. Cargo		950.0	0	25.0	3	3	8	1,800.0	0.1	0.53	0.0	365	0.0
	Container		276.0	0	25.0	2	3	8	1,200.0	0.1	0.23	0.0	365	0.0
	Other Use													30.0
	(Total)													47.3
4	Steel		2,420.0	0	30.0	3	3	8	2,160.0	0.1	1.12	0.0	365	0.0
	Timber		2,080.0	0	30.0	3	3	8	2,160.0	0.1	0.96	0.0	365	0.0
	Vehicle		300.0	0	76.0	1	3	8	1,824.0	0.1	0.16	0.0	365	0.0
	Bulk Grain		13,750.0	0	170.0	1	3	8	4,080.0	0.1	3.37	0.0	365	0.0
	Livestock		460.0	0	61.0	1	3	8	1,464.0	0.1	0.31	0.0	365	0.0
	G. Cargo		950.0	0	25.0	3	3	8	1,800.0	0.1	0.53	0.0	365	0.0
	Container	56,984.0	276.0	206	25.0	1	3	8	600.0	0.1	0.46	115.6	365	31.7
	Other Use													0.0
	(Total)													31.7
5	Steel		2,420.0	0	30.0	3	3	8	2,160.0	0.1	1.12	0.0	365	0.0
	Timber		2,080.0	0	30.0	3	3	8	2,160.0	0.1	0.96	0.0	365	0.0
	Vehicle		300.0	0	76.0	1	3	8	1,824.0	0.1	0.16	0.0	365	0.0
	Bulk Grain		13,750.0	0	170.0	1	3	8	4,080.0	0.1	3.37	0.0	365	0.0
	Livestock		460.0	0	61.0	1	3	8	1,464.0	0.1	0.31	0.0	365	0.0
	G. Cargo		950.0	0	25.0	3	3	8	1,800.0	0.1	0.53	0.0	365	0.0
	Container	56,984.0	276.0	206	25.0	1	3	8	600.0	0.1	0.46	115.6	365	31.7
	Other Use													0.0
	(Total)													31.7
6	Steel	51,100.0	2,420.0	21	30.0	3	3	8	2,160.0	0.1	1.12	25.8	365	7.1
	Timber	9,200.0	2,080.0	4	30.0	3	3	8	2,160.0	0.1	0.96	4.7	365	1.3
	Vehicle		300.0	0	76.0	1	3	8	1,824.0	0.1	0.16	0.0	365	0.0
	Bulk Grain		13,750.0	0	170.0	1	3	8	4,080.0	0.1	3.37	0.0	365	0.0
	Livestock		460.0	0	61.0	1	3	8	1,464.0	0.1	0.31	0.0	365	0.0
	G. Cargo	46,500.0	950.0	49	25.0	3	3	8	1,800.0	0.1	0.53	30.7	365	8.4
	Container		276.0	0	25.0	2	3	8	1,200.0	0.1	0.23	0.0	365	0.0
	Other Use													15.8
	(Total)													31.8
7	Steel	55,000.0	2,420.0	23	30.0	3	3	8	2,160.0	0.1	1.12	27.7	365	7.6
	Timber	10,000.0	2,080.0	5	30.0	3	3	8	2,160.0	0.1	0.96	5.1	365	1.4
	Vehicle		300.0	0	76.0	1	3	8	1,824.0	0.1	0.16	0.0	365	0.0
	Bulk Grain		13,750.0	0	170.0	1	3	8	4,080.0	0.1	3.37	0.0	365	0.0
	Livestock		460.0	0	61.0	1	3	8	1,464.0	0.1	0.31	0.0	365	0.0
	G. Cargo	58,000.0	950.0	53	25.0	3	3	8	1,800.0	0.1	0.53	33.0	365	9.1
	Container		276.0	0	25.0	2	3	8	1,200.0	0.1	0.23	0.0	365	0.0
	Other Use													15.8
	(Total)													33.1
8	Steel	55,000.0	2,420.0	23	30.0	3	3	8	2,160.0	0.1	1.12	27.7	365	7.6
	Timber	10,000.0	2,080.0	5	30.0	3	3	8	2,160.0	0.1	0.96	5.1	365	1.4
	Vehicle		300.0	0	76.0	1	3	8	1,824.0	0.1	0.16	0.0	365	0.0
	Bulk Grain		13,750.0	0	170.0	1	3	8	4,080.0	0.1	3.37	0.0	365	0.0
	Livestock		460.0	0	61.0	1	3	8	1,464.0	0.1	0.31	0.0	365	0.0
	G. Cargo	58,000.0	950.0	53	25.0	3	3	8	1,800.0	0.1	0.53	33.0	365	9.1
	Container		276.0	0	25.0	2	3	8	1,200.0	0.1	0.23	0.0	365	0.0
	Other Use													15.8
	(Total)													33.1
TOTAL	Steel	220,200.0	2,420.0	91	30.0	3	3	8	2,160.0	0.1	1.12	111.0	365	3.8
	Timber	70,000.0	2,080.0	34	30.0	3	3	8	2,160.0	0.1	0.96	35.0	365	1.2
	Vehicle	86,600.0	300.0	289	76.0	1	3	8	1,824.0	0.1	0.16	76.3	365	2.6
	Bulk Grain	258,300.0	13,750.0	18	170.0	1	3	8	4,080.0	0.1	3.37	63.2	365	2.2
	Livestock	20,000.0	460.0	45	61.0	1	3	8	1,464.0	0.1	0.31	18.7	365	0.6
	G. Cargo	171,700.0	950.0	181	25.0	3	3	8	1,800.0	0.1	0.53	113.5	365	3.9
	Container	184540	276.0	669	25.0	2	3	8	1,200.0	0.1	0.21	203.9	365	18.8
	Other Use	0.0		0										9.4
	(Total)			1,328										34.5

※ Only cargo-related berth occupancy is shown.

(b) Queuing Simulation

Table 6-4-3 shows the average ship waiting time by ship type obtained through this simulation model. In this calculation, cargo allocation to each berth is set such that ship waiting time is limited to about three hours.

(c) Berth Use Allocation in 1995 and 2000

Cargo allocation between Mina Qaboos and the New Port is set as shown in Table 6-4-4.

Table 6-4-3 Calculated Average Ship Waiting Time

(Hours)

Year / Ship Type \ Berth No.	1995			2000		
	1 & 2	4 & 5	6,7 & 8	1 & 2	4 & 5	6,7 & 8
Container	1.9	3.0	-	2.4	2.6	-
Timber	1.1	-	0.6	1.9	-	0.1
Steel	1.5	-	3.3	2.2	-	3.8
Vehicle	1.4	-	-	1.5	-	-
Livestock	1.0	-	-	1.4	-	-
G. Cargo	1.9	-	0.8	2.3	-	0.8

Talbe 6-4-4 Cargo Allocation between Mina Qaboos and New Port

Cargo	1995		2000	
	Mina Qaboos	New Port	Mina Qaboos	New Port
Steel	230,200(Ton)	0	220,200(Ton)	141,200(Ton)
Timber	100,500(Ton)	0	70,000(Ton)	54,000(Ton)
Bulk Grain	204,300(Ton)	0	250,300(Ton)	0
Vehicle	68,700(Ton)	0	86,600(Ton)	0
Livestock	17,400(Ton)	0	20,800(Ton)	0
General Cargo	208,800(Ton)	0	171,700(Ton)	141,400(Ton)
Container	236,646(TEUs)	0	246,058(TEUs)	102,354(TEUs)
(Total)	829,900(Ton)	0	819,600(Ton)	336,600(Ton)
	236,606(TEUs)	0	246,058(TEUs)	102,354(TEUs)

6.5 Land Use Plan

6.5.1 Land Use of Existing Area

In terms of total available land area, about 5,600m^2 of area will increase, as shown in Table 6-5-1.

Table 6-5-1 Land Use of Existing Area

Land Use	Area	
	Present	After Zoning
Covered storage	19,094 m^2	10,065 m^2
Open storage	37,910 m^2	67,780 m^2
CFS	4,722 m^2	0 m^2
Marshalling yard	87,425 m^2	76,954 m^2
Total	149,151 m^2	154,799 m^2

6.5.2 Required Land Area in 1995 and 2000

The area required for each storage mode is shown below. All the cargo handled at Mina Qaboos is divided into 3 storage modes; covered storage, open storage and container yard. The relations between the required area and annual throughput in the years 1988, 1995 and 2000 are shown in Table 6-5-2.

