3.3.4 Radar Facilities

(1) General

1) Present Status of Vessel Traffic in Suez Bay

For an establishment and design of Harbor Control Radar System, it is important to make analysis and study the exact vessel traffic data in the local area and the maritime transportation scenario and so on, indicated in the Suez coastal area development program. This includes examination of relevant statistical data of vessel movement in the inner Suez Bay territories, to assess necessity of Harbor Control Radar System for assisting the practicable vessel movement near the ports; namely, Ataqa new commercial, Adabiya and Ibrahim Ports.

In this concern, all necessary statistical data and relevant information should be confirmed through Red Sea Port Authority (RSPA) and Suez Canal Authority (SCA) to make analysis the present traffic conditions and future trends.

This study will address an establishment concept of necessary Harbor Control Radar System required for the ports, where allocated within the inner Suez Bay coastal area, to lead efficient monitoring and operating for the vessels approaching into the ports, and also to maintain safety and security of the marine transportation activities including vessel traffic management in the port operation tasks.

2) Vessel Traffic Density

- Vessels Movement at Port in the Suez Bay Area

The vessels calling or leaving to/from the ports area along the western inner Suez Bay named port of Adabiya and Ibrahim, and private ports are confirmed by the vessel traffic data on 1992 provided by RSPA. From this data, it is possible to estimate minimum number of vessel traffic volume and categories of vessels.

The summarized number of vessels calling or leaving to/from vicinity of port area is as follows:

Table3.3-4-1 Vessel Moving in the Port Area (1992)

Type of Vessel	Yearly Data		Averaged Monthly Data		Averaged Daily Data	
	Number	GWT(ton)	Number	GWT(ton)	Number	GWT(ton)
						per vessel
Grain	27	689,448	2.25	57,500	1/13 days	25,500
Tanker	330	2,197,299	27.5	183,100	9/10 days	6,700
General Cargo	531	2,627,440	44.25	219,000	3/2 days	5,000
Passenger	354	1,643,864	29.5	137,000	1/1 day	4,500
Total	1,242	7,158,051	103.5	596,600	7/2 days	5,800
						per vessel

The number of vessels mentioned above is not partitioned into territories of respective ports, however when the Harbor Control Radar System is established that all of these vessels are satisfactorily monitored by a radar surveillance system set up at Ataqa New Commercial Port.

The number of vessels on daily basis reflects a significant figures for the radar tracking capability to be required in the radar surveillance system. More over, Gross Weight Ton (GWT) of per vessel also determines a radar tracking characteristics, while considering the scale of ship cross section depending on the GWT.

- Vessel Traffic in Eastern Channel related to the ports in Suez Bay area

Relating to the marine transport activities in the Suez Bay coastal area, following numbers and types of vessel are calling or leaving to/from the ports namely Adabiya, Ibrahim and private ports along the coastal line.

Table 3.3-4-2 Vessel Traffic in Eastern Channel (1991/July-1992/June)

Type of Vessel	Yearly Data		Averaged Monthly Data	Averaged Daily Data
	Loaded	Unloaded	Loaded & Unloaded	Loaded & Unloaded
Tanker	173	114	23.9	3/4 days
Dry Bulk Cargo	218	21	19.9	
Mixed Cargo	19	6	2.0	1/14 days
General Cargo	295	28	26.9	8/9 days
Container	289	3	24.3	4/5 days
Tractor Cargo	39	8	3.9	1/8 days
Car Carrier	65	11	6.3	1/5 days
Military Ship	13	-	1.1	1/28 days
Others	74	14	7.3	1/4 days
Total	1,185	205	115.8	3.9 per day

This data shows the same vessel traffic situation in the port area described on Table 3.3-4-1 of Vessel Moving in the Port Area and it is supposed that data mentioned above may indicate a ship moving condition before enter or leave to/from the port in the Suez Bay.

3) Vessel Traffic in Suez Canal

The vessel navigation in Suez Canal and Suez side area including anchorage position and traffic channel into the canal is managed by Suez Canal Authority and those vessel navigational conditions is shown as below.

The vessel traffic volume in Suez Canal from January 01, 1992 to December 14, 1992 is as follows:

Table 3.3-4-3 Vessel Traffic in Suez Canal

Type of Vessel	Number of Today		Cumulated This Month		Cumulated Yearly	
	L.	B.	L.	B.	L.	B.
Tanker	8	4	78	38	1,791	1,065
Container	13	0	141	0	3,194	35
General Cargo	6	3	136	20	3,110	383
Others	12	5	197	42	5,445	804
Total:	39	12	552	100	13,540	2,287
	(51)		(652)		(15,827)	

L: Loaded
B: Ballasted
Source: SCA

From the data mentioned above, the averaged daily and monthly vessel traffic volume will be re-calculated for estimating the vessel navigation volume sailing on the traffic channel at Suez side. The estimated vessel volume re-calculated is as follows:

- Number of Daily Vessels : 48 vessels
- Cumulative Monthly Vessels : 1,440 vessels
- Cumulative Yearly Vessels : 17,280 vessels

4) Maritime Communication

The maritime communications to vessels in the Suez Bay are carried out by both of Red Sea Port Authority (RSPA) and Suez Canal Authority (SCA) for the port operation and the canal operation and for ship traffic management within the national sea territory.

The communications mentioned above are employed with the VHF band frequencies to be assigned in the International Maritime Mobile Service and UHF band frequencies. At present, the following frequencies are utilized by RSPA and SCA.

Table 3.3-4-4 International Maritime Mobile Service Frequency in VHF Band

RSPA		SCA	
Channel 6.	156.300 MHz	Channel 11.	156.550 MHz
Channel 8.	156.400 MHz	Channel 14.	156.700 MHz
Channel 10.	156.500 MHz	Channel 16.	156.800 MHz
Channel 12.	156.600 MHz	Channel 74.	157.725 MHz
Channel 16.	156.800 MHz		

Table 3.3-4-5 International Maritime Mobile Service Frequency in UHF Band

RSPA	SCA	
	Transmitting	Receiving
	415.6 MHz	413.1 MHz (DUP)
	415.85 MHz	415.35 MHz (DUP)
	416.6 MHz	414.1 MHz (DUP)
- No employing -	416.35 MHz	413.85 MHz (DUP)
	416.125 MHz	413.6 MHz (DUP)
	414.75 MHz	414.75 MHz (SIMP)
	414.775 MHz	414.775 MHz (SIMP)
	414.8 MHz	414.8 MHz (SIMP)

For designing the maritime communication system to be established in this project, it should be considered to avoid radio interference between new equipment system and existing one. Therefore, the actual maritime communication frequency for the VHF radio equipment in the project will be assigned with the same frequency employed by RSPA.

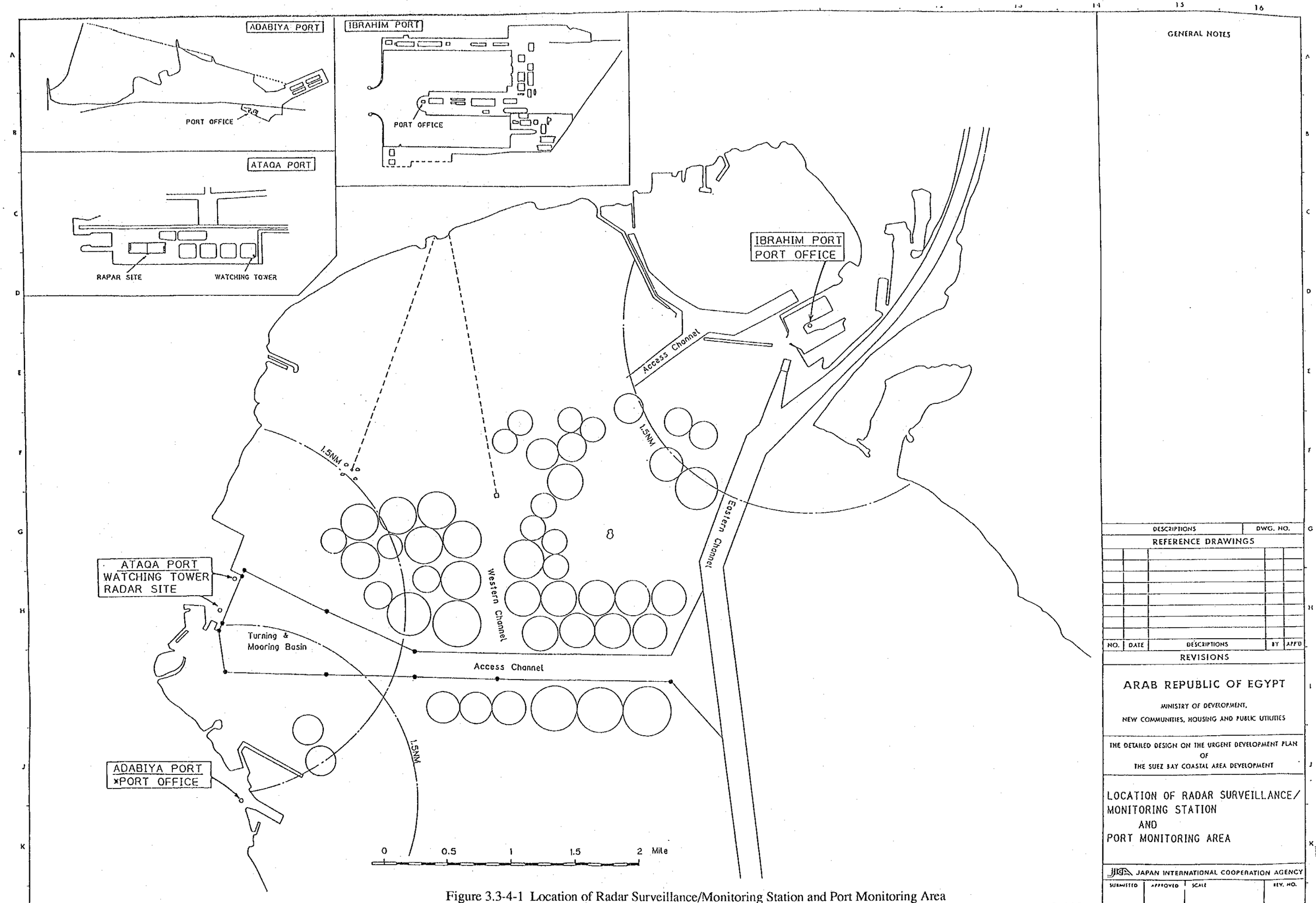


Figure 3.3-4-1 Location of Radar Surveillance/Monitoring Station and Port Monitoring Area

GENERAL NOTES

DESCRIPTIONS	DWG. NO.
REFERENCE DRAWINGS	

NO.	DATE	DESCRIPTIONS	BY	APP'D
REVISIONS				

ARAB REPUBLIC OF EGYPT

MINISTRY OF DEVELOPMENT,
NEW COMMUNITIES, HOUSING AND PUBLIC UTILITIES

THE DETAILED DESIGN ON THE URGENT DEVELOPMENT PLAN
OF
THE SUEZ BAY COASTAL AREA DEVELOPMENT

LOCATION OF RADAR SURVEILLANCE/
MONITORING STATION
AND
PORT MONITORING AREA

JICA JAPAN INTERNATIONAL COOPERATION AGENCY

SUBMITTED	APPROVED	SCALE	REV. NO.
DATE		DWG. NO.	3-10-1

DG - 1

(2) Outline of System

1) General

The need for the harbor control radar system is a requirement to realize the maximum vessel moving service in the port area, and to assist the safety navigation of vessels within the port water limit, and to improve environmental sea pollution increasing by vessel transportation activities.

The implementation of the Suez Bay Coastal Area Development Project will increase the basic requirement for coordination of all maritime transportation activities, being emphasized by guideline to optimize port facilities utilization.

Similarly, the harbor control and management is evolving to meet the present and future demands, but new facilities are required to allow the several plans such as improving the efficiency and safety of vessel traffic, organizing the vessel movement and protecting the accident and environment.

A comprehensive harbor control radar system is a major tool to achieve those requirement.

Depending on the port situation and those phenomena in the Suez coastal area, the following system and service will be provided in the harbor control radar system.

- Radar Surveillance/Monitoring System for vessel traffic monitoring and assistance to navigation.
- VHF Maritime Communication Equipment System for corresponding with the vessels.
- Meteorological Observation Equipment to assist the vessel movement and pilotage operation.
- Ship Schedule Indicating Equipment for organizing the vessel movement.

2) Radar Surveillance/Monitoring System

a) General

For the safety and efficient vessel management, and exact monitoring of ship's position and movement in the port water-limit, it will be necessary to establish and to equip adequate network of radar surveillance system for collecting vessel movement data to be sent them to port office in each ports on time to time.

In order to monitor the vessel movement in the port water areas belonging to the Ataqa, Adabiya and Ibrahim Ports, one of radar surveillance station, one of monitor station and one of port station will be constructed in this project stage. The radar surveillance station will analyze those vessel movement that is sent to monitor station for controlling the ships moving activities.

b) Location of Radar Station

The area for monitoring by a radar surveillance station is of three areas, namely Ibrahim, Ataqa and Adabiya Port area along the western coast line in the bay and each port possess a port water-area of radius 1.5 NM from the port office respectively and the distance between ports is as follow:

- Ataqa to Ibrahim : 5.0 NM
- Ataqa to Adabiya : 1.6 NM
- Ibrahim to Adabiya : 6.0 NM

For satisfying radar surveillance functions, the station will be placed at Ataqa new port site, because, it is understood that the station site is required to have a fine outlook along the sea side so as to cover all area mentioned above, including port approaching channels.

For determinating the radar station site, the following should be considered.

- Height of radar antenna
- Topographical pattern

a. Consideration of height of radar antenna

The height of radar antenna is mainly determined by the condition of electrical line of site and the situation of artificial structures dispersed near the antenna site.

Confirmation of electrical line of site

Line of site considering the terrestrial radius of curvature is determined by the following equation;

$$R = 2.23\left(\sqrt{h1} + \sqrt{h2}\right)$$

where;

R: Distance of line of site in nautical miles (NM) where any obstructional structure or materials are not existent between h1 site and h2 site.

h1: Height of radar antenna position in meter (m), where measured from the sea level.

h2: Height of effective ships height in meter (m), where value of h2 is affected by ship's gross tonnage (GWT).

As a reference, the height of radar antenna for covering the range of 8 sea-miles is shown as follow:

Table 3.3-4-6 Height of Radar Antenna

Distance R (NM)	Vessel Height (m)	Antenna Height (m)
8	0	13
8	2	5
8	5	1.2

Confirmation of artificial structure

The Ataqa new port has two main berths, named bulk terminal and grain terminal, and there are many large silo tanks (34m height) and a silo operating building (66m height) at the grain terminal.

On the other hand, these terminal will be moored with maximum three vessels which have a size of 20,000 DWT or 80,000 DWT so as to load/unload the cargos and the height of those ships is estimated about 30m from the sea level.

b. Analysis of topographical pattern

The topographical pattern is a very important factor to determine the location of radar station for avoiding the shadow caused by the hills/mountain and artificial structure including large vessels situated within the prospective radar monitoring area.

In the radar monitoring area to be covered by the radar station at Ataqa Port, many large vessels are anchored for passing through Suez Canal and this will cause a shadow for watching the target behind those vessels.

For the estimation of shadow size caused by the vessels in the radar coverage, following data is applied for determining the height of radar antenna.

Table 3.3-4-7 Vessel GWT vs. Vessel Size

GWT (ton)	Height (m)	Length (m)
7	< 2	10
40	3.5	20
100	5	30
300	7	45
600	9	60
1,000	11	70
5,000	21	100
10,000	27.5	150
20,000	35	150 more
80,000	= 35	150 more

c. Conclusion

As shown in preceding section, the vessel size at cargo terminal in Ataqa new port and ships in anchorage area in the bay will limit the characteristics of line of site to the Ibrahim Port water area and to Ataqa port water limit by size of vessels berthed at terminals.

Therefore, radar antenna must be installed on the position of more than 35m height for the long distance watching, and more over for the short distance watching, it is required to consider the site condition for radar antenna installation.

When radar antenna installed on the top of silo operation building at Ataqa Port, the electrical shadow by vessels berthed at terminal is of 110m from the wharf. Therefore, radar antenna will be installed on the top of silo operation building.

3) VHF Maritime Communication Equipment System

a) General

It is very important to correspond and to confirm ship's information as early as possible concerning the estimated time of arrival to the port and other relevant navigational informations such port of destination, etc. in order to identify and monitor the vessels navigation within the port water-area, and to make supporting works for the port operation.

The VHF radio facilities will be set up at Ataqa port radar station, Adabiya port monitor station and Ibrahim port station respectively. The corresponding terminal such a speaker and a microphone of the VHF radio equipment should be equipped on the radar or monitor display console to ensure the quick correspondence between radar operator and the vessels.

b) Communication Area of VHF Radio

It is considered that necessary and sufficient number of maritime VHF communication channels for this system will be more than four channels, one channel for continuous watch-keeping on VHF CH 16 and other three channels for working operation on International VHF Maritime Service frequencies. Also these three channels will be independently assigned to Ataqa, Adabiya and Ibrahim Port.

These maritime VHF communication channels will cover the area in Suez Bay including the radar surveillance/monitoring area.

4) Meteorological Observation Equipment

a) General

For assisting the accurate operation and safety administration with navigational support to the vessels, it will be important to observe the atmospheric air conditions including the temperature, wind speed and direction.

The observed data of each of these atmospheric conditions are recorded on the intermittent recorder and analogue recorder, and broadcasts the data to vessels through the maritime VHF communication system.

5) Voice Recording Equipment

a) General

In order to support safety administration and control of vessels, it will be necessary to record the correspondence between port operator and vessels and will provide detailed informations to the port authorities for evaluating the corresponding data. The voice communication of each of port and vessels on the VHF band will be recorded on the voice recorder together with time signals.

b) Required Equipment

A eight channels type voice recorder will be installed in the port watching room at Ataqa Port and will continuously record the voice of calling and distress watching frequency by CH 16 and any voice in working frequencies operated by RSPA on 24-hour basis.

6) Ship Schedule Indicating Equipment

a) General

This is an equipment system to provide the schedule and the assisting data to the port operator and the vessels for maintaining the safety movement of vessels in the respective port water-area to be managed by RSPA. The data for this system will be gathered from the shipping agencies and port operating authorities concerned, and those data including the vessel informations will be compared and confirmed with the vessel data tracked by radar surveillance system and maritime VHF communication equipment for the ships traffic control and traffic assistance.

b) Schedule Service Activity

The service activity will be limited to a certain number of vessels within the port water area, where is possible the searching of vessels by the radar surveillance system.

The vessels arrived into the radar surveillance area will be identified by comparing with data registered in the schedule indicating equipment, and based on these identified schedule of the vessel movement in the port water area will be controlled and managed in safely and economically.

c) Required Equipment

a. Work Station Terminals

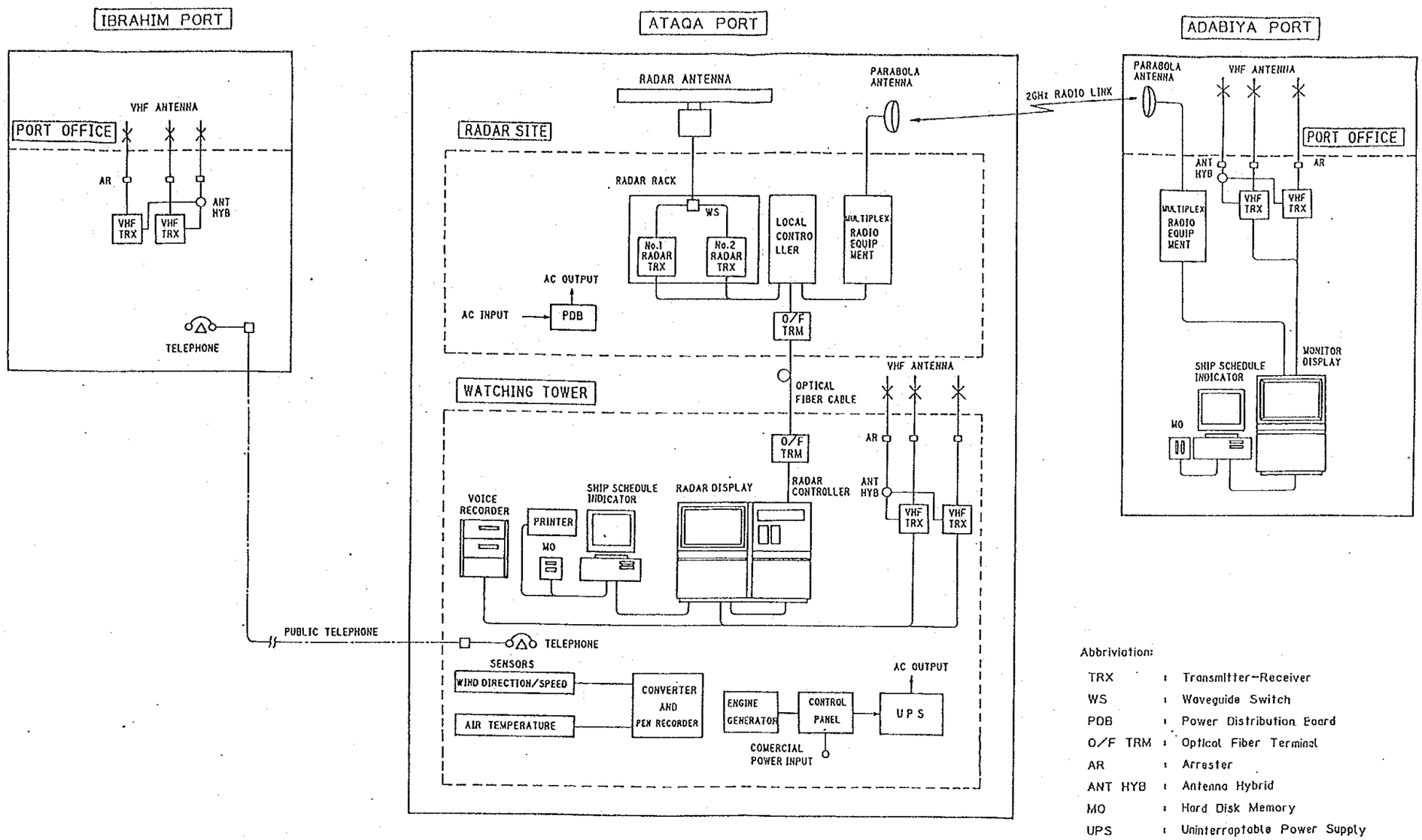
Each one set of work station terminal will be installed in the port watching room at Ataqa Port and in the port office at Adabiya Port except Ibrahim Port and will process the vessel data to indicate ship movement schedule, ship data, berth utilization schedule and anchorage schedule on the display screen.

b. Memory Unit

The memory unit is a supplementary equipment for the work station terminal and will utilize as a data base for the ship schedule indication equipment system.

c. Printer

For producing the statistical data to be handled by ship schedule indication equipment, this printer will be used and these data will be applied for supporting the safety and effective management of the port.



Abbriviation:

TRX	:	Transmitter-Receiver
WS	:	Waveguide Switch
PDB	:	Power Distribution Board
O/F TRM	:	Optical Fiber Terminal
AR	:	Arrester
ANT HYB	:	Antenna Hybrid
MO	:	Hard Disk Memory
UPS	:	Uninterruptable Power Supply

GENERAL NOTES

DESCRIPTIONS	DWG. NO.
REFERENCE DRAWINGS	

NO.	DATE	DESCRIPTIONS	BY	APP'D

REVISIONS

ARAB REPUBLIC OF EGYPT

MINISTRY OF DEVELOPMENT, NEW COMMUNITIES, HOUSING AND PUBLIC UTILITIES

THE DETAILED DESIGN ON THE URGENT DEVELOPMENT PLAN OF THE SUEZ BAY COASTAL AREA DEVELOPMENT

BLOCK DIAGRAM FOR HARBOR CONTROL RADAR SYSTEM

JICA JAPAN INTERNATIONAL COOPERATION AGENCY

SUBMITTED	APPROVED	SCALE	REV. NO.
DATE		DWG. NO. 3-10-2	

Figure 3.3-4-2 Block Diagram for Harbor Control Radar System

(3) System Design

1) System Description

This system consists of Radar Surveillance/Monitoring system and VHF Maritime Communication Equipment System. These two systems have a relationship of mutual aid and will provide data and information to manage the vessel movement in port water-area by collecting accurate vessel position data on the sea.

On the other hand, vessel movements at Ataqa, Adabiya and Ibrahim Ports to be included in coastal area development project will make uneasy and difficult conditions in the port area for the movement of vessels and produces many sea pollution in the port water-area along the coast line. Therefore, harbor control radar system will be constructed there to manage the vessel movement and to prevent the pollutions.

Vessel position data, tracking data and ship data incoming to Ataqa Port will be handled at Ataqa radar surveillance station and some of those data is sent to Adabiya port office, but Ibrahim Port will receives only information, and these data will be used for port control in western coastal area at Suez Bay.

Radar Surveillance Station (shall be constructed at Ataqa Port, herewith called Radar Surveillance Station) will detect and supervise all function mentioned above. All functions and detailed explanations is shown on the Figure 3.3-4-1. The summary of the function of each system are explained in hereinafter.

2) Ataqa Port Radar Surveillance Station System

i) General

a. The system is composed with a radar site system at silo operation building and a port watching site system at port watching tower and both sites are connected with a optical fiber cable link for transmitting the radar signal and for remote controlling the radar equipment from port watching site.

b. The radar signal transmitted from radar will be input and processed by the video data processor of the radar display console, and in the processor, the vector of speed and direction of tracked vessels and the additional information such character and symbols will be added on the tracked radar signals.

c. The above vessel data with additional information are displayed on color CRT display screen incorporated in the console, and also display screen indicates the radar image and graphical map overview to be assigned for the radar surveillance system.

d. In addition to the mentioned above, processed radar tracking data is transferred to radar monitoring station at Adabiya port office through 2GHz band radar relay link.

e. The maritime correspondence to be handled by VHF radio between this station and vessels are automatically recorded on a voice recorder and those informations are tabulated by processor of the ship schedule indicator for scheduling the ship movement and for recording on the printer.

f. This radar surveillance system has a tracking capability of 100 moving targets and 50 fixed targets.

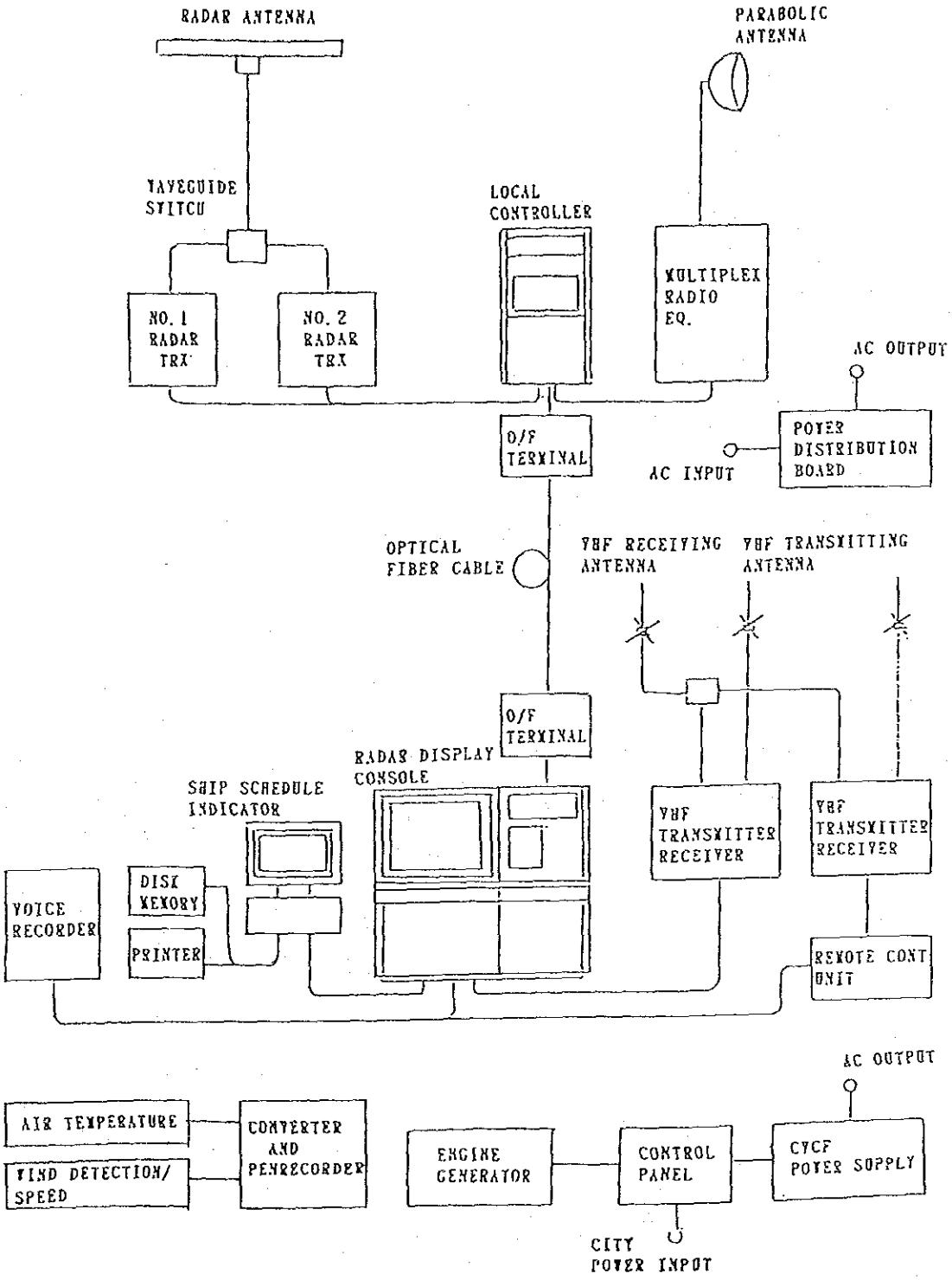


Figure 3.3-4-3 Block Diagram of Ataqa Port Radar Surveillance System

ii) Equipment Configuration

Ataqa port radar surveillance system consists of following equipment:

- Radar site equipment

a. X-band radar antenna (with a pedestal)
b. X-band radar transmitter-receiver (main-standby type)
c. Local control equipment (with maintenance display)
d. 2GHz band parabolic antenna
e. 2GHz multiplex radio equipment (with PCM terminal)
f. Power distribution board

- Port watching tower equipment

a. Radar display console (with radar controller)
b. VHF radio equipment (total two sets)
c. VHF antenna equipment (with arrester and total three sets)
d. Antenna hybrid
e. Vessel schedule indicator (with CRT display)
f. Memory unit (hard disk and cartridge MT)
g. Printer
h. Voice recorder
i. Meteorological observation equipment (sensor and recorder)
j. Interruptable power supply equipment
k. Diesel engine generator

iii) Function of Radar Surveillance Station

Radar surveillance station shall be established at Ataqa new commercial port and processes following functions. Block diagram is given in previous page.

a) Vessel surveillance

Radar surveillance performs the tracking and monitoring of the vessels and analyses tracked data. The main functions of radar surveillance station are as follows:

a. Automatic tracking of vessels and buoys to support and to monitor the vessel movement in the port water limit (max. 100 moving and 50 fixed targets)
b. Automatic data allotment on tracked target to identify those targets (symbol, number and vector/speed and course)
c. Collision calculation and indication to warn operator
d. Indication of raw and processed signal detected by the system to ensure tracked data
e. Superimposing the guard ring and line to avoid accidental ship movement and to warn operator
f. Control, change-over the radar-surveillance area (0.75, 1.5, 3.6 and 8 nautical miles)
g. Programming the figure and map to illustrate the situation of surveillance area
h. Control, change-over the radar-equipment of radar site.
i. Off center control to select the monitoring area within the radar coverage

b) VHF maritime communication

Radar surveillance station performs port communication and management for the vessels within the port water limit through VHF radio equipment. The main functions of this VHF radio equipment are as follows:

a. Monitor the calling and distress calls from the vessels
b. Receive the ship reports to enter into the port
c. Communicate with the pilot embarked on vessels to coordinate entering or leaving to/from the port
d. Record the VHF communications between operator and vessels

c) Display on radar display console

Following conditions of radar equipment and monitor situations are shown on the radar display console for monitoring.

a. Tracking situation of port water area on CRT display
b. Alarming status of tracking condition of target
c. Status of display mode (north-up, head-up and off-center)
d. Coverage range status of display screen
e. Operating status of radar transmitter-receiver
(working or reserve, failure)

d) CRT display

Data which is tracked and superimposed are shown on CRT display. This data will be used for anticipate and observe of vessel movement in the port water area.

Items shown on CRT display are as follows:

a. Raw and synthetic signal of vessels and buoys etc.
b. Analysis data of moving targets
c. Electric guard ring/line for protecting the prohibited areas
d. Alphabetical and numerical figures for identifying the tracked data
e. Illustrated synthetic map/figure of channel, port wharf, breakwater and land lines

The conceptual symbols are given in hereinafter;

e) Sending and receiving the data between Adabiya Monitoring Station and Radar Surveillance Station.