Table 6-5-2 Relation between Required Area and Available Area

Storage	Required & Available Area	1988	1995	2000	2000
Covered Storage	Cargo throughput (Ton)	49,670	56,562	47,600	68,810
	Required Area (m^2)	2,227	2,596	1,653	4,187
	Available Area (m^2)	19,094	10,065	10,065	10,065
	(Balance of Area)(m^2)	16,867	7,469	8,412	5,878
Open Storage	Cargo throughput (Ton)	301,600	459,358	394,068	709,458
	Required Area (m^2)	23,904	40,285	39,174	61,465
	Available Area (m^2)	37,910	67,780	67,780	67,780
	(Balance of Area)(m^2)	14,006	27,495	28,606	6,315
Marshalling Yard	Cargo throughput (TEU)	147,882	236,464	246,065	348,524
	Required Area (m^2)	99,835	118,305	116,475	153,135
	Available Area (m^2)	87,425	76,954	76,954	76,954
	(Balance of Area)(m^2)	-12,410	-41,351	-39,521	-76,181
C F S	Cargo throughput (TEU)	6,308	10,329	9,979	12,041
	Required Area (m^2)	4,722	21,190	21,190	25,157
	Available Area (m^2)	4,722	0	0	0
	(Balance of Area)(m^2)	0	-21,190	-21,190	-25,157
Ground Service Area	Cargo throughput (TEU)	3,270	5,237	4,906	6,948
	Required Area (m^2)	4,892	7,854	7,339	10,394
	Available Area (m^2)	0	0	0	0
	(Balance of Area)(m^2)	-4,892	-7,854	-7,339	-10,394
Other Space	Required Area (m^2)	15,000	40,000	40,000	40,000
	Available Area (m^2)	15,000	15,000	15,000	15,000
	(Balance of Area)(m^2)	0	-25,000	-25,000	-25,000
Total Area	Required Area (m^2)	160,580	230,230	225,831	294,338
	Available Area (m^2)	174,151	169,799	169,799	169,799
	(Balance of Area)(m^2)	13,571	-60,431	-56,032	-124,539

*In case the new port is not functioning in 2000.

6.5.3 Reclamation of Shutaify Bay

As discussed in previous sections, 15 more hectares of land will be needed in order to accommodate future traffic demand by 2000. However it is impossible to find enough vacant space around Mina Qaboos presently. Therefore, the only feasible alternative is the reclamation of Shutaify Bay.

6.6 Facility Plan

6.6.1 Water Basin

Mina Qaboos has suffered from insufficient depth. Given -13m depth, ships with -11.5m draft, which corresponds to the draft of second generation container ships, can call at Mina Qaboos without any constraints.

In order to accommodate the Royal Support Yacht and the Royal Dhow, the water basins should be dredged to -8m and -4m, respectively.

6.6.2 Container berth

(a) Marshalling Yard behind Berths Nos.3, 4 & 5

Table 6-6-1 shows the annual volume estimated to be handled in 1995 and 2000 at berths Nos.4 and No.5, and the ground spots in the marshalling yard corresponding thereto.

Table 6-6-1 Storage Capacity of Berth Nos.4 & 5

	storage capa(TEUs)	required capacity 1995	balance 1995	additional g.spot
import	33969	31417	2552	37
export (e)	35220	28326	6894	174
export (l)	4291	4350	-59	0
reefer E&I	4505	5266	-761	-19
transship	49332	41320	8012	66
sum	127316	110679		257

	storage capa(TEUs)	required capacity 2000	balance 2000	additional g.spot
import	33969	27687	6282	92
export(e)	35220	24757	10463	263
export(l)	4291	4145	146	1
reefer E&I	4505	5875	-1370	-35
transship	49332	44747	4585	38
sum	127316	107211		360

6.6.3 Multipurpose Berth

(a) Concept of Facility Layout

For the handling containers, two gantry cranes will be installed. Although containers are to be mainly handled at Berths 1, and 1A, rail tracks for gantry cranes will be extended to Berth No.2. In order to use the yard space efficiently for on a multipurpose basis, transit sheds Nos.1A, 1 and 2 will be demolished and used as open storage areas. The container stockyard for this Berth will be developed on Shutaify Bay.

(b) Container Freight Station

CFS will be developed at Shutaify Bay Yard. Table 6-6-2, shows the annual volume estimated to be handled in 1995 and 2000 at multipurpose berth, and the required and available ground spots in the marshalling yard in Shutaify Bay.

Table 6-6-2 Required and Available Ground Spots

summary	storage capa(TEUs)	required capacity 1995	balance 1995	balance g.spot
import	18417	17495	922	14
export(e)	16686	15774	912	23
export(1)	3576	2423	1153	10
reefer E&I	4224	2933	1291	33
transship	29019	23011	6008	50
sum	71920	61636		129

summary	storage capa(TEUs)	required capacity 2000	balance 2000	balance g.spot
import	18417	17146	1271	19
export(e)	16686	15332	1354	34
export(1)	3576	2567	1009	8
reefer E&I	4224	3638	586	15
transship	29019	27712	1307	11
sum	71920	66395		87

6.6.4 New Berth for the Royal Yacht

Royal Fleets are using Berth No.6, 11 and 12 at present. However, in view of the safety, security and convenience of the Royal Services, it may be better for all the Royal vessels being positioned in one place. The only feasible location for a new berth is the area in the vicinity of berth

No.12. Considering the calmness conditions in the water basin the layout of berth is decided as shown in Fig. 6-6-1.

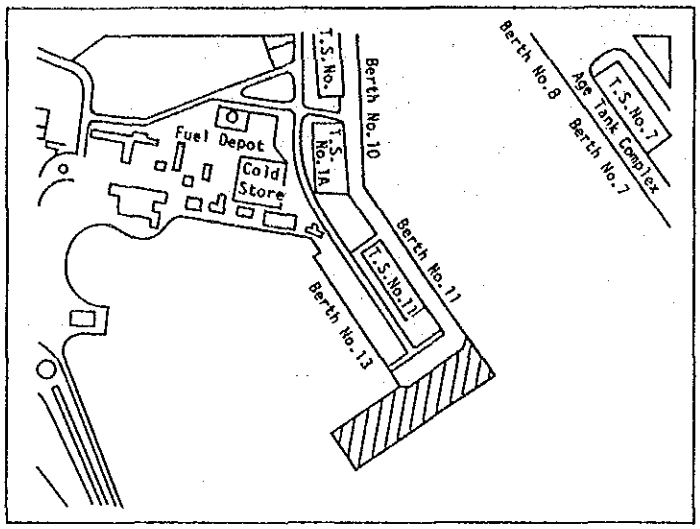


Fig. 6-6-1 Layout of Royal Yacht Berth

6.6.5 Other Facilities

(a) Conventional Berths

(1) Berth No.3

Berth No.3 is to be used mainly by grain ships.

(2) Berth No.6

Berth No.6 is to be used for conventional cargoes.

(3) Demolition of Covered Storages

For the future use of land area, Transit Sheds Nos.1A, 1, 2, 3 and 4 are to be demolished.

(b) Cold Storage

The cold storage facility with two stories (40m x 40m) is to be built on the space next to Transit shed No.7.

(c) Administration Office Building

For the staff members of the PSC, an administration building should be constructed including a yard control tower. The best site for the building is considered to be behind berth No.3 near the corner of berth Nos.2 and 3, with a 20m width and 40m length with three floors.

(d) Gate Facility

For the gate, functionally subdivided into incoming and outgoing it is necessary to arrange six lanes: four lanes for container traffic and two lanes for conventional cargo traffic, each equipped with a truck scale.

(e) Electrical Power Station

(f) Lighting

Future development plan of Mina Qaboos is shown in Fig.6-6-2.