Following data are sent and received between Adabiya monitoring station and Ataqa radar surveillance station through 2GHz radio link.

a. From Ataqa Station to Adabiya Station
- Processed radar tracked data of Adabiya port water limit
(approx. 1.5 nautical miles from port office)
- Vessel schedule data to be treated by Ataqa Station

b. From Adabiya Station to Ataqa Station
- Vessel schedule data to be treated by Adabiya Station
- VHF maritime correspondence to record on voice recorder at Ataqa Port

f) Sending and receiving the data between Ibrahim Port Station and Radar Surveillance Station

Both station is connected through public telephone line. Therefore, the monitoring informations by radar and the vessel schedule to be handled by Ataqa Station are informed by operator through telephone line.

g) Meteorological observation

Meteorological observation equipments are established at Port Watching Tower and install following equipment.

a. Combined anemometer and wind-vane
b. Thermometer and pen recorder

h) Voice recording

Voice recorder is established in the watching room of Port Watching Tower and install following equipment.

a. Multi-channel type cassette tape recorder including a time code channel and re-play function.

b. The equipment provides function of 12.5 hours continuous recording including 30 minutes overlap time capability.

i) Ship schedule monitor

Ship schedule indicator is established in the watching room of Port Watching Tower and install following equipments with functions.

a. Work station to process data introduced by harbor control radar system and relevant authorities or agents for assisting the vessel movement schedule in the port water limit.

b. Memory unit to save data such ship, anchorage, berth, tugboat and pilot data as database.

c. Printer to record the schedule and data to be processed by work station on the tabulation.

Items of tabulation is as follows:

- Ship movement table
- Ship information table
- Anchorage schedule table
- Berth schedule table

iv) Equipment for Radar Surveillance Station

The equipments of radar surveillance station are participated into two groups such radar site equipments and port watching tower site equipments and each group consists of following equipment. The block diagram of the radar surveillance station's equipment is given in previous section.

Radar site equipment:

- Radar antenna with pedestal
- Waveguide switch
- Radar transmitter-receiver (main - standby)
- Radar controller with monitor display
- MODEM units
- Power distribution board (PDB)

Watching tower site equipment:

- Display console with radar controller
- MODEM units
- VHF radio equipment
- UPS power supply
- Diesel engine generator

In addition to mentioned above equipment, optical fiber cable is provided for connecting both site.

a) Radar antenna equipment

This is an antenna for transmitting-receiving the radar electric wave. It belongs to the slotted array type antenna and radiates horizontally polarized wave. The following principle performance is required for monitoring the planed sea area.

- Type	:	Slotted array type
- Length	:	9-feet (2743mm)
- Frequency	:	9GHz band
- Beamwidth	:	Horizontal 0.9°+10%
		Vertical 20°or less
- Gain	:	31 db more
- Scanning	:	22 RPM approx.

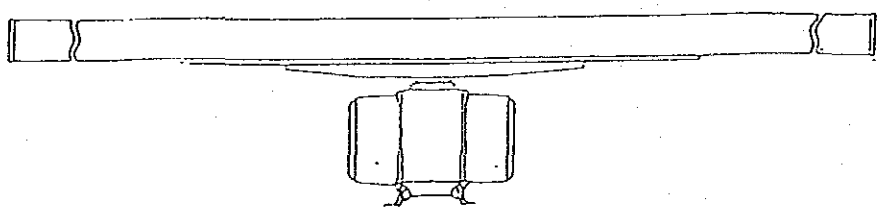


Figure 3.3-4-4 View of Radar Antenna

b) Radar transmitter-receiver

The equipment consists of a magnetron, transmitting-receiving microwave circuit and high-voltage power supply. The equipment is a pulse radar transmitter-receiver and it provides the detecting function of vessels and/or any target on the sea through the antenna.

The following principle performance is required to perform the stable search on the sea.

- Operating frequency	:	9GHz band, except 9.3 - 9.5GHz range	
- Transmitter output power	:	25kW less	
- Transmission pulse width	:	0.08us, 0.2us, 0.9us and 1.0us selectable	
- Pulse repetition frequency	:	750Hz, 1000Hz and 2000Hz selectable	
- Noise figure	:	6dB less	
- Duplexer	:	Circulator + TRHPL	
- Transmitter tube	:	Magnetron	
- IF amplifier	:	Center frequency	60MHz
		Bandwidth	20/3MHz
		Gain	90dB more

c) Radar control equipment

This control equipment has the functions controls and the indication at radar site.

The control items and indication items on control equipment are as follows:

a. Control item

- Control selection (Local - Remote)
- Radar TRX selection (Main - Standby)
- Radar TRX ON-OFF
- Alarm buzzer OFF

b. Indication item

- Radar TRX failure
- Fan failure
- Temperature high
- Modulation failure

The equipment incorporates a monitor display for the maintenance of radar at site.

d) Radar display console

This display console has the functions of control for radar monitoring display and remote operation, and status indication. The control items and indication items on console desk are as follows:

a. Control items of radar monitoring display

- North-up/Head-up selection
- Coordinate indication of any position
- Radar raw video ON-OFF
- Processed radar video ON-OFF
- Display screen hold
- Target data ON-OFF
- Bearing mark ON-OFF
- Radar monitor range selection and ON-OFF
- VRM, EBL and TB control and ON-OFF
- Speed/bearing vector indication select and ON-OFF
- Off-center control and ON-OFF
- Map indication ON-OFF

b. Remote control items of radar equipment

The control items are applied with same items mentioned on item c) in previous section.

In addition to mentioned above functions, this console is required to provide the following eliminating functions to avoid the interference caused by surrounding phenomena.

- Sea clutter suppression
- Rain clutter suppression
- Radar interference suppression
- Sweep averaging
- Scan to scan correlation
- Correlative detection

e) Optical fiber cable link

This is a data transmission circuit to connect radar site and watching tower site and it is composed with the optical transmitter/receiver and a multi-core type optical fiber cable. The following signals are conveyed between the sites.

a. From radar site to watching tower site
- One-channel of radar signal
- One-channel of radar equipment monitor signal
- Two-channels of voice signal (for Adabiya port)
- One-channel of data signal (for Adabiya port)

b. From watching tower site to radar site
- One-channel of processed radar signal (for Adabiya port)
- One-channel of radar equipment control
- One-Channel of data signal (for Adabiya port)
- One-channel of voice signal (for Adabiya port)

For this link, the following characteristics are applied.

- Wave length	: 0.85um
- Transmitter component	: A1GaSa-LED
- Receiver component	: Si-PIN-PD
- Cable	: Grated index type multi-core cable

f) VHF Communication equipment

a. VHF communication equipment consists of following components.

- VHF radio transmitter-receiver (156 - 174MHz)
- Antenna equipments (including antenna hybrid)
- Voice recorder

The radio equipment will be operated with simplex or duplex mode on the frequency of International Maritime Mobile Service indicated in the Radio Regulation.

b. The equipment has a simultaneous operation capabilities that the first channel to be assigned on Channel-16 will be used for the calling channel including the watching of distress call by vessels, and other channels are used for the correspondence between radar surveillance station and vessels. The equipment provides following operational functions.

- Remote exchanging of simplex and duplex operation mode
- Remote selection of operation frequency
- Recording of VHF correspondence

c. The following principle characteristics is required for the equipment.

VHF radio equipment

- Frequency range	: 156 - 174 MHz band
- Number of channel	: 8-channel max.
- Type of emission	: G3E
- RF output power	: 25W
- Operation mode	: Simplex and duplex available

VHF antenna

- Type of antenna	: Brown or dipole type
- Impedance	: 50 ohms
- VSWR	: 1.5 or less
- Gain	: 2.15 dBi or more
- Radiation	: Omni-direction

Antenna hybrid

- Type	: One input + two output
- Insertion loss	: 2.0 dB or less
- VSWR	: 1.2 or less
- Allowable RF power	: 25 watts or more

Voice recorder

- Number of channel	: 6-track/6 channels Voice/5 channels Time code/1 channel
- Head	: Recording and reproducing heads are provided
- Recording time	: 12.5 hours or more
- Overlap time	: 30 minutes or more
- Frequency response	: 300 - 3,000 Hz
- Voice monitor	: Level meter, monitor output

g) Meteorological observation equipment

a. The meteorological observation equipment consists of the following components:

- Combined anemometer and wind vane
- Thermometer
- Recorder for wind speed/direction and temperature

Block Diagram of Meteorological Observation Equipment

b. Weather condition recorder

This recorder consists of converter unit and pen-recorders for weather, sensor and provides following characteristics.

Recorder for temperature and wind speed/direction

- Type	: Null-balancing servo type, dot printing
- Chart speed	: 25 mm/hour
- Chart size	: 180 mm width x 20 m long
- Scale	: Wind direction/0 - 540
	Wind speed/0 - 60 m/s
	Temperature/0 - 100℃

h) Ship schedule indication equipment

a. The vessel schedule indication equipment consists of following components:

- Work station (with CRT display and keyboard)
- Memory
- Printer

The block diagram of the equipments is shown as below:

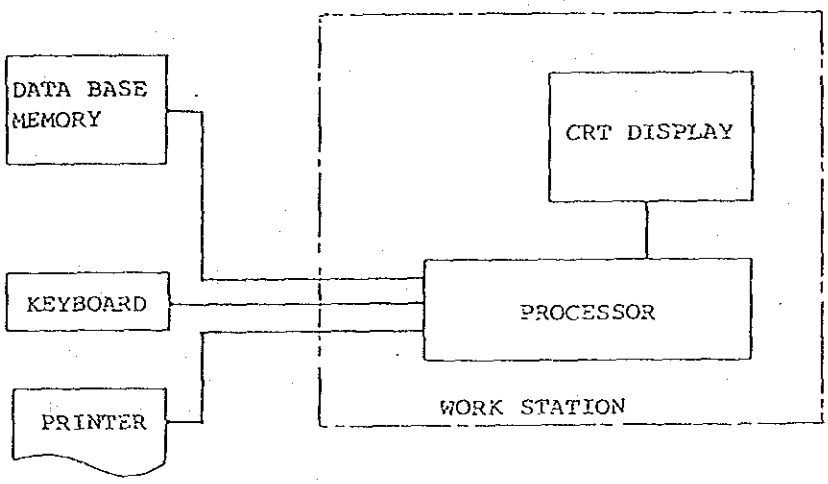


Figure 3.3-4-5 Block Diagram of Ship Schedule Indication Equipment

b. Work station

This is a data processing equipment to handle schedule and assistance work for the port operation tasks which is coordinated by port operator for maintaining safety and reliable vessel movement within the port territories.

The data for this equipment will be gathered from shipping agency and port operation authority concerned, and these data will be compared and confirmed with the vessel data observed by radar surveillance system for the control and assistance of the vessel movement in the port area.

The equipment process following items for the Ataqa, Adabiya

and Ibrahim ports;

- Ship movement schedule
- Anchorage schedule
- Berth schedule
- Ship information

The principle characteristics of work station are as follows:

Processor

Architecture	: RISC
CPU/FPU	: R3000A/R3010
Process Technology	: CMOS
Clock Speed	: 33 MHz
Address/Data Bus	: Multiple×32 bit
Cache Size	: 64 Kbyte (instruction)
	64 Kbyte (data)
Memory	: 24 Mbyte
General Register	: 32 bit×32
MIPS/Dhrystone	: 34 MIPS
FPU Performance (Linpack)	: 5.9 MFLOPS

Bus Speed	: 50 Mbyte/s (Internal) 50 Mbyte/s (SCSI-II)
Ethernet	: Thick Wire Ethernet (10 Mbit/s)
Floppy Disk	: 3.5" Type

CRT Monitor

CRT	: 19" Torinitron Color CRT
Display Resolution	: 1280×1024
V-sync Frequency	: 72 Hz
Display Color	: 256

Keyboard

Key	: 105 Sculptured Key 20 Function Key

c. Memory

This memory consists of 1.5G bytes board disk and a 95 M bytes cartridge MT memory and it is mounted in a small cabinet.

d. Printer

Record of printer is as follows:

- Ship movement schedule
- Anchorage schedule
- Berth schedule
- Ship information

The contents of format is shown as section (3)-i) in this clause.

3) Adabiya Port Monitoring Station System

i) General

a. The system is installed in the room of existing port administration building and the radar data and vessel information required for port control are received from Ataqa Station through 2GHz multiplex radio link.

b. The processed radar signal received from Ataqa Station is input into monitor display console and is indicated on color CRT display screen assembled on the console. And also the display area for monitoring is able to be selected by operator considering the port operating conditions within the range of 8-nautical miles.

c. The maritime communication on VHF band is available to correspond between this station and vessels for supporting the port operation.

d. he ship schedule indicator receives the data processed by Ataqa radar surveillance station and the data is able to retrieve according to the some information gathered by operator in Adabiya Port.

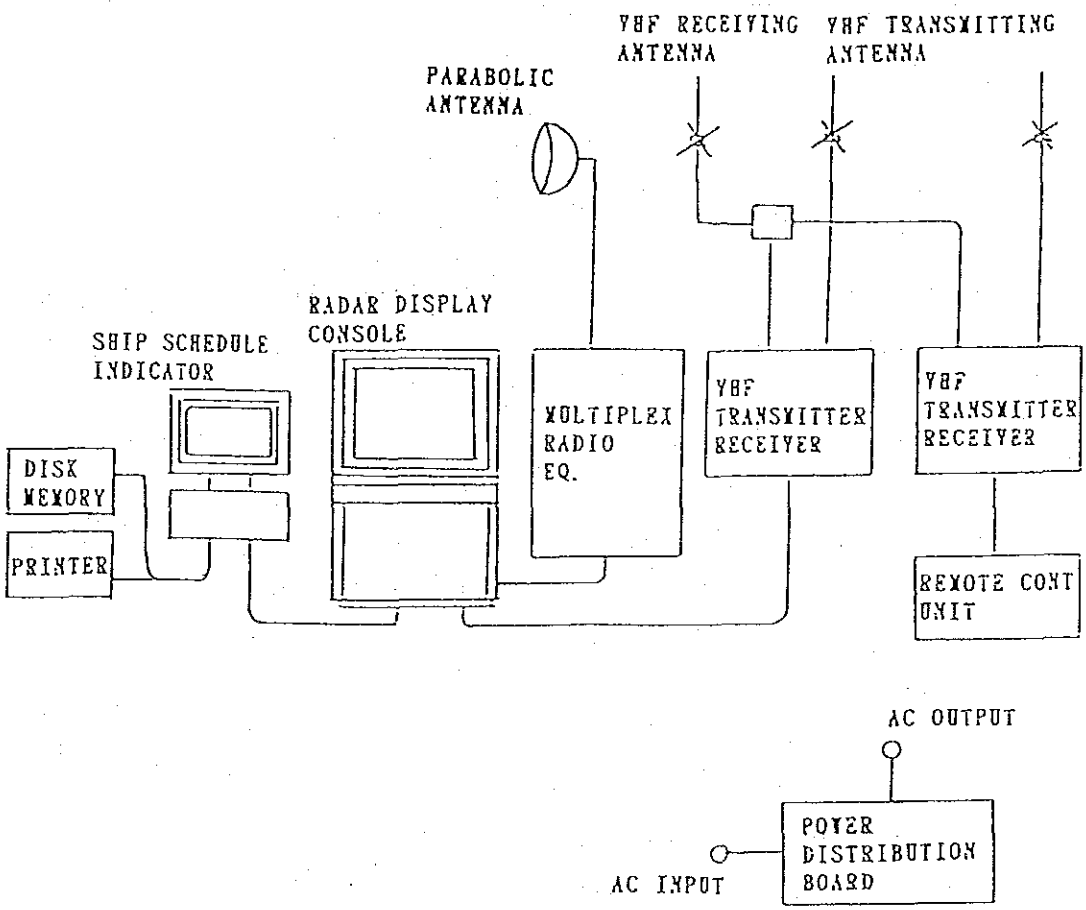


Figure 3.3-4-6 Block Diagram of Adabiya Port Monitoring Station System

ii) Equipment Configuration

Adabiya Port monitoring station system consists of following equipment:

a. Monitor display console
b. VHF radio equipment (total two sets)
c. VHF antenna equipment (with arrester and total three sets)
d. Antenna hybrid
e. Ship schedule indicator (with CRT display)
f. Memory unit (hard disk and cartridge MT)
g. Printer
h. 2GHz band parabolic antenna
i. 2GHz multiplex radio equipment (with PCM terminal)
j. Power distribution board

iii) Function of Monitor Station

Monitor station will be established at Adabiya Port and executes following functions. Block diagram is given in previous section.

a) Vessel monitoring

Monitor console displays the of synthetic vessel echo and the synthesized vessel data to be transferred from Ataqa radar surveillance station, and is able to illustrate some of figure and map on the display screen in this monitor. The main functions of monitor console are as follows:

a. Selection of monitoring area by off-centering function
b. Display of vessel data tracked by radar at Ataqa Port
c. Programming and superimposing the guard ring/line, figures and maps.

b) VHF maritime communication

This communication provides the same functions with Ataqa Port VHF maritime communication system as described in previous item 2)-(3)-b).

c) Ship schedule monitor

This ship schedule monitor provides the same functions as described in previous item 2)-3)-i) and a rearrangement of data considering exact situation of Adabiya Port can be proceeded.

iv) Equipment for Monitoring Station

Composition of equipment is described in the "Equipment Configuration" of item 3)-(2) in this section.

a) Monitor display console

This monitor display console provides the same operational functions as described in previous item 2)-(4)-d. except remote radar control functions.

b) VHF communication equipment

The equipment and operational functions are provided with the same system as described in previous item 2)-(4)-f) except voice recorder.