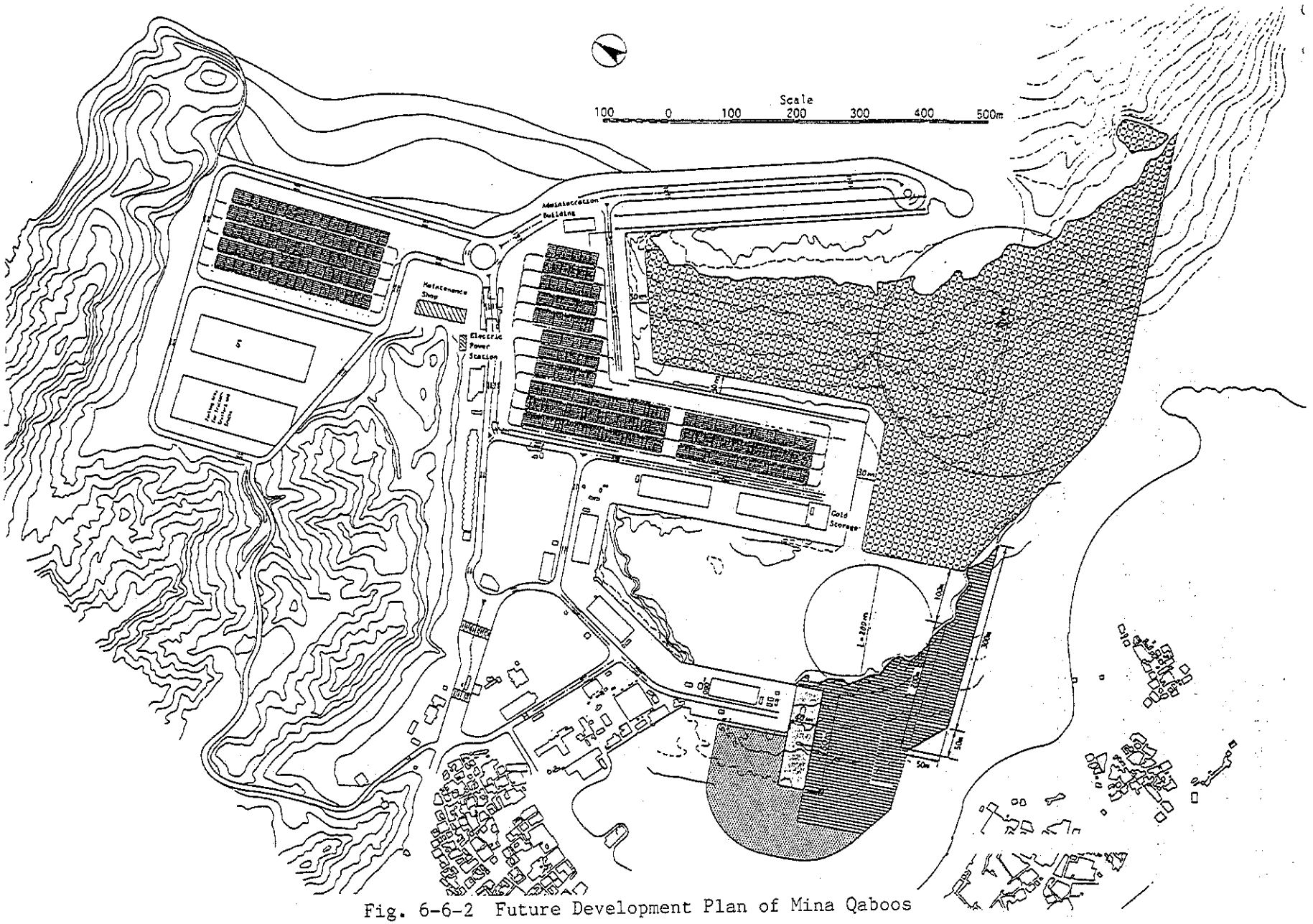


Fig. 6-6-2 Future Development Plan of Mina Qaboos

6.7 Operation System

6.7.1 Cargo Handling System

The competent cargo handling system at the Mina Qaboos is considered to be a transfer crane system and the cargo operation at the container terminal is recommended to use the advanced computer system level 3.

6.7.2 Man System

(a) Comventional Cargo Operation

The nessary number of gangs in conventional terminal is estimated s follows:

Table 6-7-1 Number of Gangs

	1988	1995	1997-1998	2000	2000*
Cargo throughput (tons)	390,200	539,400	670,000	461,900	798,500
Number of gang	12(G)	17(G)	21(G)	14(G)	25(G)

From above table, it is considered to increase the number of gangs to 17 until 1995, and then the number is depending to the extent of allocation of cargo handling to the new port.

(b) Container Cargo Operations

Shipside operations at the container terminal must be carried out on a 24-hour, 365-day a year basis. In addition to berths No.4 and 5, container vessels must also be berthed at Berths No.1 and 2 thus more gangs will be necessary.

Container handling gangs

Common ship supervisors	:	1 man
Head planners	:	1 man
Planners	:	2 men
Inspection clerks	:	2 men(1 man/crane)
Foremen or gang leaders	:	2 men(1 man/crane)
Winchmans	:	2 men(1 man/crane)
Laborers	:	12 men(6men/crane)
Total	:	22 men/shift/gang/2 cranes

(c) Gangs for the CFS Operation

The necessary number and the constitution of CFS operation are as follows:

The necessary number of gangs = 3

Foremen	: 1 man
Tally clerks	: 2 men
Marker boys	: 1 man
Laborers	: 8 men
Forklift truck drivers	: 3 men

(d) Summary

Based on the above investigation, the recommended number of gangs by 1995 is shown in Table 6-7-2. The number of gangs needed to handle conventional cargo, should increase more than the figures indicated in the table if cargo is not allocated between Mina Qaboos and the New Port.

Table 6-7-2 Required Number of Ganags

	Present	1995	2000
Conventional	12	17	14
Container	3	6	6
CFS	1+α	3	3

Note: The make-up of each gang is unchanged.

6.8 Handling Equipment

6.8.1 The Quantity of Machinery Necessary for Cargo Handling

The required number of cargo handling equipment at 1995 and 2000 are as follows:

Table 6-8-1 Required Number of Cargo Handling Equipment

	Shipside operations		Landside operations	Number required
	Berths Nos.1-2	Berths Nos.4-5		
(1995)				
Container crane	2	2		4
Transfer crane	2	2	4	8
Tractor	12	8	3	23
Trailer	12	8	20	40
(2000)				
Container crane	2	2		4
Transfer crane	2	2	4	8
Tractor	14	10	3	27
Trailer	14	10	22	46

Table 6-8-2 Specifications and Allotment of Equipment

Equipment	Dimension	Units	Remark
Container crane	Cap, 35t Span 30m	2	(Exist) Berths Nos.4 and 5
Container crane	Cap, 41t Span 20m	2	(New) Berths Nos.1 and 1A
Transfer crane	Cap, 30.5t(40t) One over 4high	8	(New) Berths for Nos.3 and 4: 5 units for Shutaify Bay Yard: 3 units
Tractor trailer	for 40 feet container	27	(New) for Berths Nos.3,4 and 5: 10units for Berths Nos.1 and 1A : 14units for CFS : 3units
Trailer	for 40 feet container	17	(New) for CFS
Folk lift (Heavy type)	Cap, over 25t	5	(Exist) for Shutaify Bay Yard for general cargo
Folk lift (Light type)	Cap, over 1t	45	(New)

6.9 Maintenance System

The maintenance system in the future development plan of Mina Qaboos should be consisted of following items.

(1) Staff increase

	Engineers	Workers
Electrical	2	6
Mechanical	2	10
Other		10
(including auto mobile drivers)		
Total	30	

(2) Working area

A new maintenance shop should be built in the entrance zone at Shutaify bay to handle repairs and ensure the safety and case of port operations.

	New	Former
Working area	10,800m^2	5,000m^2
Shop Building	1,300m^2	700m^2

(3) The essential point of preventive maintenance aer as follows.

1) A preventive maintenance budget
2) A manual or checklist for preventive maintenance should be delivered to the staff after being translated from English or other languages, into Arabic
3) Training and education to upgrade technical ability.

6.10 Training of Maintenance and Operational Staff Members

The details of training new staff memebers are explained in detail in Chapter 9, "Operational Procedure", Section 9.6. "Training" in the CFS report.

6.11 Design of Facilities

(1) Berths

Berth No.12(A) is designed for a water depth of -8m, deep enough to accommodate 7,000t class ships. The water depth of berth No.12(B) is -4.0m, which can accommodate small craft such as tugboats and pilot boats.

(2) Seawall

The seawall for reclaimed land in Shutaify Bay is designed for an average water depth of -10m and a total length of 420m. (Fig. 6-11-2)

(3) Other Facilities

1) Crane Foundation for Gantry cranes at berths Nos.1A, 1 and 2.

2) Pavement and Transfer Crane Tracks

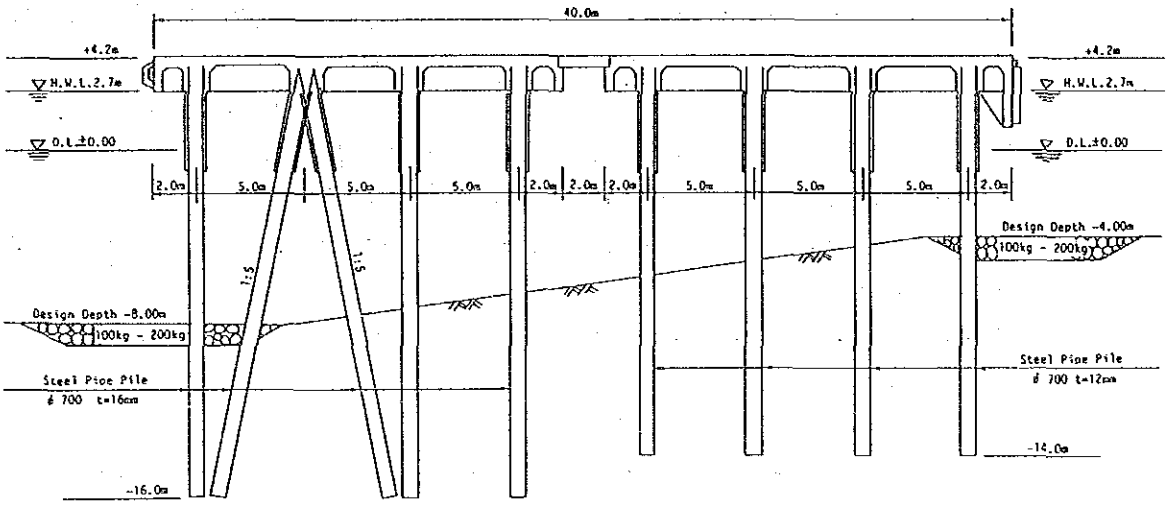


Fig. 6-11-1 Standard Cross Section of the Berths

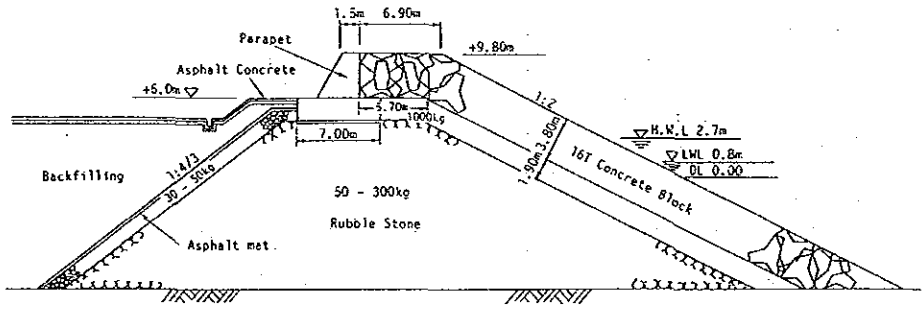


Fig. 6-11-2 Standard Cross Section of the Seawall

6.12 Implementation Schedule of Port Construction

6.12.1 General

It is quite important to formulate a well designed construction program that will not obstruct the ongoing operations of Mina Qaboos,

because it is a very busy port, with about one thousand ship calls a year.