The block diagram of VHF communication equipment for Adabiya Station is shown as below:

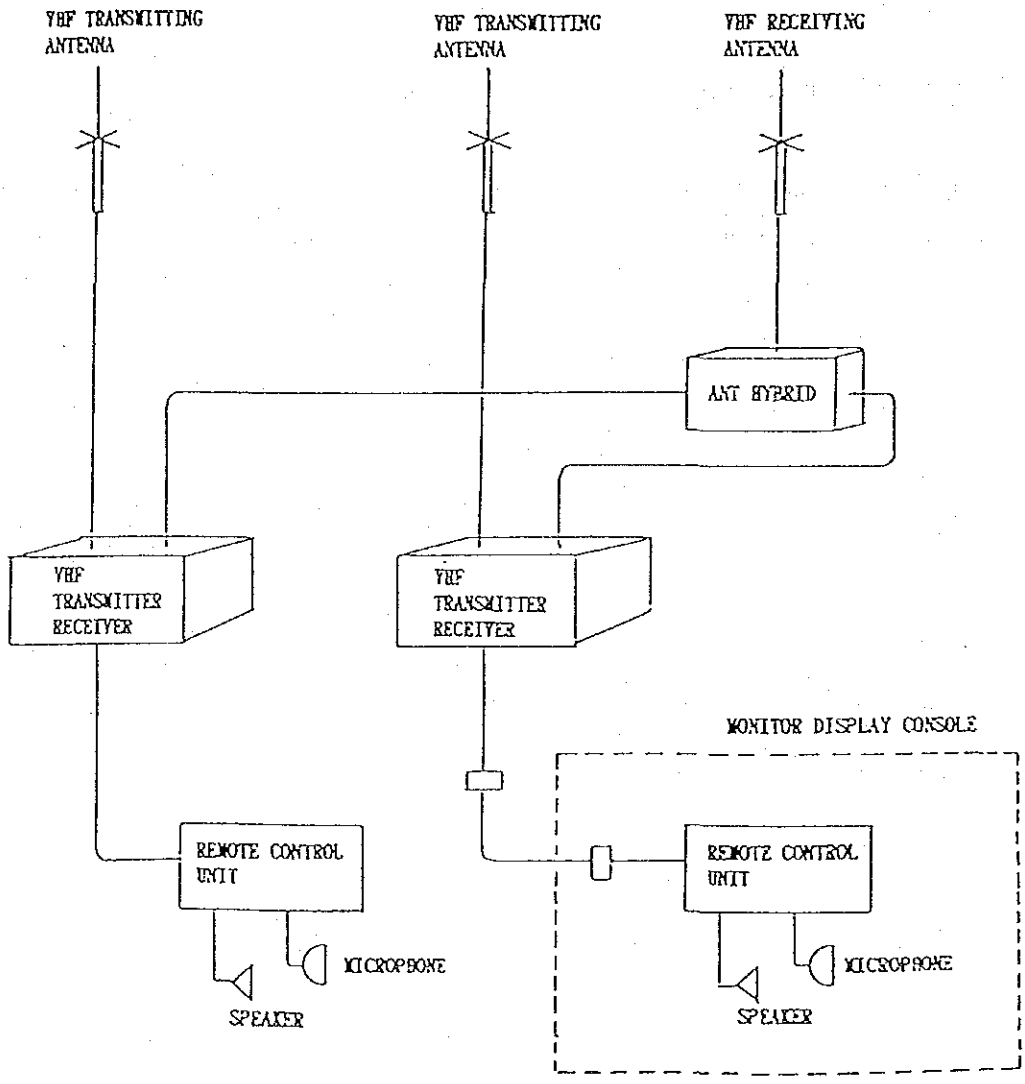


Figure 3.3-4-7 Block Diagram of VHF Communication Equipment

c) Ship schedule indication equipment

The equipment including its functions is provided with the same system as described in the previous section 2)-(4)-h) for Ataqa radar surveillance station, and also this system is able to operate independently for a rearrangement of vessel schedule data.

4) Ibrahim Port Station System

a. The system of Ibrahim Port Station is planned to be installed only with VHF maritime communication equipment.

b. The installation site of those equipments is at the office of port control tower of central mole in the Ibrahim port.

c. The equipment composition and its operational function are the same system as Ataqa Port VHF communication system except voice recorder system and remote control system.

d. The block diagram of the equipment is shown as below:

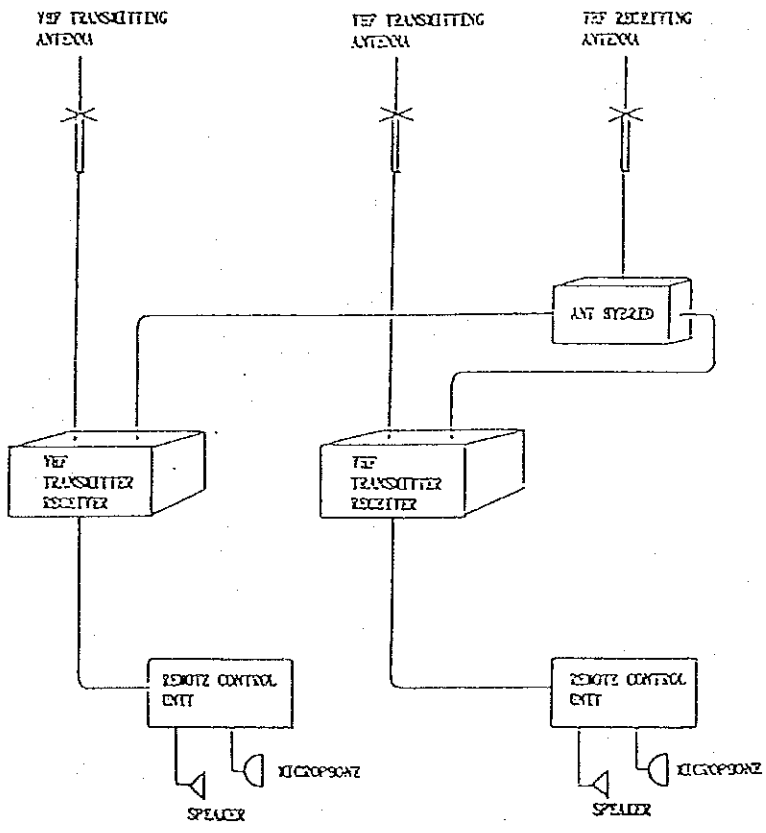


Figure 3.3-4-8 Block Diagram of VHF Communication Equipment

5) Selection of Radar Frequency

i) General

It is necessary that the radar frequency for this system have a high reliability and stability, which have no affection from other radar interference and operating conditions in the surveillance area.

The radar frequencies are governed by the radio administrative authorities of the Egypt government. Therefore, the radio frequency allocation for the radar system, it will be designated by the authorities.

For designating the operating frequency of the radar system, this frequency must be determined by taking physical element such as weather condition, surveillance area and radio interference from other radio stations etc. into account, as is well known.

Generally, the operating frequency for land radar system will be assigned with X-band frequency taking into consideration with general world-wide tendency, because the land radar system is required with a precisely vessel tracking performance at the sea.

ii) Selection of Radar Frequency

Presently, this radar system requires only one radar frequency, but it is restricted by existing or other radar frequencies which are operated by both land radar station and ship radar equipments. Following radar frequencies are radiated in the Suez Bay area.

- Radar frequency to be operated by SCA.
  a. 9.310 MHz in X-band
  b. 9.350 MHz in X-band
  c. 9.485 MHz in X-band

- Ship radar frequency (Typical) on the sea
  a. 9.375 MHz in X-band
  b. 9.410 MHz in X-band
  c. 5.540 MHz in C-band
  d. 3.050 MHz in S-band

For the evaluation of radar frequency, following comparison between X, C and S-bands is considered.

Table 3.3-4-8 Evaluation of Radar Frequency

	Azimuth Resolution	Range Resolution	Detection Range	Weather Affection	Economy
X-band	excellent	even	relatively short	relatively short	not expensive
C-band	medium	even	medium	medium	expensive
S-band	relatively poor	even	relatively long	relatively excellent	relatively expensive

iii) Conclusion

For the selection of radar frequency in the restricted situation, it is considered that most important factor is a azimuth resolution in the Suez bay coastal area. Therefore, Ataqa radar surveillance station system will employ one channel on X-band frequency so as to precisely detect the vessels in the bay.

For the determination of the radar frequency of this system, it is required to have no interference against existing radar station and ship radar equipment so that, it is recommended to designate a frequency of 9.740MHz leaved approximately 200MHz from existing land radar frequencies and ship radar frequencies on X-band, together with consideration of the Radio Regulation.

6) Radar Detecting Performance

i) General

For completing the radar surveillance system, it is required to form radar detecting performance of good stability in the expected monitoring area. The following is considered for the establishment of the radar surveillance system.

- Radar coverage range performance
- Range resolution
- Azimuth resolution
- Range accuracy
- Azimuth accuracy

In order to determine the above, it is required to esteem the coefficient of detection probability and false-alarm rate by site condition, size of cross section of vessels and RF output power of radar equipment, and to ensure that the radar wave transmitted from the radar station will secure the tracking of vessels on the sea, considering of the propagation and system losses.

The radar transmitting power is so designed as to secure the surveillance area satisfactorily and the minimum power consumption, taking into account the possibility of disturbance to other radar systems. Accordingly 25kW is considered as standard when designing and the following coefficients are also applied in designing.

- Detection probability (Pd) : 75%
- False-alarm rate (fa) : 10^{6}
- Cross section of vessel (δ) : m^2
- Radar RF output power : 25kW

The results of calculation of detecting performance are given in hereinafter.

ii) Radar Coverage Range Performance

The radar coverage range is calculated by following radar equation.

$$R = \left(\frac{Pt \cdot Gt \cdot \lambda^2 \cdot \delta}{(4\pi)^3 \cdot (KT) \cdot (1.2/\tau) \cdot (NF) \cdot (So/No)i/n \cdot Li(n) \cdot Lf \cdot Lsys} \right)^{1/4}$$

Where:

Pt	:	Transmitter peak power
Gt, Gr	:	Antenna gain
λ	:	Wave length
δ	:	Target cross section
K	:	Boltzman's constant
T	:	Equivalent noise figure temperature
τ	:	Pulse width
NF	:	Noise figure
(So/No)i	:	S/N ratio (depending upon Pd and FAR)
n	:	Number of hit
Li(n)	:	Integral loss by number of hit
Lf	:	Loss at target fluctuation
Lsys	:	System loss

Depending upon mentioned above equation, the calculation results for the radar coverage area vs. the pulse widths are given in Table 3.10.3-3 hereinafter.

Table 3.3-4-9 Radar Coverage Performance

Pulse width	RF Output	Antenna	Radar Cross Section	Detection Probability	False-alarm Rate	Radar Coverage
0.08us	25kw	9-feet slotted array type	10㎡	75%	10^5	6.28NM
0.25us	-ditto-	-ditto-	-ditto-	-ditto-	-ditto-	8.28NM
0.75us	-ditto-	-ditto-	-ditto-	-ditto-	-ditto-	10.78NM
1.00us	-ditto-	-ditto-	-ditto-	-ditto-	-ditto-	11.29NM

iii) Range Resolution

Range resolution is determined by the transmission pulse width (τ). The calculation result is shown as follows:

Table 3.3-4-10 Range Resolutions Determined by the Transmission Pulse Width

Pulse width τ (us)	Range resolution (m)
0.08	12.0
0.25	37.5
0.75	112.5
1.0	150.0

iv) Azimuth Resolution

The azimuth resolution is defined by following equation.

Azimuth resolution (m) = R× π /180× θ

Where:

R : Radar surveillance range (m)

θ : Antenna horizontal beam width (degree)

As an example, calculation data of 9-feet and 12-feet slotted type antenna is shown as follows:

Table 3.3-4-11 Azimuth Resolutions (9 feet and 12 feet Antenna)

Surveillance range R (NM)	Azimuth resolution (m)	
	9-feet antenna θ =0.8	12-feet antenna θ =0.6
1.5	38.8	29.1
3	77.6	58.2
6	155.0	116.3

v) Range Accuracy

Range accuracy is defined by following equation.

Range accuracy (m) = 150 (τ + Ts)

Where:

τ : Transmission pulse jitter and other components (us)

Ts : A/D sampling period (us)

While, transmission pulse jitter and other components can be ignored because value of this factor is very small compared with A/D sampling period. However, A/D sampling period is applied with a definite value of 0.05 us considering the minimum transmission pulse width of 0.08 us, accordingly the range accuracy is calculated as follows:

Range accuracy (m) = 150 x (1 x 0.05)
= 7.5m

vi) Azimuth Accuracy

The azimuth accuracy is determined by the moving accuracy of mechanical structure such rotary encoder and gears for rotating the antenna. Therefore, it is needed to assume some operational accuracy of those mechanical parts.

Therefore, the following value is applied for the calculation.

Accuracy of rotary encoder	:	0.04°
Accuracy of gears	:	0.05°
Accuracy of total mechanical parts	:	0.09° ≒ 0.1°

The result of calculation applied mentioned above value of 0.1 is as follows:

- At surveillance position of 1.5 NM : 4.8m
- At surveillance position of 3.0 NM : 9.8m
- At surveillance position of 6.0 NM : 19.4m

vii) Conclusion

This radar surveillance system is designed to monitor three ports water areas simultaneously by one radar equipment installed at Ataqa new port. Based on the calculation result, it is recommended that radar equipment shall be 25kW transmitter-receiver and 9-feet slotted array type antenna system as a minimum requirement.

7) Interlinkage Link Design

i) General

As mentioned in the item 3.10.2, it is required to establish a data and communication circuit of good stability in connecting the Ataqa port radar surveillance station to Adabiya port monitoring station and Ibrahim port station for this harbour control radar system. The following is considered in establishment of the data and communication circuit.

- Number of data and communication channel
- Selection of interlinkage system

In order to determine the above, it is necessary to study the categories of data and communication to be required for the harbor control radar system and to ensure that the data and signals transmitted from Ataqa radar surveillance station will be secured for the receiving grade higher than a certain level, considering the gravity of the data.

ii) Channel Plan for Data and Signal Transmission

For the accomplishment of vessel moving monitor and control at Adabiya and Ibrahim Ports, the following data and signals will be transmitted from Ataqa port radar surveillance station to Adabiya port monitoring station and Ibrahim port station respectively.

a. Between the Ataqa Port Station and the Adabiya Port Station

Table 3.3-4-12 Channel Plan for Data and Signal Transmission
(Between Ataqa Port Station and Adabiya Port Station)

Type of signal	Number of Channel	Ataqa Station — Adabiya Station	Remarks
Radar data	1CH	○——→○	(One-way)
Ship data	1CH	○←——→○	(Both-way)
Voice signal for recording	2CH	VHF CH16 ○←——○	(One-way)
		VHF working CH ○←——○	(One-way)
Hot line	1CH	○←——→○	(Both-way)
Spare	1CH	○←——→○	(Both-way)
Total	6CH		

b. Between the Ataqa Station and the Ibrahim Station

Table 3.3-4-13 Channel Plan for Data and Signal Transmission
(Between Ataqa Port Station and Ibrahim Port Station)

Type of signal	Number of Channel	Ataqa Station — Ibrahim Station	Remarks
Voice for communication	1CH	○←——→○	(Both-way)
Total	1CH		

iii) Interlinkage Link

In order to realize the transmission of data and signals mentioned above, it is required to form the interlinkage link with high reliability, and the following situation is considered in establishment of the interlinkage link.

a. Link between Ataqa Port Station and Ibrahim Port Station

As mentioned in the item 2) above, this link requires only one voice signal circuit so as to communicate between operators at both sites.

On the other hand, presently there is a public telephone network in the area of Suez City including the sites Ibrahim Port and Ataqa Port, organized by the ARENTO, and those networks provide the public telephone service except the data communication service. For the above reason, this link will be utilized with a public telephone line.

b. Link between Ataqa Port Station and Adabiya Port Station

It is considered that the multiplex radio link is adequacy for data and voice transmission between both stations, so that, the system provides a high reliable digital transmission measures for the transmit of the observed vessel tracking data and ship's data to Adabiya port monitor station on real time basis, and together with exchange predict and the analyzed vessel moving data between both sites.

According to the reason mentioned above, the interlinkage system between Ataqa port station and Adabiya port station is recommended to have the pulse cord modulation type (PCM) multiplex radio system of 2GHz band, considering of the climate conditions, surrounding site conditions including the sea situation along the coast line and the world-wide tendency for designating the radio frequency in those communication categories.

However, the radio frequencies are governed by the radio administrative authorities of the Egypt government. Therefore, the radio frequency allocation for the radio interlinkage system is required to have an approval by the authorities.

(4) Power Supply System

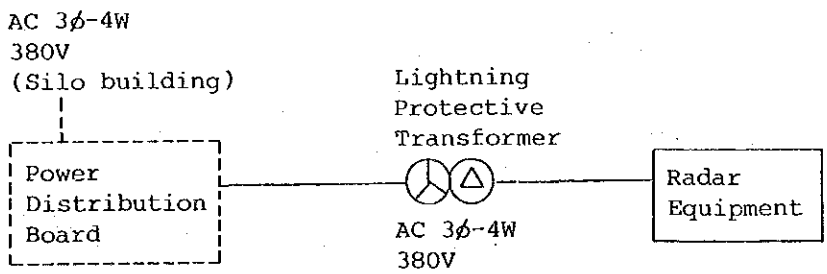
1) Power Supply System for Station

Ibrahim port station and Adabiya monitor station are planned to be established at existing port tower and port administration building respectively. The power source for both stations will be introduced from city power source without any additional power supply facilities.

Ataqa radar surveillance station, composed of watching station and radar station, will be constructed at the port control tower and silo operation building. The power for watching station and radar station are planned to be supplied by power, sourced by this coastal area development project. However watching station needs uninterruptable power source, because radar display console including data processor requires no break power supply for maintaining the data processed by radar surveillance system. Taking into consideration of power supply scheme in the development project, CVCF type uninterruptable power supply equipment is adopted as a supplementary power source for the radar surveillance system.

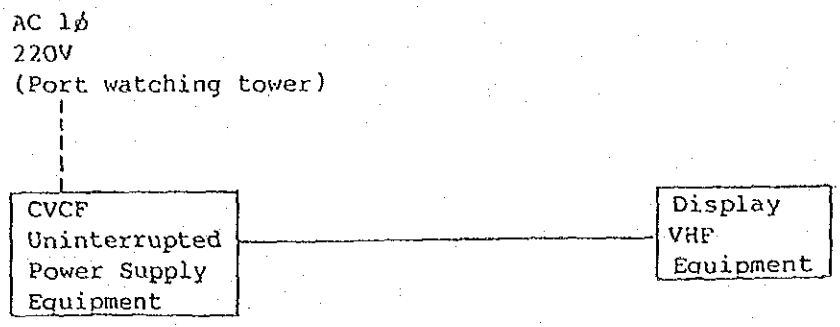
2) Configuration of Power Supply System

The configuration of power supply system at radar station and watching station at Ataqa port is shown as follows:

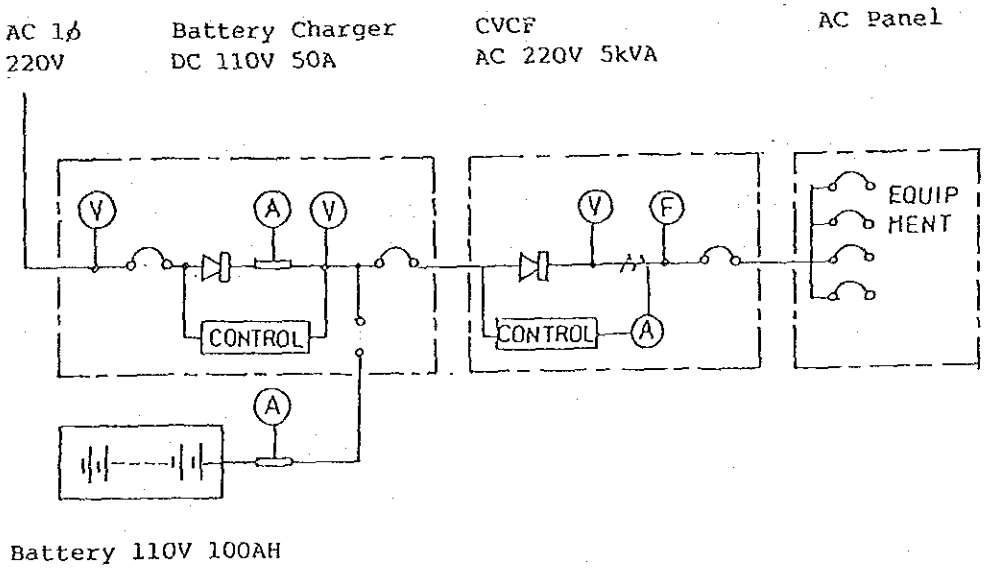


(a) Radar Station

Figure 3.3-4-9 Configuration of Power Supply System



(b) Watching Station



(c) Block Diagram of CVCF Circuit

Figure 3.3-4-9 Configuration of Power Supply System

3) Power Consumption of Respective Stations

The power consumption of each equipment at stations is shown as follows:

Table 3.3-4-14 Power Consumption of Respective Stations

Equipment	Power Consumption
Ibrahim port station VHF radio equipment	300W (150W x 2 sets)
Total:	300W
Adabiya monitor station Display monitor console VHF radio equipment Ship schedule indicator equipment Multiplex radio equipment	1,200W 300W (150W x 2 sets) 100W 150W
Total:	1,750W
Ataqa radar surveillance station Radar station Radar antenna Radar transmitter-receiver Local controller Multiplex radio equipment	350W 1,300W (650W x 2 sets) 500W 150W
Total:	2,350W
Watching station Radar display console Ship schedule indicator equipment Voice recorder VHF radio equipment Meteorological equipment CVCF power supply equipment	1,500W 100W 200W 300W 150W x 2 sets) 300W 900W
Total:	3,300W

(3) Radar Performance and Radio Wave Test

1) General

When establishing a radar surveillance system and VHF communication system, the necessary condition must be studied concerning the system plan established on a map and data on-site survey, and also the radio wave propagation test must be adequately performed.

2) Radar Propagation Test

The following radar wave propagation test shall be performed at the planned place actually for determining the height of antenna position and its place in order to grasp the environmental phenomenon, by using the radar equipment.

a. Measuring instrument

The following measuring instrument are required for radar wave propagation test.

- Radar transmitter-receiver
- Radar display unit
- Simulated target board
- Ship for traffic simulation (Rental base)
- VHF radio with antenna for communication
- Camera for data recording
- Tools
- Various connector cords
- Portable generator

b. How to test

①Place the radar equipment with antenna at the planned location for evaluating the height and location, and ②proceed a test from radar site to Ibrahim port area and Adabiya port area, and to traffic channel into Ataqa port, and to respective wharves allocated in the port, and to entrance gates and mooring zone in the port respectively.

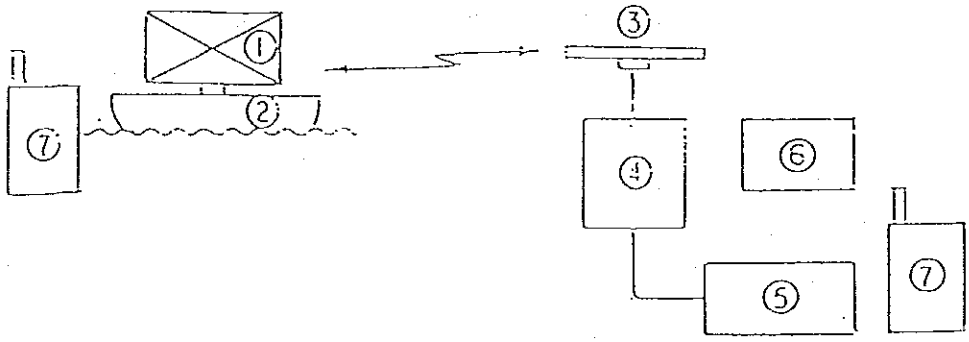
Testing item is as follow;

- Take a photograph of simulated plan pattern of vessel and radar tracking data
- Take a photograph of simulated height pattern of vessel and radar tracking data.

③Judge the condition of the position and place, based on the measured picture.

When it is judged that antenna height and place are not good, the place and height shall be reconsidered.

c. Outline of the radar measuring system



① : Simulated target board
② : Ship
③ : Radar antenna
④ : Radar transmitter-receiver
⑤ : Portable power supply
⑥ : Camera
⑦ : VHF radio

Figure 3.3-4-10 Outline of the Radar Measuring System

3) VHF radio wave propagation test

The following radio wave propagation test shall be performed at the planned place in order to maintain the service area and for determining the setting place of VHF antenna by using the radio equipment.

a. Measuring instruments

The following measuring instruments are required for radio wave propagation test. Moreover, since the measuring instruments are carried frequently, they must be carefully managed to prevent from their loss or damage. Radio wave propagation measuring instruments are given below.

- VHF radio equipment
- Antenna and pole
- Feeder cable — With connectors
- Mobile radio tester — CM Power Meter
  Level Meter
- Field strength meter
- Recorder
- Portable generator
- Circuit tester
- Tools
- Various connection cords

b. How to test

① Install the antenna pole at the planned place for setting the antenna, and install the antenna on it. ② The test will be carried out from radar station to Ibrahim and Adabiya port water area.

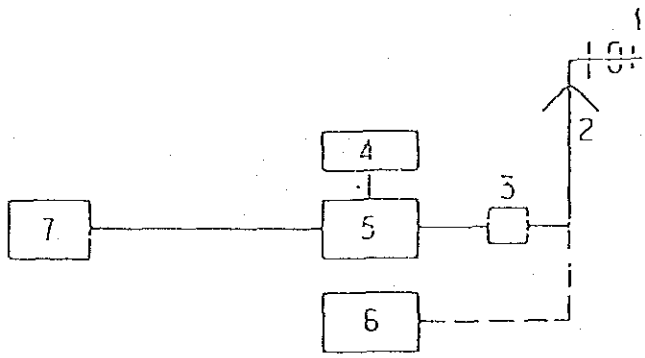
The test item is as follows;

- Field strength dB/MV
- S/N dB
- Noise strength

③ Judge the conditions of the circuit, based on the measured values.

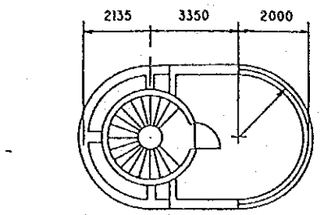
When it is judged that the location of VHF site is not good, the circuit composition including the change of the place (planned place for setting the building) shall be reconsidered.

c. Outline of the measuring system

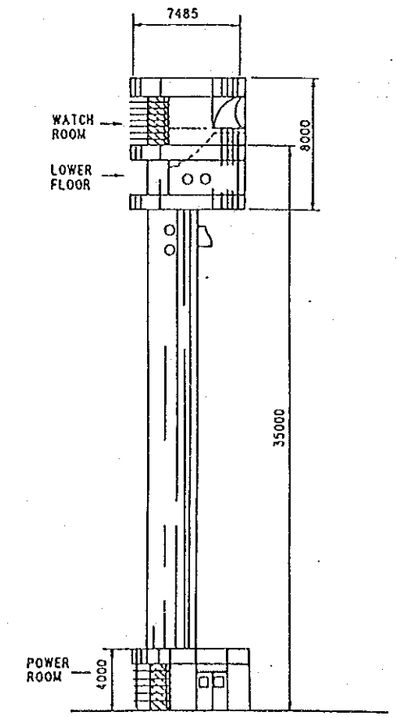


① : Antenna
② : Antenna pole
③ : Power meter
④ : Level meter
⑤ : Radio equipment
⑥ : Field strength meter
⑦ : Portable generator

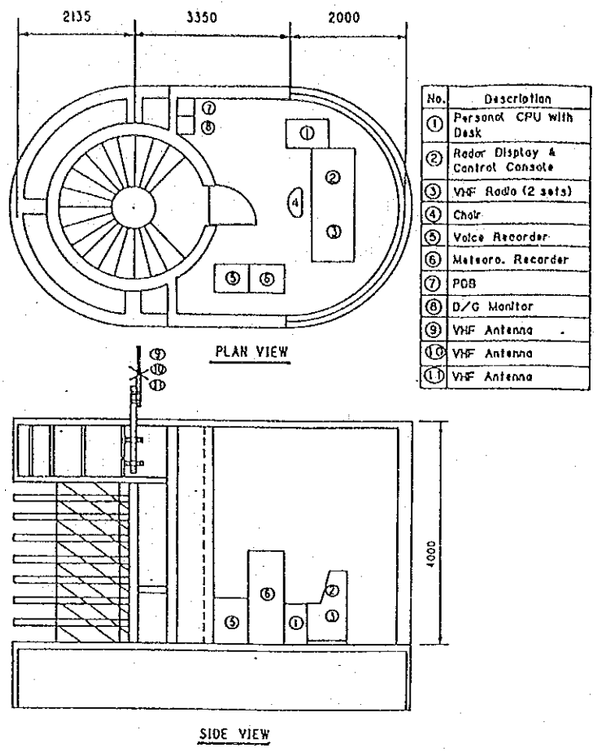
Figure 3.3-4-11 Outline of the Measuring System



PORT WATCHING TOWER

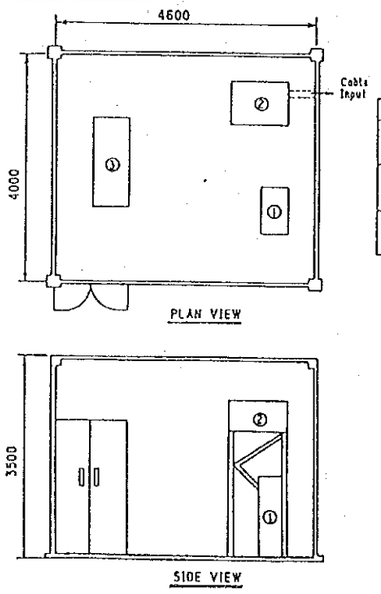


WATCHING ROOM



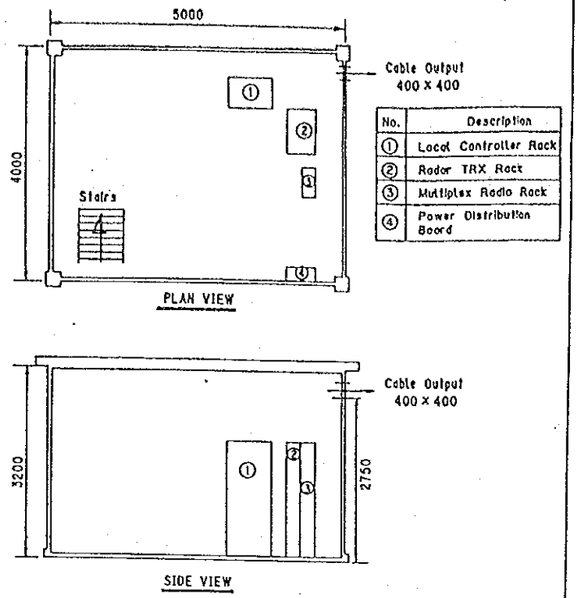
No.	Description
①	Personal CPU with Desk
②	Radar Display & Control Console
③	VHF Radio (2 sets)
④	Chair
⑤	Voice Recorder
⑥	Meteoro. Recorder
⑦	POB
⑧	D/G Monitor
⑨	VHF Antenna
⑩	VHF Antenna
⑪	VHF Antenna

POWER ROOM



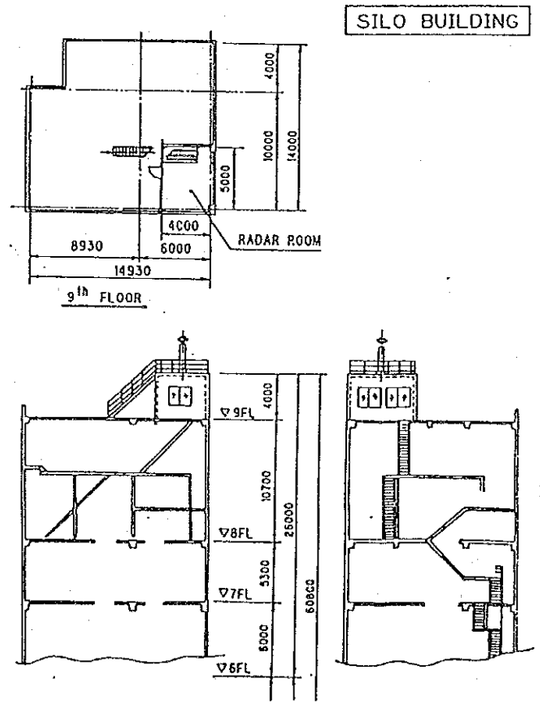
No.	Description
①	CVCF Power Supply Equipment
②	Fuel Tank
③	Engine Generator

RADAR ROOM



No.	Description
①	Local Controller Rack
②	Radar TRX Rack
③	Multiplex Radio Rack
④	Power Distribution Board

SILO BUILDING



GENERAL NOTES

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MINISTRY OF DEVELOPMENT,
NEW COMMUNITIES, HOUSING AND PUBLIC UTILITIES

THE DETAILED DESIGN ON THE URGENT DEVELOPMENT PLAN
OF
THE SUEZ BAY COASTAL AREA DEVELOPMENT

STATION FOR
ATAQA RADAR SURVEILLANCE
STATION SYSTEM

JICA JAPAN INTERNATIONAL COOPERATION AGENCY

SUBMITTED	APPROVED	SCALE	REV. NO.
DATE		DWG. NO. 3-10-3	

Figure 3.3-4-12 Station for Ataqa Radar Surveillance Station System

3.3.5 Tugboat

The JICA Study Team had the meetings with MODANC and RSPA, and discussed tugboats which were required in the minutes of meeting dated September 12, 1992, between JICA Study Team and MODANC.