The construction of the port facilities is to start in late 1990 and be completed by 1992. The project implementation schedule is briefly described below:

1) Blasting work at the quarry site at Jebel, and seawall construction will be executed, and reclamation and pavement work for the container yard will follow at Shutaify Bay.
2) In conjunction with the above work, the following work will be carried out on land; demolition of the sheds at Berths No.1 and 2; foundation-reinforcement work; and erection of container cranes.
3) Dredging work will be initiated at the -8m/-4m area, and the dredged materials will be used for reclamation at Shutaify Bay.
4) On completion of the dredging in the -8m/-4m area, dredging in the -13m area will start. The dredged materials therefrom will also be used for reclamation at Shutaify Bay.
5) Construction of Berth No.12 (A) (B) will start after completion of the dredging work.

The construction quantities for each work component are shown in Table 6-12-1.

Table 6-12-1 Construction Quantities

Facility	Unit	Quantity
Land/Container Yard at Shutaify Bay	m^2	153,000
Land/Container yard at Mina Qaboos	Tracks for Container Crane, Container yard and road	
Dredging/Dumping (-13m, -8m, -4m)	m^3	1,186,800
Berths No.1 and 2	Concrete beam and rails for Container Crane	
Berth No.12 (A)(B)	m^2	6,400 (160m x 40m)
Buildings	m^2	15,600
Cargo Handling Equipment	No	56

6.12.2 Construction Schedule and Cost Estimation

The construction schedule and the cost estimation at Mina Qaboos, based upon the foregoing preliminary design and construction method are shown in Table 6-12-2.

Table 6-12-2 Construction Schedule and Cost Estimation

Facilities		Unit	Quantity	Amount (1,000 R.O)			Construction Schedule
Item	Sub Item			Foreign Currency	Local Currency	Total	1990 / 1991 / 1992
1. Land/Container Yard at Shutaify Bay	(1) Blasting Jebel	m3	319,000	-	479	479	
	(2) Seawall	m	420	170	2,368	2,538	
	(3) Reclamation/Surface Dressing	m2	153,000	-	143	143	
	(4) Road/Yard	m2	150,000	-	675	675	
	(5) Tracks of Transfer Crane	m	2,900	-	203	203	
	(6) Demolition	m2	13,200	-	66	66	
	Sub-Total			170	3,934	4,104	
2. Land/Container Yard at Mina Qaboos	(1) Demolition of Sheds	m2	22,100	-	35	35	
	(2) Road	m	1,100	-	48	48	
	(3) Tracks of Transfer Crane	m	4,820	-	34	34	
	Sub-Total			-	117	117	
3. Dredging/Dumping	(1) -8m/-4m Area	m3	383,300	697	118	815	
	(2) -13m Area	m3	803,500	1,462	249	1,711	
	Sub-Total		1,181,800	2,159	367	2,526	
4. Quay	(1) Berths No.1 and 2	m	970	14	151	165	
	(2) Berth No.12(A)(B)	m2	6,400	725	1,217	1,942	
	Sub-Total			739	1,368	2,107	
5. Buildings	(1) Office/C.F.S. etc.	m2	15,600	76	1,016	1,092	
	Sub-Total			76	1,016	1,092	
6. Cargo Handling Equipment	(1) Transfer Crane/Container Crane etc.	No	56	8,380	-	8,380	
	Sub-Total			8,380	-	8,380	
7. Miscellanies	(1) Access Road behind Shutaify Bay	m	940	-	9	9	
	(2) Mobilization	L.S.	3	600	-	600	
	Sub-Total			600	9	609	
8. Total				12,124	6,811	18,935	
9. Indirect Cost		L.S.	1	6,018	567	6,585	
10. Grand Total				18,142	7,378	25,520	

Chapter 7 FORMULATION OF THE MASTER PLAN OF THE NEW PORT

7.1 Planning Premises

7.1.1 Cargo Volume in the Future

The forecast future cargo volume in the new port is 1.08 Million tons in 2000 and 4.42 Million tons in 2015.

In addition to the above cargoes, the volume of petrochemical products is as follows:

1) Ammonia ; 57,000tons(Export)
2) Urea ;174,000tons(Export)
3) Methanol ;500,000tons(Export)
4) MTBE ;100,000tons(Export)
5) SMDS ;500,000tons(Export)

The volume of unloaded fishes will be 8,600 tons in 2000 and 16,000 tons in 2015.

7.1.2 Vessel Size and Berth Dimensions

Sizes and berth dimensions of the various vessels used for the plan are as follows:

(1) General Cargo Vessels

Overall Length of Vessels : 175m
Breadth : 24.4m
Full Load Draft : 11.7m
Berth : Length : 220m ; Depth : -13.0m

(2) Container Vessels

Overall Length : 290m
Breadth : 32.2m
Full Load Draft : 12.7m
Berth : Length : 320m ; Depth : -14.0m

(3) Other Special Vessels

a. Bulk Grain Carriers

Maximum Vessel Size : 50,000DWT
(L, B, Dr) = (208.0m, 32.2m, 11.2m)
Berth : Length = 220m, Depth = -13.0m

b. Ro-Ro Vessels

Maximum Vessel Size : 30,000DWT
(L, B, Dr) = (200m, 32.2m, 10.0m)

Berth : Length = 220m; Depth = -11.0m

c. Livestock Carriers

Maximum Livestock Carriers : 34,000 GRT

Length : 195.0m

Full-load Draft : 10.7m

Berth : Length = 220m; Depth : -12.0m

d. Petrochemical Product Carriers

Vessel Size

i) Ammonia ; 5,000GRT Chemical Tankers
(L, B, Dr) = (123.0m, 8.3m, 7.8m)

ii) Urea ; 25,000DWT General Cargo Vessels
(L, B, Dr) = (174m, 24.4m, 10.9m)

iii) Methanol, MTBE and SMDS ; 50,000DWT Product Tankers
(L, B, Dr) = (170.7m, 32.2m, 11.3m)

Required Berth Dimensions :

i) Ammonia Tankers : Length : 135m; Depth: -8.6m

ii) Urea : Length : 200m; Depth : -12.0m

iii) Products Tankers : Length : 200m, Depth : -12.5m

e. Fishery Boats and Vessels

Vessel Size:

	(L, B, Dr)
1-2GT Boats	: (7.0m, 2.0m, 0.7m)
30GT Dhows	: (20.0m, 4.2m, 2.3m)
Trawling Vessels	: (30.0m, 8.0m, 4.0m)

Required Berth Dimensions :

In 2000	Depth	Unloading	Preparation	Sub-total	Laying	Total
1-2GT Boats	:-1.5m	24.5m	16.5m	41.0m	102.0m	143.0m
30GT Dhows	:-3.0m	23.0m	23.0m	46.0m	50.4m	96.4m
Trawling Vessels	:-5.5m	34.5m	34.5m	69.0m	84.0m	153.0m
Total	:	82.0m	74.0m	156.0m	236.4m	392.4m
In 2015						
30GT Dhows	:-3.0m	23.0m	23.0m	46.0m	82.0m	128.0m
Trawling Vessels	:-5.5m	92.0m	92.0m	184.0m	168.0m	352.0m
Total		115.0m	115.0m	230.0m	250.0m	480.0m

7.2 Required Scale of Port Facilities

7.2.1 Container Berths

The required number of container berth is as follows:

	Number of Berths
In 2015	3
In 2000	1.5

7.2.2 General Cargo Berth

The required number of general cargo berth is as follows:

	Number of Berths
In 2015	4
In 2000	2

7.2.3 Bulk Grain Berths

In 2015, Mina Qaboos will not be able to handle the total forecast amount of bulk grains. So we plan one berth for bulk grain carriers in 2015.

7.2.4 Petrochemical Berths

If this project is adopted by the government of Oman, one liquid petrochemical berth will be necessary. The location of this berth will be at the main breakwater. The berth for chemical tankers carrying ammonia will be at the existing jetty.

7.2.5 Other Berths

The required berth length for the fishery port is described in 7.1.2. We did not plan berths exclusively used for the Royal Fleet. But it is possible to berth His Majesty's Vessels at the general cargo berths, considering the projected berth occupancy rates for 2000 and 2015.

A bunkering berth should be constructed at the breakwater.

The selected development plans are shown in Figs.7-2-1 and 7-2-2.