Through the meeting in December, it was confirmed that the following number and capacity of the tugboats should be appropriate and sufficient to assist the vessels up to 80,000 DWT in berthing. The pollution protection equipment for the 32 ton tugboat was canceled by RSPA.

1) The Number of tugboat : One (1) 32 ton static bollard pull
   Two (2) 25 ton static bollard pull

2) The tugboats should have speed of :
   32 ton tugboat : at least 12.0 knot
   25 ton tugboat : at least 11.0 knot
   at 100 % loaded condition

3) All tugboats should be equipped with high efficiency propulsion system of 360 degree steerable knot nozzle propellers.

4) In addition to the towing and pushing functions, the tugboats should have following special equipment of fire fighting and salvage purposes, while the pollution protection equipment for 32 tons bollard pull tugboat was canceled.

   32 ton tugboat : a) Fire fighting equipment by sea water and from with three (3) monitors
   b) Salvage equipment and diving equipment
   25 ton tugboat : a) Fire fighting equipment with one(1) monitor

5) Each tugboat should have spare parts for 15,000 working hours for all major equipment.

6) According to the Red Sea Port Authority's request, Voith-Shneider type was

applied for propulsion system of the tugboats instead of Knot nozzle type which was recommended by the Stydy Team.

Table 3.3-5-1 The Principal Particulars and Equipment of the Tugboats

Particulars	32 ton tugboat	25 ton tugboat
Number of boat	One (1)	Two (2)
Loa (m)	about 32.0	about 20.0
Lpp (m)	about 30.0	about 18.0
Beam (m)	about 8.6	about 7.0
Draft (m)	not more than 4.5	about 2.5
Gross Ton	about 300	about 150
Bollard Pull (ton)	at least 32.0	at least 25.0
at MCR Ahead	at least 32.0	at least 25.0
Complement	at least 8	at least 8
Classification Society	LR ABS or equivalent	LR ABS or equivalent
Trial Speed (knots) (100% loaded cond.)	at least 12.0	at least 11.0
Cruising Range (N.M.)	at least 1,500	at least 1,200
Main Engine	4-cycle Marine Diesel x 2 sets	4-cycle Marine Diesel x 2 sets
Propulsion	Voith Scheiher x2	Voith Scheiher x2
Towing Equipment	Winch combined with windlass (force) towing hook	Winch combined with windlass (force) towing hook
Fire Fighting	Sea water and form 3 monitors	Sea water and form 1 monitor
Salvage Equipment	Welding, cutting machine, diving equipment, under water video camera, etc. 1- work boat	not provided
Spare Parts	15,000 working hours	15,000 working hours

3.3.6 Incinerator

The incinerator is to be installed in the Ataqa Port area. The materials to be incinerated are garbage from the Ataqa Port.

As recommended in the Interim Report (I), the incinerator to be used is of a fixed stoker type with an under-floor combustion system, having no after-burner for complete burning and having a cyclone as a dust collector.

(1) Design Conditions

The type and quantity of garbage estimated in 2005 are shown in Table 3.12.1.

Table 3.3-6-1 Type and Quality of Garbage

Type of Waste (Shource of Generation)	Quantity (ton/year)	Transport Cargo (x 10^3 ton/year)	Unit Generation Rate(%)
1.Grain	40	80	0.05
2.Coal	200	2,000	0.01
3.Container Cargo	360	240	0.15
4.Grain	(1,800)*	1,800	0.10
Total	600	-	-

Note : * The waste solids of grain are re-used. Therefore, they do not contribute to the total garbage quantity.

The design conditions of Ataqa Port incinerator are set forth as follows:

(1)	Operational days per year:	n = 300 day
(2)	Working hours per day:	h_1 =8 hours.
(3)	Actual combustion hours per day:	h_2 =6 hours.
(4)	Garbage amount:	K = 600 tons
(5)	Capacity: C	C = K/n = 2.0 ton/day
		= (K×10³)/(n×h_2) = 333.3 kg/hour

(2) Detailed Design

1) Computation of Combustion Chamber

Volume and floor area of combustion chamber is computed as follows:

$$V = (W \times H \times Y)/K_1$$

$$S = W/K_2$$

Where,

- V : Volume of combustion chamber
- S : Floor area of combustion chamber
- W : Amount of garbage to be burned
- H : Heat generation = 3,000 kcal/kg
- K_1 : Burning load per volume = 150,000 kcal/m³·hr
- K_2 : Burning load per stoker area = 150 kg/m²·hr
- Y : Incinerator efficiency = 0.95

$$V = (333.3 \times 3{,}000 \times 0.95)/150{,}000 = 6.33\ m^3 < 6.92\ m^3$$

$$S = 333.3/150 = 2.22\ m^2 < 2.82\ m^2$$

Therefore, the incinerator combustion chamber volume shall be larger than 6.33 m³, and also the floor area shall be larger than 2.22 m².

2) Fuel Cost

The fuel cost which represents a large portion of the incinerator's operational cost is estimated as follows:

Fuel will be consumed only for about one hour for daily starting-up.

Fuel amount : 20 1/hour/day x 300 day/year = 6,000 1/year
Fuel cost : 6,000 1 / 0.8 LE/1 = 4,800 LE/year

Based on the above cost estimate, the oration and maintenance cost of the incinerator can be considered as a minor cost.

(3) Study and Recommendations

Figure 3.3-6-1 shows the recommended incinerator type and a general layout of the Incinerator Station for reference only. The building details of the Incinerar tation are shown in Drawing Nos.6A-P24/1-01, 6S-P24-01, 6E-P24-01, 6M-P24-01 and 6P-P24-01.

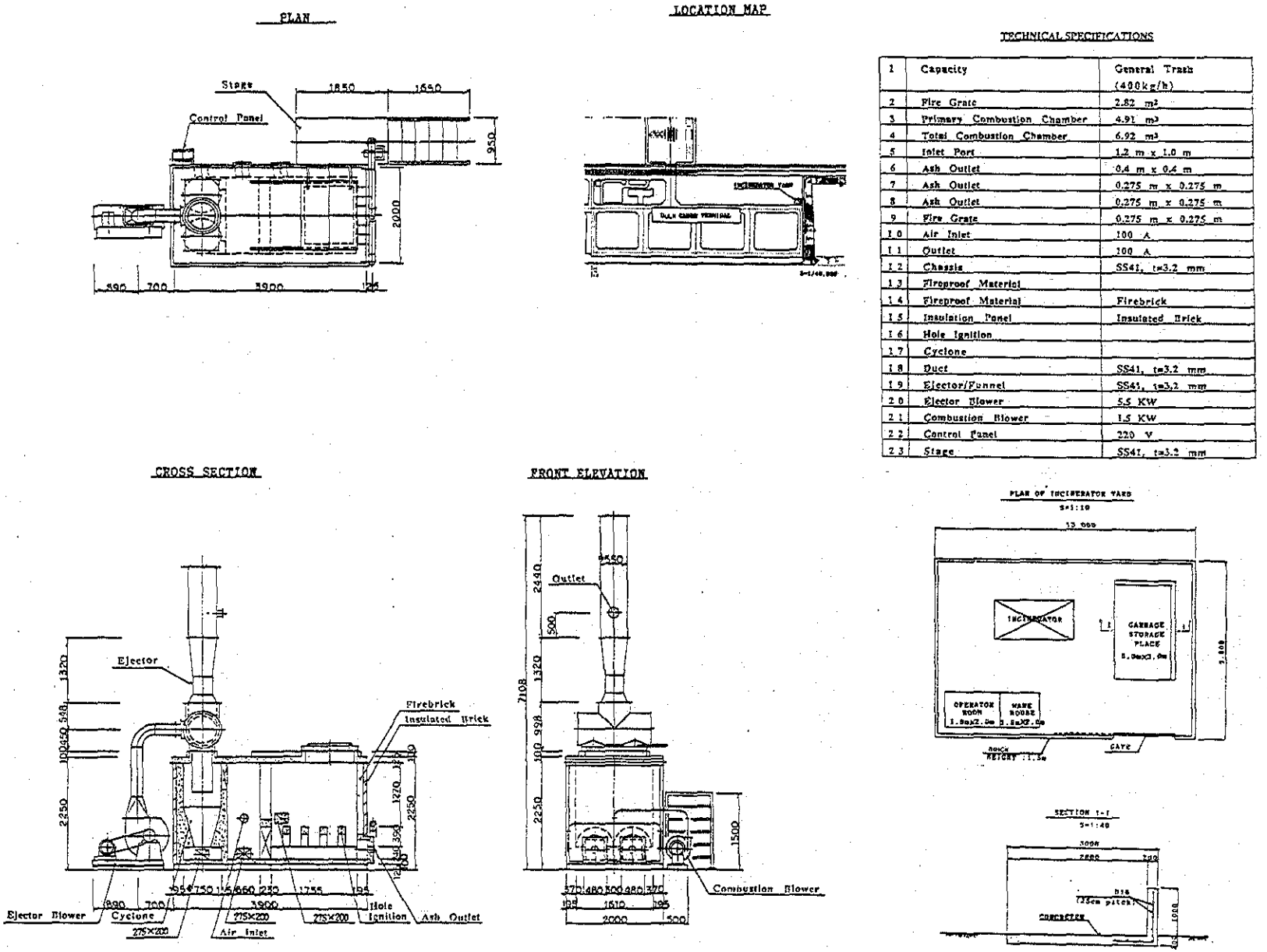


Figure 3.3-6-1 Type and General Layout of the Incinerator

3.4 ROADS, PAVEMENT AND EARTHWORK

3.4.1 Roads and Pavement

(1) Review of JICA F/S report

According to the JICA F/S report, the road development plans are as follows;

1) Suez-Adabiya Coastal Road
Addition of 7.5m wide carriageway of 10.3km in length in the section between Suez and Adabiya Port.

An estimated maximum traffic volume is 25,404 P.C.U./day in 1995. The volume capacity ratio is 33% for dual carriage road. Provision of 2-lane road is sufficient for the 1995 traffic in Ataqa-Adabiya industrial and port areas. However, it is mentioned that the 4-lane road will be developed to meet the demand in 2005.

2) Road network plan in the Ataqa I.E.
Will be developed the following roads:

30m width road	(4-lane)
21m width roads	(2-lane 12,855.0m)
18m width roads	(2-lane 6,650.0m)

3) Road network plan in the Adabiya I.F.Z.
Will be developed the following roads:

21m width roads	(2-lane 1,455.0m)
18m width roads	(2-lane 8,330.0m)

(2) Design Concept

1) A Road Network Plan

An idea of the road network plan in the industrial estate is based on the feasibility study. However, formation and location of the roads will be modified to meet the master plan which is concluded in Chapter 2 of this report.

2) Type of Roads

The network is composed of four (4) types of roads based on the feasibility study. These types will be determined to compare with JICA F/S report, cross sections of roads in related projects in Egypt and Japanese standard.

3) Earthwork

Roads in the industrial estate will be built according to the existing topography. The grading work of the factory lots in the land area will not be carried out in initial development from the economical point of view. (This matter will be mentioned and concluded in Earthwork in sub-section 3.4.2.)

4) Road alignment and Intersections

Road alignment and intersections will be determined to meet the road network plan, design speed and existing topography.

5) Pavement

Pavement structures will be determined to meet the design C.B.R. and expected traffic volume. Traffic volume will be re-studied for the pavement design study.

6) Ancillary Facilities

Ancillary facilities such as markings, traffic signals, traffic signs and road lighting will be proposed.

(3) Road Network Plan

The road network plan is shown in Figure 3.4-1-1. The network is composed of four (4) types of roads as shown in below.

Type of Road	Lane Num.	R.O.W. Width	Roads
- 35 m Width Road	4L	(45 m)	: Suez-Adabiya Coastal Road
- 30 m Width Road	4L	(40 m)	: Main connection road between Adabiya-Suez/Cairo Road to Suez-Adabiya Coastal Road
- 21 m Width Road	2L	(31 m)	: Secondary Connection and Arterial Roads
- 18 m Width Road	2l	(28 m)	: Collector Roads

Features of the network plan are as follows:

1) Suez-Adabiya Coastal Road is planned as a four (4) lane road to meet the traffic demand in 2005. Two (2) carriageways will be added to the existing two (2) lanes of this road.

2) Two 2) connection roads are planned between Adabiya-Suez/Cairo Road to Suez-Adabiya Coastal Road. One of them is 30m in width four (4) lane as a main connection road. And the other one is two (2) lane secondary connection road with 21m in width.

3) 21m and 18m width two (2) lane roads are planned as a arterial and collector road in the industrial area.

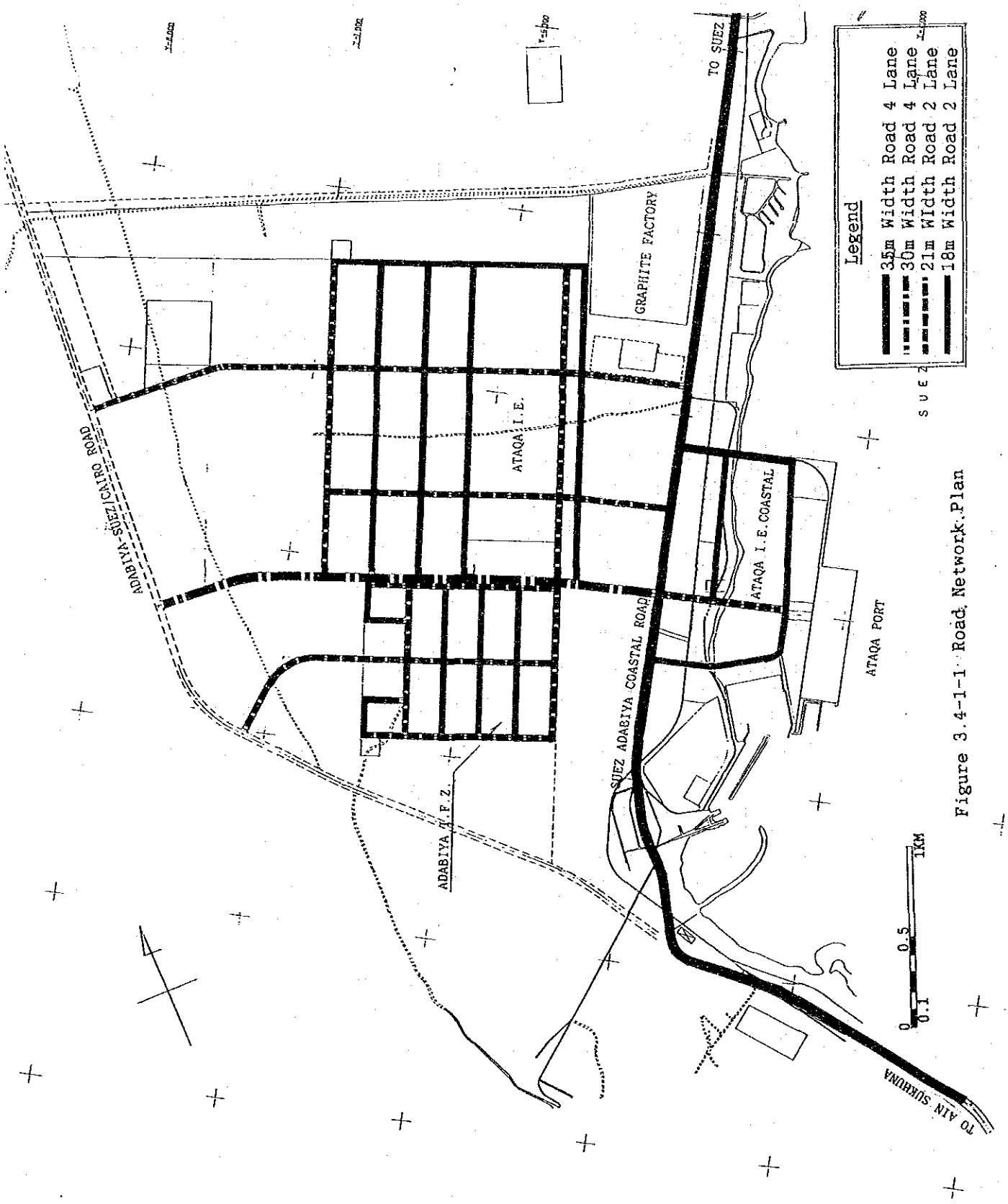


Figure 3.4-1-1 Road Network Plan

(4) Type of Roads

1) Right-of-Way

The 5m width to be added on both side (hereinafter called buffer zone) of each road to provide some space for installation of power supply cables and telecommunication.