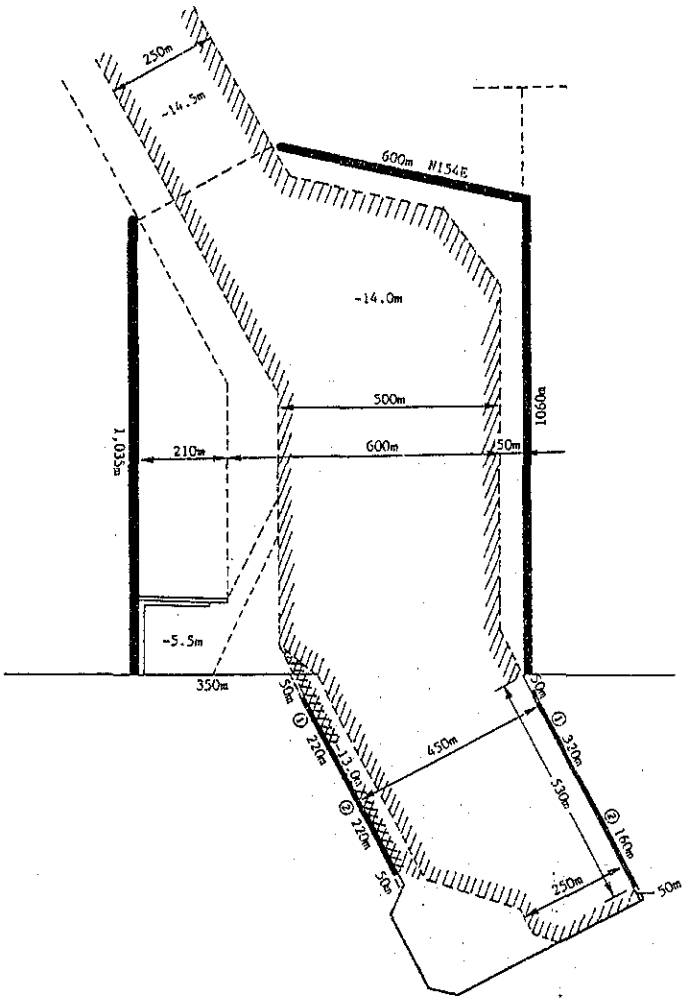


Fig. 7-2-1 Selected Plan in 2000

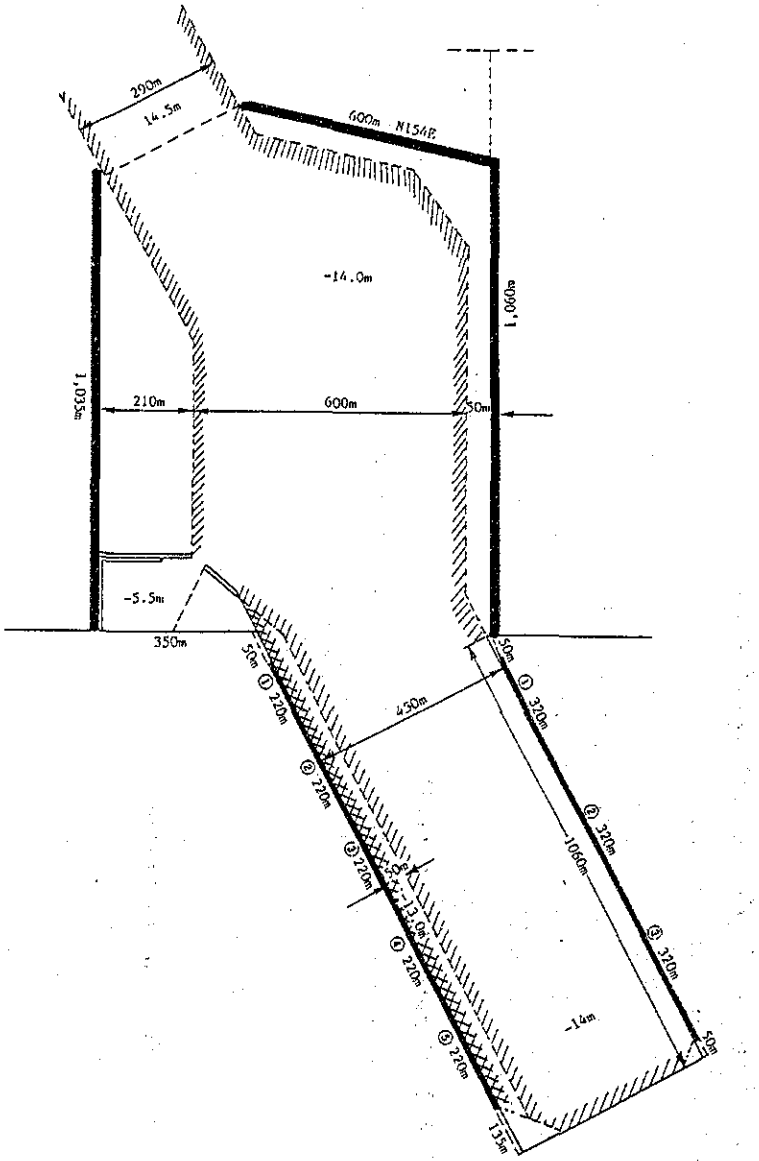


Fig. 7-2-2 Selected Plan in 2015

7.3 Required Scale of the Cargo Handling Equipment

7.3.1 Required Numbers of Handling Equipment

A list of the cargo handling equipment required for the new port is listed below in Table 7-3-1.

Table 7-3-1 Cargo Handling Equipment

DISCRIPTION	2000	2015
Container Cranes	3	3
Transfer Cranes	8	7
Tractor-Trailers	27	20
Trailers	20	-
Mobil Cranes	2	2
Fork Lifts	30	10
Truck Scales	1	1
Tug Boats	2	1

7.4 Required Scale of Storage Facilities

7.4.1 Estimation of Area Required for General Cargo

The required areas and available areas at respective sites are summarized in Tables 7-4-1 and 7-4-2.

Table 7-4-1 Required Area and Available Area (Open Area)

Unit: m^2

	2000	2015
Required Area	17,414	73,656
Available Area		
No.1 Berth	47,000	47,000
No.2 Berth	22,000	22,000
No.3 Berth		22,000
No.4 Berth		15,000
No.5 Berth		47,000
Sum	69,000	153,000
Balance	51,586	79,344

Table 7-4-2 Required Area and Available Area (Covered)

Unit: m^2

	2000	2015
Required Area	3,740	9,258
Available Area		
No.2 Berth	4,550	4,550
No.3 Berth		4,550
Sum	4,550	9,100
Balance	810	-158

The expected layout of the general cargo berth in 2015 is as follows:

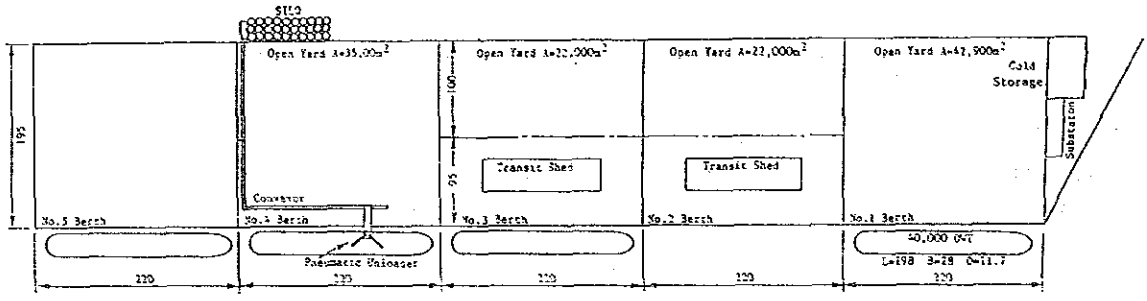


Fig. 7-4-1 Layout of General Cargo Berth

7.4.2 Estimation of Area Required for Container Cargo

The number of ground spots required for each container mode is estimated in the tables below:

Table 7-4-3 The Number of Ground Spots (Based on the Year 2000)

summary	storage cap.(TEUs)	required slot 2000	balance 2000	additional g.spots
import(r)	9097	3949	5148	122
import	33496	18648	14848	202
export(l)	14632	2793	11839	92
export(e)	33628	16665	16963	396
transship	70314	30150	40164	308
sum	161168	72205		1122

Table 7-4-4 The Number of Ground Spots (Based on the Year 2015)

summary	storage cap.(TEUs)	required slot 2015	balance 2015	additional g.spot
import(r)	22742	17937	4805	114
import	83741	70011	13730	187
export(l)	43896	9852	34044	265
export(e)	67770	61785	5985	140
transship	159370	135854	23525	181
sum	377529	295439		887

The container berth configuration shown in Figs.7-4-2 and 7-4-3 was planned.