2) Road width

Four (4) types of road mentioned above are based on the JICA F/S report. The components of each road such as carriageway, shoulder and border width, walkway width and so on, and they were determined by the following ways.

a) 35m Width Road (Suez-Adabiya Coastal Road)

Two (2) lane will be added to 10.3 km section of the existing two (2) lane Suez-Adabiya Coastal Road.

The width of each carriageway is 3.75m. The border and shoulder are 1.5m and 2.5m respectively. These widths are determined similar to those of Suez-Adabiya Ring Road. The width of median strip and sidewalk are adjusted to meet the 35m width proposed in the feasibility study report.

b) 30m Width Road

This road is planned as four (4) lane main connection road. The 3.5m carriageway width is recommended for the following reasons:

- 3.5m carriageway width is constructed in the 10th of Ramadan City.
- 3.5m width carriageway should be kept for main arterial roads in urban areas in line with the Japanese standard.
- 3.5m width is recommendable to meet the traffic movements of large vehicles for arterial roads in the project area.

The border and shoulder on the road each 1.5m width same as JICA F/S report are to be provided for emergency parking, security and maintenance.

The median strip of this road in the project area is planned to be 2m. In this regard, the total width of the reservation of the 30m width road in the project area becomes 5m including 1.5m borders and 2m median strip. This reservation is regarded same with that of the road of 10th of Ramadan City.

The walkway width is 4m. One pedestrian may occupy about 0.75m width on walkway. At least 1.5m width is necessary for pedestrians to pass by each other. From this point of view, 4.0m width of the walkway is considered enough, and the remaining area is for tree planting.

c) 21m Width Road

The widths of carriageway and shoulder are determined for the same reasons as 30m width road. The walkway width is determined by adjusting the total width to 21m.

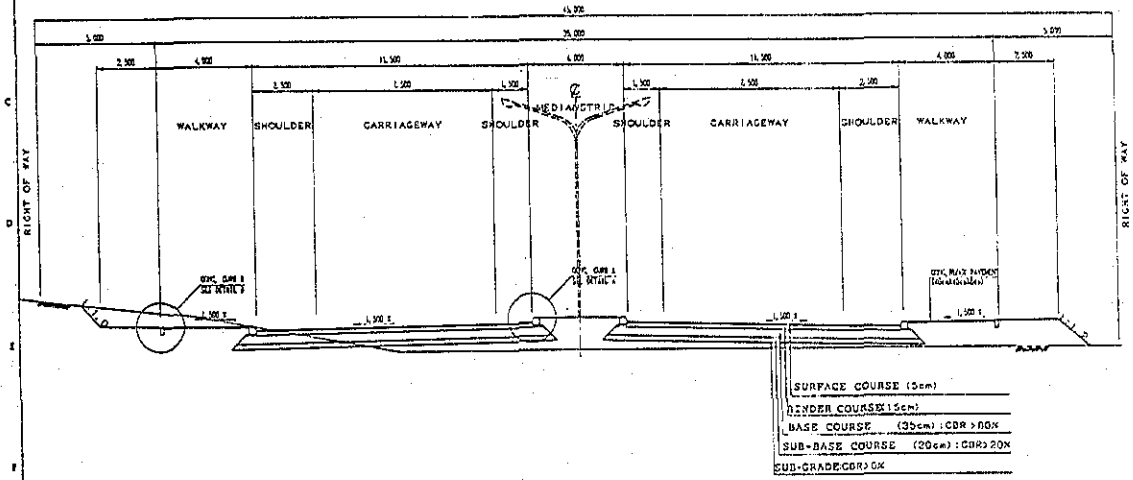
d) 18m Width Road

The widths of carriageway and walkway are reduced to 0.5m and 1.0m from the dimensions of the 21m width road respectively. This reduction is considered for the reasons below:

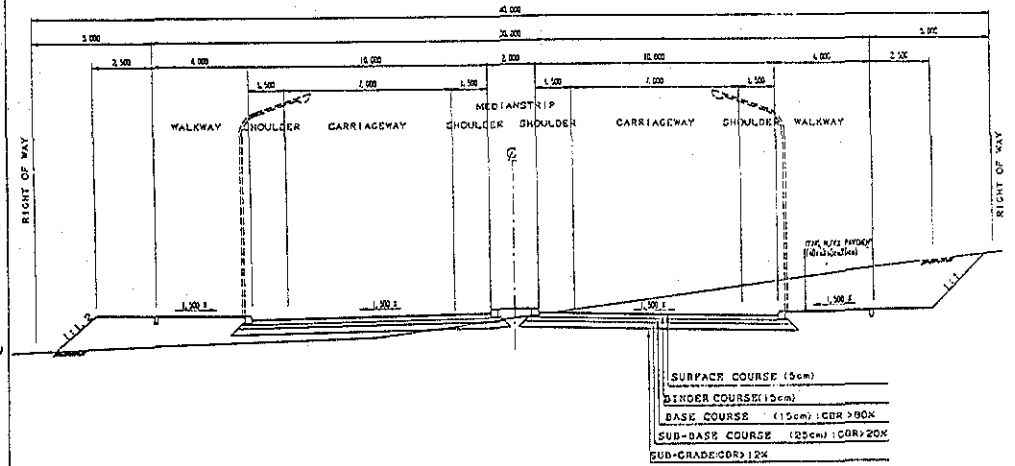
- The road is planned as a collector road in the factory area, and to increase effective factory lots.

3) Typical Cross Sections

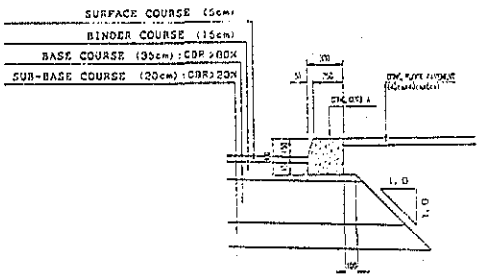
Typical Cross Sections of these roads mentioned above are shown in Figure 3.4-1-2.



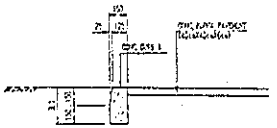
TYPICAL SECTION 1
SCALE 1:100
FOR SUEZ ADABIYA COASTAL ROAD
35m WIDTH ROAD



TYPICAL SECTION 2
SCALE 1:100
FOR ROAD EW1
30m WIDTH ROAD



DETAIL A
SCALE 1:20



DETAIL B
SCALE 1:20

Figure 3.4-1-2 Typical Cross Sections (1)

GENERAL NOTES

1. ALL LEVELS ARE IN MILLIMETERS UNLESS OTHERWISE INDICATED.
2. READ THIS DRAWING IN CONJUNCTION WITH DTG. NO. 4-1-02.

DESCRIPTIONS	DWG. NO.
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MINISTRY OF DEVELOPMENT,
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THE DETAILED DESIGN ON THE URGENT DEVELOPMENT PLAN
OF
THE SUEZ BAY COASTAL AREA DEVELOPMENT

TYPICAL CROSS SECTIONS (1)

JICA JAPAN INTERNATIONAL COOPERATION AGENCY

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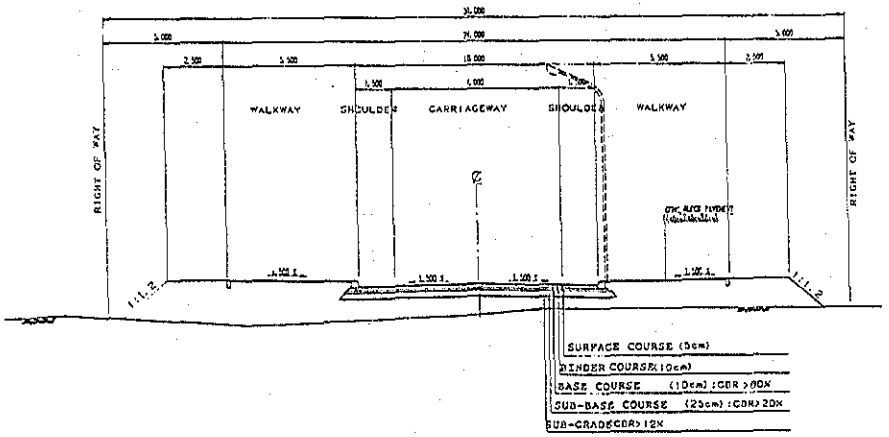
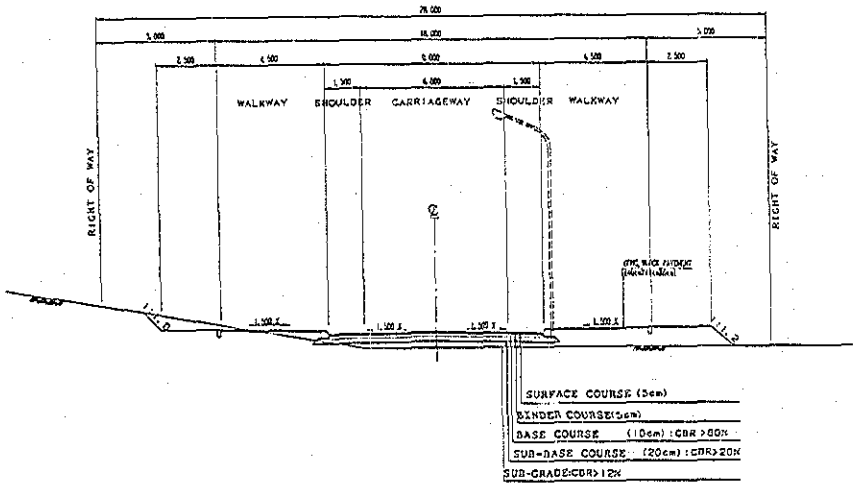


TYPICAL SECTION 3

SCALE 1:100

FOR ROAD EW3

21m WIDTH ROAD



TYPICAL SECTION 4

SCALE 1:100

FOR ROAD SN4

18m WIDTH ROAD

Figure 3.4-1-2 Typical Cross Sections (2)

GENERAL NOTES

1. ALL LEVELS ARE IN MILLIMETERS UNLESS OTHERWISE INDICATED.
2. READ THIS DRAWING IN CONJUNCTION WITH DWG. NO. 4-1-02.

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TYPICAL CROSS SECTIONS (2)

JICA JAPAN INTERNATIONAL COOPERATION AGENCY

SUBMITTED	APPROVED	SCALE	REV. NO.
		1:100	

DATE March, 1993 DWG. NO. 4-3-02

(5) Design Conditions and Criteria

(a) Design speed and size of vehicle

- Design Speed

The following speeds are taken into consideration according to the request by MODANC.

Road Width	Design Speed
35 m	120 km/hr
30 m	100 km/hr
21 m	80 km/hr
18 m	80 km/hr

- Size of Vehicle

The following figures represent the standard dimensions of the vehicles. The dimensions of Combo-Trucks will be considered aslarge vehicles in the project area.

Table 3.4-1-1 Standard Dimensions of Vehicles

	L	W	H	Ov.F	W.B.	Ov.R	M.R
- Cars	4.7	1.7	2.0	0.8	2.7	1.2	6.0
- Trucks and Busses	12.0	2.5	3.8	1.5	6.5	4.0	12.0
- Combo-Trucks	16.5	2.5	3.8	1.3	4.0 9.0	2.2	12.0

Note : L : Length (m)
W : Width (m)
H : Height (m)
Ov.F : Front Overhang (m)
W.B. : Wheelbase (m)
Ov.R : Rear Overhang (m)
M.R : Minimum Turning Radius (m)

(b) Traffic Volume

1) Review of F/S report

According to the JICA F/S report, the average daily traffic (A.D.T.) volume in 1979 and 1983, and expected traffic volume in peak hour peak direction in 1995 and 2005 on Suez-Adabiya Coastal Road are as shown in Table 3.4-1-2.

Table 3.4-1-2 Traffic Volumes of Suez Adabiya Coastal Road

(1) Average Daily Traffic (A.D.T.) Volumes

Year	Type of Vehicle A.D.T.	Cars	Busses	Single Trucks	Combo-Trucks	Slow Vehicles	Total
1979	ADT (Vehicles)	356	140	216	140	17	869
	ADT (P.C.U.)	356	657	670	882	330	2,895
1983	ADT (Vehicles)	347	46	71	46	3	513
	ADT (P.C.U.)	347	216	220	290	58	1,131

Sourse: JICA F/S Report, 1986

(2) Design Traffic Volume of Suez Adabiya Coastal Road

Year	Type of Vehicle	1985 Trucks & Slow Vehicles	Ind.Prod., Import & Export: Trucks (Additional)	Passenger Vehicles	Sub Total (1985 Trucks & Slow Vehicles included)	Recreation Trips (One Direction)	Commuter Trips (One Direction)		Peak Hour Total (Peak Direction)
							Cars	Busses	
1995	P.C.U./Peak Hour	51	1,539	93	1,683	237	949	730	2,521
	Number of Vehicles	3	245	93	341		949	156	1,446
2005	P.C.U./Peak Hour	51	2,183	177	2,411	260	2,074	1,595	4,875
	Number of Vehicles	3	347	177	527		2,074	340	2,678

Sourse : JICA F/S Report, 1986

Number of Vehicles are Estimated by Study Team Peak Hour Ratio 9%

Conversion factors were applied same as F/S report as shown in Table 3.4-1-3.

Table 3.4-1-3 Passenger Car Unit (P.C.U.) Conversion Factor

Vehicle Type	Conversion Factor
Passenger cars, taxis, pickups	1.0
Buses	4.7
Single trucks	3.1
Combo-Trucks	6.3
Slow vehicles	19.4

Referring to Table 3.4-1-2, traffic volume of peak hour peak direction in the year 2005 is as follows.

- 2,678 Vehicles/peak hour peak direction
- 4,875 P.C.U./peak hour peak direction

These traffic volumes are considered to form the basis of estimating the design hourly traffic volume.

2) Estimation of daily traffic volume in 2005.

The relation between design hourly traffic volume and design daily traffic volume is obtained by the formula below:

$$Vdh = Vdd \times K/100 \times D/100$$

where,

Vdh : Design hourly traffic volume
(Vehicle/Peak Hour, Peak Direction)
Vdd : Design daily traffic volume
(Vehicle/Day, Both Directions)
K : Peak factor (= 9 %)
D : Rate of direction (= 60 %)

In the above formula, he peak factor (K) and the rate of direction (D) are estimated 9 % and 60 % respectively. The peak factor is based on the description in the F/S

report, and the rate of direction is assumed based on the Japanese standard.

In accordance with the above relation, the expected traffic volume in one day is estimated by the following formula.

$$Vdd = Vdh \times 10000/(K \times D)$$

As a conclusion, the expected daily traffic volume in 2005 on Suez-Adabiya Coastal Road is 49,600 Vehicles/Day in both directions.