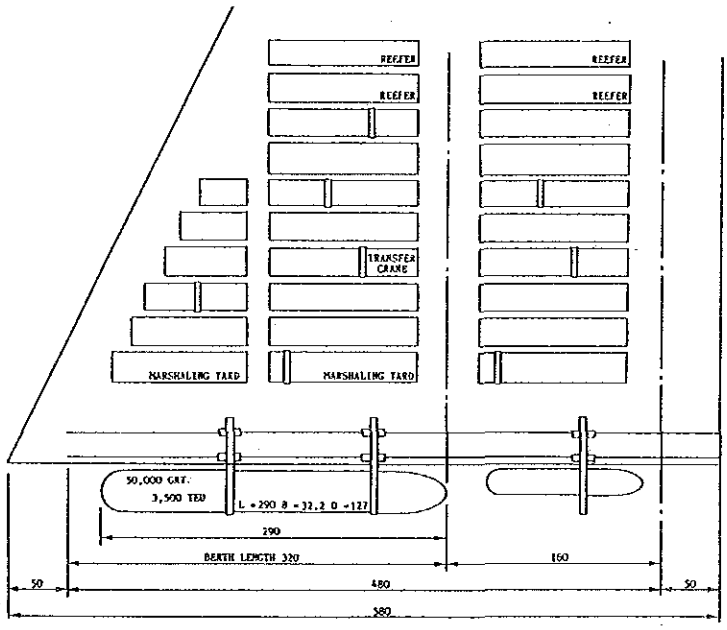


Fig. 7-4-2 Container Berth Layout in the Year 2000

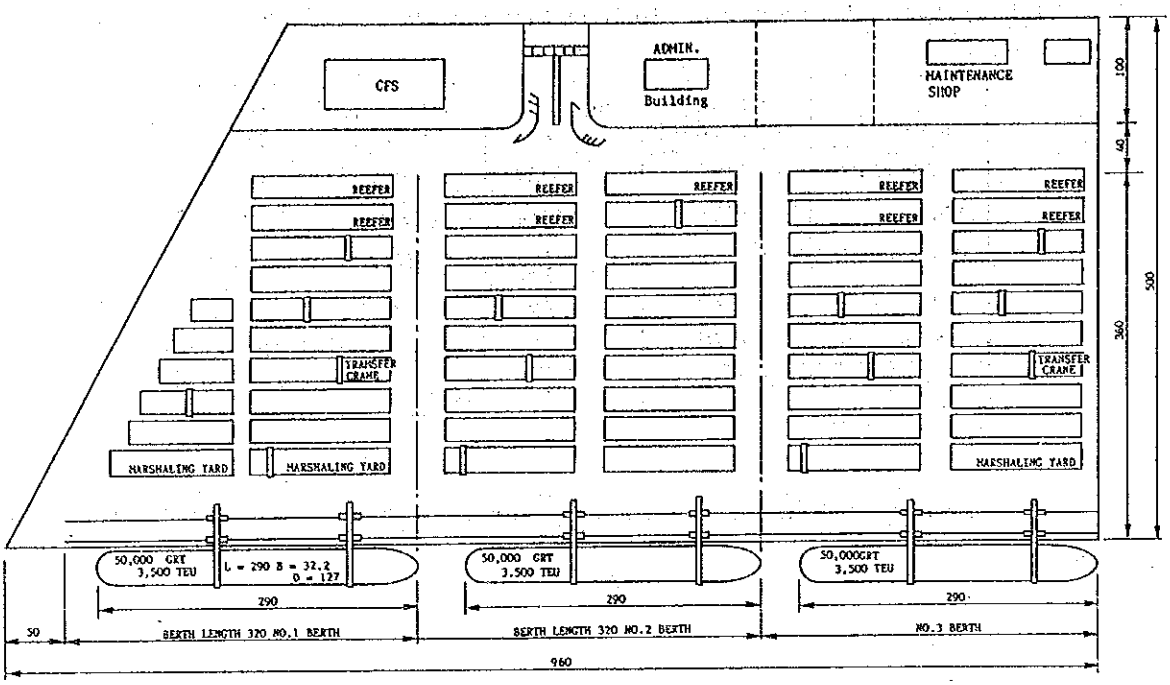


Fig. 7-4-3 Final Layout of Container Berth in the Year 2015

7.4.3 Other Facilities

(1) C.F.S.

The area required for the C.F.S. is 5,170m^2. The dimension of the C.F.S. is 50m in width and 110m of frontage.

(2) Container berth administration building

This building will have three stories and be 800m^2 in area, 20m width and 40m length.

(3) Maintenance shop

The required shop area will be 1,700m^2 (1200m^2 for maintenance, plus 500m^2 for damaged containers) with a width of 25m and a length of 70m. A further 3,000m^2 or so of open working and storage area will be needed for damaged containers, handling equipment etc.

7.5 Other Facilities

7.5.1 Electric Transfomer Substation

Two electric transformer substation will be needed at the new port facility.

7.5.2 Cold Storage

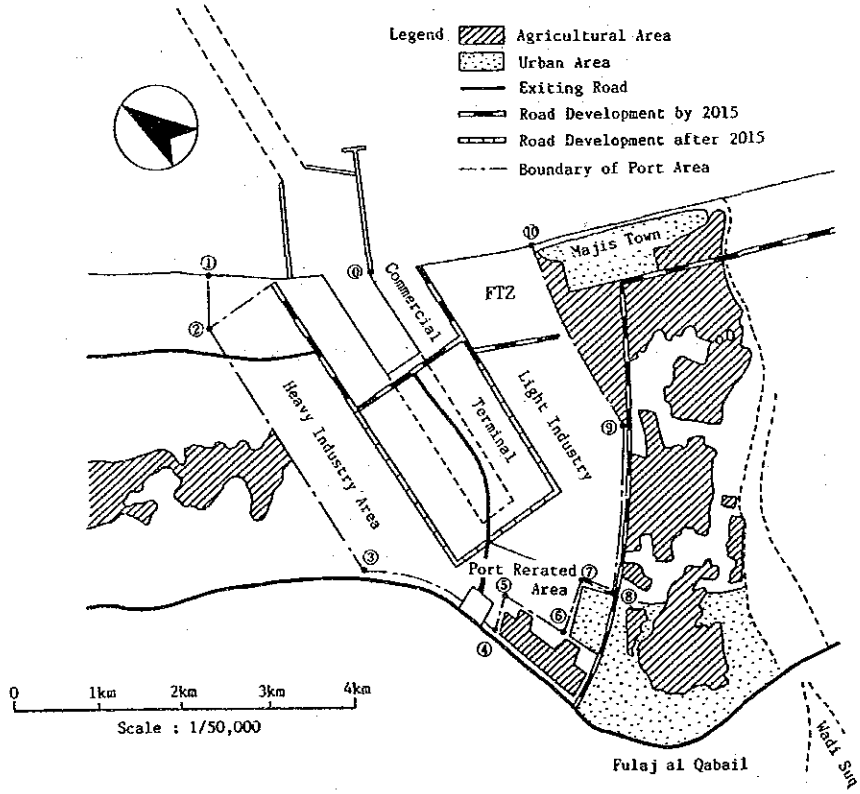
A cold storage facility will be required at the general cargo berth near the fishery port and No.1 berth in the new port. The area of cold storage will be 1,860m^2 (40m x 50m).

7.5.3 Grain Silos

Grain silos with a capacity of 60,000 tons will be built behind No.4 General Cargo berth.

7.6 Proposed Land Use Plan

In the Master Plan for 2015, two main roads, of which one will be behind the container berths and another behind the general cargo berths, should be connected to the existing road. The entrance to the port should be located at the crossing of the existing trunk road and the existing branch road. The proposed land use plan is illustrated in Fig. 7-6-1.



Point Coordinate

Point	East	North
⓪	56°38'02"	24°28'41"
①	56°37'25"	24°29'31"
②	56°37'06"	24°29'20"
③	56°36'18"	24°27'40"
④	56°36'24"	24°26'49"
⑤	56°36'39"	24°26'53"
⑥	56°36'39"	24°26'28"
⑦	56°37'01"	24°26'33"
⑧	56°37'03"	24°26'21"
⑨	56°38'27"	24°26'52"
⑩	56°38'45"	24°27'56"

Fig. 7-6-1 Land Utilization Plan

Chapter 8 PRELIMINARY DESIGN AND COST ESTIMATE FOR THE NEW PORT

8.1 Preliminary Design

(1) Breakwaters

Breakwaters with a total length of 3,045m. (Fig. 8-1-2)

(2) Berths

The container berth and the general cargo berth are designed to accommodate 50,000 DWT ships, 40,000 DWT ship respectively. (Fig. 8-1-3) Berths with -5.5m depth will accommodate small sized ships such as fishing boats.

(3) Other Facilities

1) Revetment

2) Pavement and Transfer Crane Tracks

3) Slipway

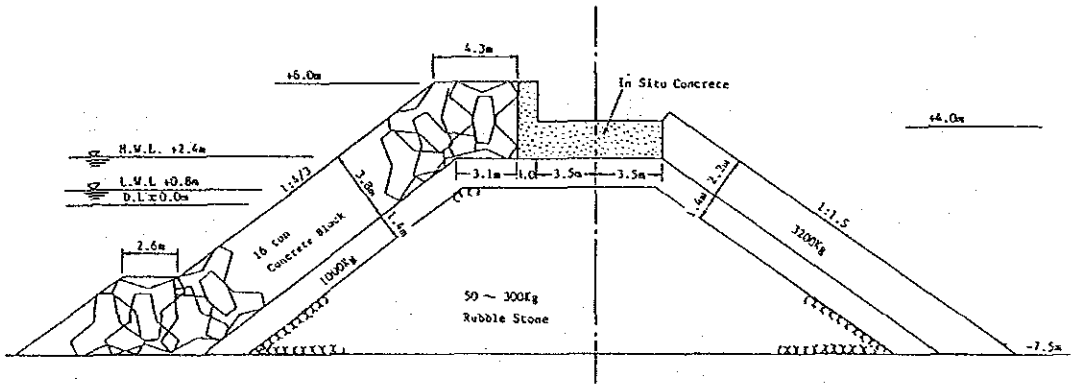


Fig. 8-1-2 Standard Cross Section of the Breakwater (1)

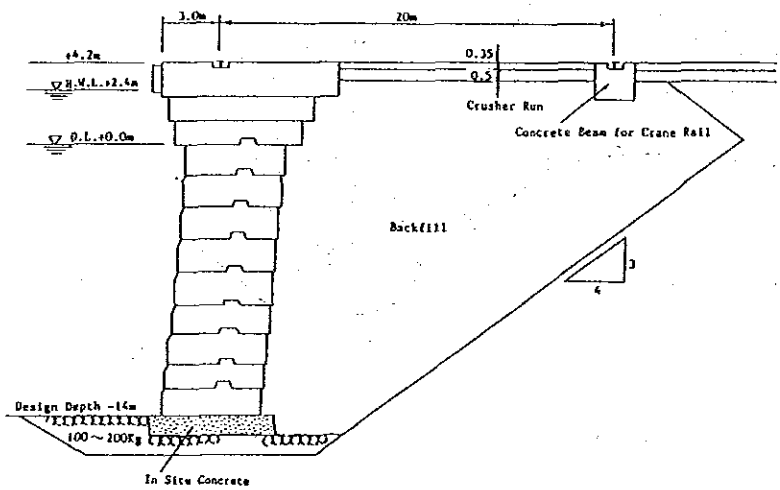


Fig. 8-1-3 Proposed Cross Section of the Bank (-14m)

8.2 Implementation of Port Construction

8.2.1 General

The construction quantities for each facility in this project up to the beginning of the year 2,000 are shown in Table 8-2-1 and Fig. 8-2-1.

To complete the project within four years, the implementation of construction and the supply of construction equipment and materials should be carefully planned.

After completion of the detailed design in 1994/1995, the construction of the port facilities is to start in 1996 and be completed by the end of 1999.

Table 8-2-1 Construction Quantities

Description	Unit	Quantities
Dredging / Land Excavation		
Channel	m^3	1,586,000
Basin (A)	m^3	6,434,000
(B)	m^3	3,842,000
Land Excavation	m^3	596,000
Quay		
-14m	m	580
-13m	m	540
-5.5m (A)	m	340
-5.5m (B)	m	156
Breakwater		
East	m	600
South	m	1,060
West	m	1,035
East Inner	m	200
Yard Pavement		
Container Yard	m^2	148,000
Open Yard	m^2	100,000
Road	m	3,500
Buildings	m^2	12,950
Cargo Handling Equipment and Tug-Boat	NO	61

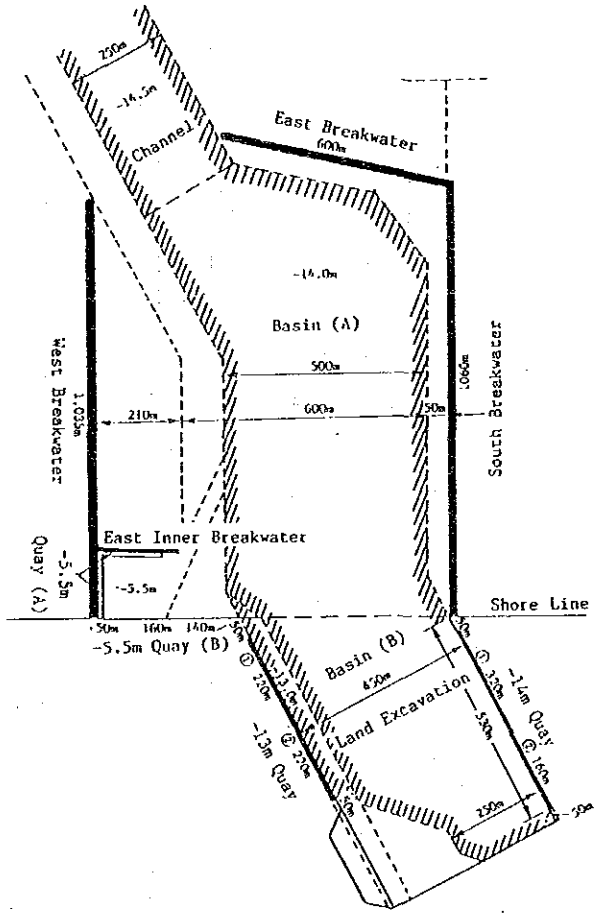


Fig. 8-2-1 Port Facilities

8.2.2 Construction Schedule and Cost Estimation

The construction schedule and the cost estimation of the project based upon the foreging the preliminary design and construction method are shown in Table 8-2-2.

Table 8-2-2 Construction Schedule and Cost Eslimation

No.	Item	Unit	Q'ty	Amount (1,000 R.O.)			Construction Schedule			
				Foreign Portion	Local Portion	Total	1996	1997	1998	1999
1.	Dredging									
	(1) Channel	m3	1,586,000	1,412	380	1,792				
	(2) Basin	m3	10,276,000	9,146	2,465	11,611				
	(3) Land Excavation	m3	596,000	-	596	596				
	Sub-Total			10,588	3,441	13,999				
2.	Quay									
	(1) - 14m Quay	m	580	341	4,579	4,920				
	(2) - 13m Quay	m	540	337	4,063	4,400				
	Sub-total			678	8,642	9,320				
3.	Breakwater									
	(1) East Breakwater	m	600	-	3,920	3,920				
	(2) South Breakwater	m	1,060	-	3,091	3,091				
	(3) West Breakwater	m	1,035	13	2,984	2,997				
	Sub-total			13	9,995	10,008				
4.	Small Craft Harbour									
	(1) East Inner Breakwater	m	200	12	221	233				
	(2) - 5.5 m Quay (A)	m	340	177	711	888				
	(3) - 5.5 m Quay (B)	m	156	2	331	333				
	Sub-Total			191	1,263	1,454				
5.	Yard Pavement									
	(1) Container Yard	m2	148,000	-	1,480	1,480				
	(2) Open Yard	m2	100,000	-	450	450				
	(3) Tracks for Transfer Crane	m	4,000	-	56	56				
	Sub-Total			-	1,986	1,986				
6.	Road	m	3,500	-	301	301				
7.	Buildings and Facilities									
	(1) Office/ C.F.S. etc	m2	12,950	63	1,102	1,165				
	(2) Other Facilities	L.S	1	450	-	450				
	Sub-Total			513	1,102	1,615				
8.	Cargo Handling Equipment	L.S	1	12,581	6	12,587				
9.	Others									
	(1) Navigation Aids	L.S	1	32	-	32				
	(2) Slipway, etc	L.S	1	-	50	50				
	Sub-Total			32	50	82				
10.	Total			24,566	26,786	51,352				
11.	Indirect Cost	L.S	1	11,657	5,328	16,985				
12.	Grand Total			36,223	32,114	68,337				

Chapter 9 ECONOMIC ANALYSIS

9.1 Purpose and Methodology

The purpose of the economic analysis is to appraise the economic feasibility of the Short-term Development Plan for the New Port from the viewpoint of the national economy. For this purpose, the economic internal rate of return (EIRR) based upon cost-benefit analysis is used in order to appraise the feasibility of the project. In estimating the costs and benefits of the project, "economic pricing" should be conducted because the values of goods quoted at a market price do not always represent the true value of those goods from the viewpoint of the national economy. The market prices are changed to economic prices by various conversion factors.

9.2 Prerequisites

A cost-benefit analysis is conducted on the difference between the "With" and "Without" investment cases. In this Study, the following conditions are adopted as the "Without" case after various possibilities are discussed:

1) No investment is made for the new port.
2) The development plan of Mina Qaboos that is proposed in our Study is implemented.
3) The distribution of ships and the working efficiency of cargo handling is the same as that assumed in the above plan.

Since the waiting time set for the Mina Qaboos Development Plan is considered to be the limit for container ships, the container cargo volume handled at Mina Qaboos under the "Without" case is the same as that under the "With" case. All the other cargo except containers is assumed to be handled at Mina Qaboos under the "Without" case.

9.3 Benefits

The following items are identified as the benefits of the Short-term Development Plan for the New Port:

1) Savings in the waiting costs of vessels.
2) Savings in time costs.
3) Savings in land transportation costs.
4) Foreign currency earnings in handling container cargoes.
5) Promotion of regional development in Sohar as well as national

development in Oman.

6) Increase in employment opportunities/incomes.

7) Multiplier effect from the investment of the new port.

Of the above, items 1) to 4) are considered as tangible benefits in terms of the cost-benefit analysis in this Study.

9.4 Costs

The items that should be considered as costs of the project are: construction costs, personnel costs, operating/maintenance costs, administration costs and renewal investment costs.

9.5 Evaluation

The EIRR is a discount ratio which makes the costs and benefits of a project during the project lift equal. It is calculated by using the following formula:

$$\sum_{i=1}^{n} \frac{Bi-Ci}{(1+r)^{i-1}} = 0$$

n : Period of economic calculation

Bi: Benefit in i-th year

Ci: Cost in i-th year

r : Discount rate

The EIRR of the Short-term Development of the New Port is calculated as 5.02%. It is generally considered that an EIRR of more than 10% is economically feasible for infrastructure or social service projects. Compared with this, the EIRR of 5.02% is not high enough to convince us that this project is feasible from the viewpoint of the national economy.

However, it should be noted that this analysis takes into consideration only four benefit items, as mentioned above. Adjacent to the new port, there are many proposed projects, such as a free trade zone, an industrial estate, industries based upon natural gas resources and so forth. At the present time, no concrete plans have been made yet and there is no way at all of knowing the scale, output, earnings/costs or profits of these projects. Although it is very difficult to quantify how these kinds of projects could benefit from a port development project in terms of a

costbenefit analysis, the EIRR will become considerably higher when added value or net gain of these projects is calculated as the benefit of the new port project.

Chapter 10 FINANCIAL ANALYSIS

10.1 Purpose of the the Financial Analysis

The purpose of the financial analysis is to appraise the financial feasibility of the short-term development plan for the new port.

10.2 Methodology

Financial Analysis is carried out using the following two (2) methods:

i. The financial soundness of the PMB is appraised using the projected financial statements including the sensitivity analysis.

ii. The viability of the project itself is analyzed using the financial internal rate of return by means of the discounted cash flow method including the sensitivity analysis.

10.3 Presuppositions and Appraisal of the Project

i. Project life is the same term as used in the Economic Analysis

ii. Port Management Body manages on a self-sustaining basis according to the Business Accounting System.

iii. Fund Management is carried out as follows:

- The amount of cash on hand is assumed to be 3% of operating expenses. The rest is assumed to be in banks with a 7.5% interest rate.
- The annual deficit will be covered by short-term loans with an 11.5% interest rate.

iv. The amount of government funds for this project is 57,245 thousand Rial Omani, that is 83.8% of the total cost for the project.

The other portion will be raised as following conditions:

Loan Period	: 20 years
Grace Period	: 5 years
Interest Rate	: 4.4% per annum
Repayment	: Fixed Amount Repayment of principal

v. The revenue is calculated using the existing tariff rate of Mina Qaboos.

iv. The expenditures of the project is consist of personnel costs,

repair/maintenance/operation costs, administration costs, depreciation expense and interest on loan.

10.4 Financial Soundness of the PMB

The calculated results of financial statement analysis is as follows:

(a) Balance in Finance

Amount unit:1000 Rail Omani

Case	Year(Deficit)/Year(Surplus)	Retained Earinings in 2029
Base Case	2007/2008	163,908
Case I	2009/2010	131,899
Case II	2010/2011	128,599
Case III	2011/2012	90,994
Case IV	2005/2006	205,315

(b) Operating Efficiency in 2005

Case	Working Ratio	Operating Ratio
Base Case	55.76%	75.38%
Case I	55.76%	75.38%
Case II	60.13%	81.72%
Case III	60.62%	71.01%
Case IV	51.38%	71.01%

Note: Case I : Higher interest rate of 8%
Case II : Cost increases by 10%
Case III : Revenue decreases by 10%
Case IV : Decrease of personnel cost by 105

10.5 Viability of the Project Itself

The viability of the project is analyzed using the financial internal rate of return by means of the discount cash flow method.

The results of the viability analysis as follows:

Case	FIRR	Lower Limit
Base Case	4.62%	
		0.71%
Case A	3.14%	
		(1.30%)
Case B	2.85%	

Note : ( )=Lower Limit in case of 8% anual interest rate
Cost A : Cost increases by 10%
Cost B : Revenue decreases by 10%

10.6 Conclusion

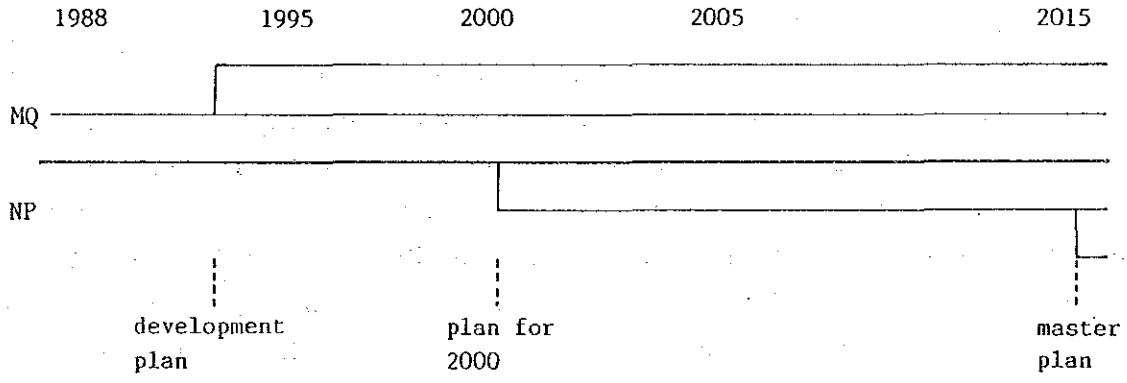
Judging from the above analysis, this project could be feasible on condition that the 80% of the total fund is raised from the government.

Chapter 11 PORT DEVELOPMENT STRATEGY-A CONCLUSION

1. Development and management of ports are largely dependent upon the behaviour of the national economy. Since there is much reason to believe that the growth of the economy will continue, the cargo volume handled in the country will likely increase.

It is widely recognized that Mina Qaboos cannot properly adapt itself to the present increasing cargo demand and the technological progress of relevant industries. Our study, taking into consideration and making appraisal of the preceeding studies, proposed a comprehensive scheme for port development in the northern part of Oman.

The time series of the scheme is shown in following figure.



Notes: MQ-Mina Qaboos; NP-New Port;
Width of the bars does not indicate cargo handling capacity.

Fig.12-1 Action Plan of Port Development

2. At this stage, the two-tier development in the above figure is considered to be the best, however, the timing of the new port's construction should be carefully re-exzmined in the future, taking into account the budgetary conditions of the time, and the following points:

(1) To assure that the new port is operating smoothly, a concerted development with related schemes such as a petrochemical industry, an industrial estate and desalination plants, as well as development plans of infrastructures, e.g. roads, eletricity and water supply, drainage, sewage disposal, schools and housings is required.

(2) The forecast of handled cargo demand should be reviewed since an authorized forecast of relevant economic indices is not entirely known.

3. Schemes regarding management and operation are more important since clients are attracted by a well-run operation. The following are main issued:

(1) Institutional Matters

The management body of the new port may be a corporation, a large portion of the capital of which will be owned by the government but independent from the existing PSC. The reason is that a large part of investment should be borne by the government and the PSC cannot bear the huge deficit envisaged at its initial stage, although the body will be self-sustaining in the long term. It is considered a wise tentative course of action that the body for the new port follows the example of Mina Qaboos with a view to learning its port management. The organizational structure may be like that of the PSC, since the area of the work is similar.

(2) Recruitment and Training

For proper operation of a port, personnel and manning are most important factors. For the new port, an enormous task has to be done before port inauguration as well as during its first few years of operation. Difficulty is envisaged in recruiting a sufficient number of experts for higher-ranking officials of the PMB, it may be advisable to hire foreign experts with much experience of port management, with a view to assist in the smooth operation of the port and also to transfer port management expertise in the inauguration period.

(3) Port Sales

A growing trend exists whereby major ports in nations with free market economies are eager to attract their customers using various techniques for port sales. However, it should be emphasized that publicity can only do a little on its own. Reputation accompanied by substance is more effective. From the customers' viewpoint the best substance is a sure and speedy cargo movement.

(4) Means of Coordination

The new port and Mina Qaboos will be competitors in terms of getting cargo, but at the same time they should cooperate and coordinate their activities in many fields. It may be advisable to establish a national port council under the Ministry of Communications consisting of executives of the PSC (Mina Qaboos) and of port managing body of the new port with a small secretariat. Meetings should be convened regularly with a view to exchange information and to draft a port policy.

Another facet of coordination relates to various projects of the region. To ensure concerted action as far as possible, some means of linking all the relevant bodies should be developed. Relevant bodies include municipalities, regional branches of central organizations dealing with housing, education, energy, customs, quarantine and immigration, the industrial estate authority, the governing body of the free-trade zone and the petro-chemical factory.

4. Launching a new port is a very ambitious project, and naturally it involves a large volume of work. As the above paragraph suggests, there are still question to be solved. Another study, which may be named as the study for preparation for the new port at Sohar, will be useful in finding solutions to some of the questions including fixing exact timing. Detailed plans for ancillary services and plans for recruitment and training may well be a part of the study. Taking into account the time schedule for the new port construction, the study should be concluded by 1997.