3) Rate of Heavy Vehicles

Rate of heavy vehicles in 1983 is 32.5 % in accordance with Table 3.4-1-2. and thirty-five (35) percent will be taken into account on the assumption that the composition of heavy vehicles in the year 2005 will be same as 1983.

4) Volume of Heavy Vehicles

For design of a pavement structure, traffic volume of heavy vehicle of one direction per day is necessary. The volume of heavy vehicles is obtained by the following formula.

$$Vh = Vdd \times D/100 \times Rh/100$$

where,

Vh : Heavy vehicle volume (Vehicle/day/direction)
Vdd : Expected daily traffic volume
(49,600 vehicle/day, both direction in 2005)
D : Rate of direction (= 60 %)
Rh : Rate of heavy vehicle (= 35 %)

The heavy vehicle volume in one direction per day is estimated 10,400 Vehicles/day/direction.

(6) Detailed Design Study

(a) Road Alignment

1) Design of the road alignment will be carried out to meet the design speed and existing topography. The conditions concerning the design speed are summarized in Table 3.4-1-4.

2) Road alignment of the Suez Adabiya Coastal Road was designed under the following conditions.

a) Horizontal alignment

a. Existing facilities such as factory, housing, public areas, electrical and telecommunication lines are going to remain unchanged as much as possible.

b. Forty-five (45) m Right-of-Way is kept so long as the existing facilities do not stand in the way.

c. If a. and b. are considered impracticable due to the site condition, the following options are carefully considered:

- Appropriate right-of-way width is selected. In this case, the minimum width is 35m, and the width adjustment will be made by omitting the 5m width buffer zone on both sides.

- Design speed is reduced locally to make the minimum curve radius smaller.

- Existing facilities are to be removed in case that neither the width adjustment nor the design speed reduction are possible or reasonable.

b) Vertical alignment

a. Same elevation as the present road surface is selected at the following points.

- Railway crossing
- Neighborhood of entrance of public, factory and housing areas

Table 3.4-1-4 Design Conditions for Road Alignment

Item		35m Width Road (Suez Adabiya Coastal Road)			30m Width Road			21 and 18m Width Road		
		Alignment Condition			Alignment Condition			Alignment Condition		
		Standard	Particular	Adopted	Standard	Particular	Adopted	Standard	Particular	Adopted
Design Speed	(km/hr)		120			100			80	
Min. Curve Radius	(m)	710	570	600	460	380	490	280	230	300
Min. Curve Length	(m)	200		200	170		170	140		143
Min. Transition Length	(m)	100			85			70		
Standard Crossfall	(%)	2.0		1.5	2.0		1.5	2.0		1.5
Max. Superelevation	(%)	8.0		-	8.0		-	8.0		-
Rate of Attainment of Superelevation		1/200		-	1/175		-	1/150		-
Braking Distance	(m)	210		-	160		-	110		-
Limited Intersection Angle	(Degree)	7.0			7.0			7.0		
Max. Longitudinal Slope	(%)	2.0	5.0		3.0	6.0	2.9	4.0	7.0	
Min. Length of Vertical Curve	(m)	100		100	85		85	70		
Min. Radius of Vertical Curve	Convex	11,000		13,600	6,500		-	3,000		
	Concave	4,000		7,200	3,000		7,000	2,000		
Max Resultant Gradient	(%)	10.0			10.0			10.5		
Max. Distance to Particular of Longitudinal Slope		Gradient	Distance		Gradient	Distance		Gradient	Distance	
		3.0 %	800 m		4.0 %	700 m		5.0 %	600 m	
		4.0 %	500 m		5.0 %	500 m		6.0 %	500 m	
		5.0 %	400 m		6.0 %	400 m		7.0 %	400 m	

b. Appropriate elevation is selected at the points of culvert and bridge crossing for storm water drainage.

3) Roads in Industrial Estate

All roads except Road Intersection Point (hereinafter called I.P.) No.27 are designed to meet the design conditions as shown in Table 3.4-1-4 in the Industrial Estate. Road alignment and I.P. Nos. are shown on the design drawings.

4) Designed Alignment

Design results are summarized in Table 3.4-1-5. Design speed is reduced locally from 120 km/hr to 60 km/hr at two points at I.P. Nos. 3 and 15 on the Suez Adabiya Coastal Road. And alignment at I.P. No. 27 in Ataqa I.E. Coastal is designed to 30 km/hr speed.

5) Intersections

Each road, except 18m width one, is provided with additional lane for left turning vehicles.

To determine the dimensions of intersection approach roads, the following formulas are taken into consideration.

$$Ls = V \times dW / 2$$
$$Lt = V \times dW / 6$$

where,

Ls : Length of main lane shift (m)
Lt : Taper length (m)
V : Design speed at intersection (m)
dW : Width of main lane shift (m)

Determined dimensions of intersection approach roads are summarized in Table 3.4-1-6.

Table 3.4-1-5 Designed Road Alignment

I.P. No.	Road No.	Design Speed	Intersection Angle	Curve Radius	Curve Length
1	Suez Adabiya Coastal Road	120	21° 08' 31"	600	221
2			12° 03' 30"	1,000	210
3		60	63° 45' 02"	170	105
4		120	19° 53' 21"	600	208
5			20° 02' 04"	600	210
6			14° 12' 42"	810	201
7			0° 08' 22"	-	-
8			0° 16' 40"	-	-
9			0° 35' 51"	-	-
10			0° 55' 02"	44,000	704
11			0° 24' 41"	-	-
12			37° 06' 54"	600	389
13			0° 12' 45"	-	-
14			34° 55' 39"	600	366
15		60	29° 56' 15"	200	105
20	EW12	80	6° 04' 49"	1,965	208
21	EW 1	100	6° 04' 49"	2,000	212
22	EW 3	80	6° 04' 49"	1,700	180
23	EW 2	80	6° 04' 49"	1,700	180
24	EW10	80	63° 39' 40"	300	333
25	EW 1	100	19° 59' 35"	490	171
26	EW 2	80	19° 59' 35"	410	143
27	WE2	30	71° 10' 31"	45	56
28	WE2	80	18° 49' 29"	450	148

NOTE : I.P. Nos. are shown in design drawings

Table 3.4-1-6 Dimensions of Intersection Approach Road

Item / Type of Road	35m	30m	21m	18m
Design Speed (km/hr)				
Standard	120	100	80	80
Intersection	100	80	80	60
Carriageway Width (m)				
One Lane Standard	3.75	3.50	3.50	3.00
Left Turn Lane	3.50	3.50	3.50	None
Main Lane Shift (m)				
Width	None	0.50	1.75	None
Length (Calculated)	None	20.00	52.50	None
(Adopted)	None	85.00	60.00	None
Left Turn Lane Shift (m)				
Width	3.50	3.50	3.50	None
Taper Length (Calculated)	58.33	46.66	35.00	None
(Adopted)	60.00	50.00	40.00	None
Lane Length	35.00	35.00	35.00	None

(b) Pavement

1) Type of pavement

Asphalt pavement is recommended for the carriageway of each road. Design of the pavement structure will be mentioned below. Concrete block pavement is proposed for the walkways. The proposed dimensions of the block are 40cm x 40cm and 6cm thickness.

2) Design C.B.R.

According to the C.B.R. test taken along the Suez Adabiya Coastal Road, the following C.B.R. values are estimated for the pavement design.

- Suez Adabiya Coastal Road : 6
- Ataqa I.E. (Land Area) and Adabiya I.F.Z. : 12
- Ataqa I.E. (Coastal) : 8

3) Pavement Classification

According to the Japanese Standard, the thickness of the asphalt pavement are classified according to the heavy vehicle traffic volume as shown in Table 3.4-1-7.

It is estimated that the 10,400 vehicles will pass the Suez-Adabiya Coastal Road in one direction per day in the year 2005. Therefore, this road needs to be paved with "D Class" pavement.

Table 3.4-1-7 Pavement Classification

Pavement Class.	Heavy Vehicle Traffic Volume (Veh./day/direction)
L	less than 100
A	100 to 250
B	250 to 1,000
C	1,000 to 3,000
D	more than 3,000

In accordance with the traffic volume and function of each road, the pavement classification is determined as shown in Figure 3.4-1-3.

4) Pavement Structure

A typical cross section of the pavement structure is as shown in Figure 3.4-1-4. The following materials are proposed for each pavement layer.

- Surface Course : Hot mixture (Bituminous material)
- Binder Course :Ditto
- Base Course : Graded Crushed Stone
  (Modified C.B.R.: more than 80)
- Subbase Course : Crushed Stone
  (Modified C.B.R.: more than 20)

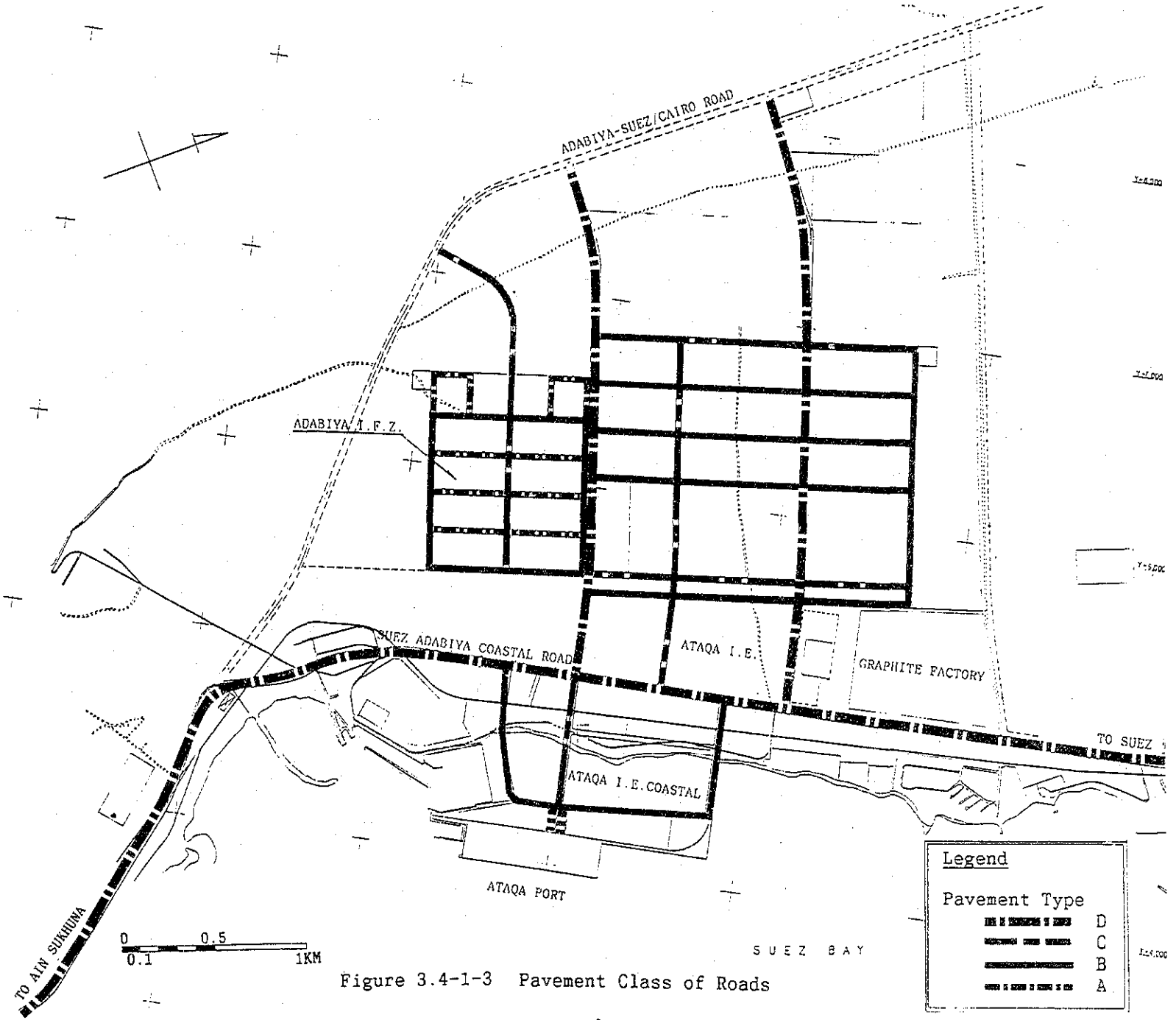


Figure 3.4-1-3 Pavement Class of Roads

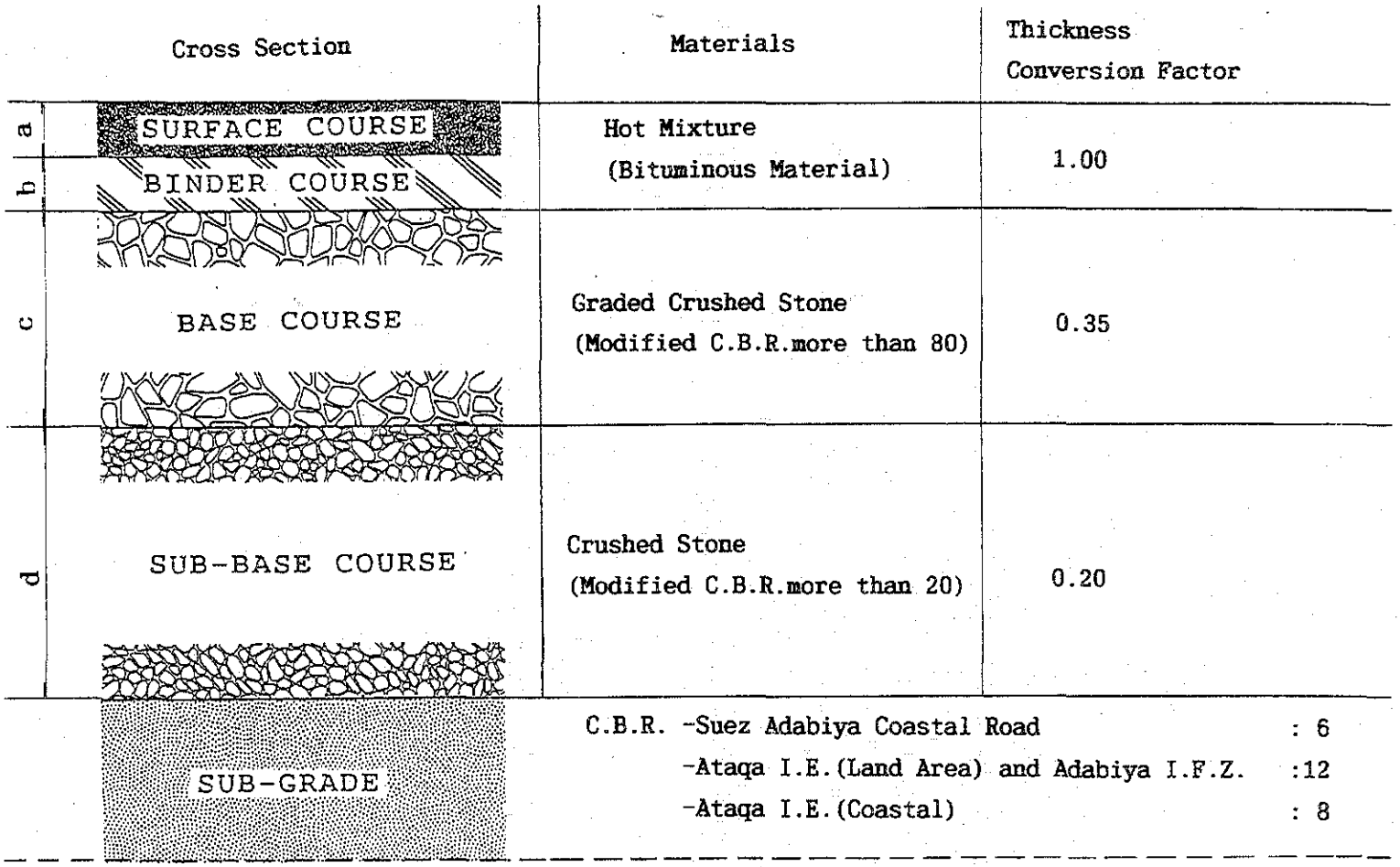


Figure 3.4-1-4 Typical Pavement Structure

Thickness of each pavement layer is determined by the following formula:

$$TA = a_1T_1 + a_2T_2 + a_3T_3 + a_4T_4$$

where,

TA : Target structural number.

a_1, a_2, a_3, a_4 : Thickness conversion factors for theabove mentioned materials as shownbelow.

$a_1 = 1.00$: Hot mixture
$a_2 = 1.00$: Ditto
$a_3 = 0.35$: Graded Crushed stone
$a_4 = 0.20$: Crushed stone

T_1, T_2, T_3, T_4 : Thicknesses of each layer (cm)

T_1 : Surface Course
T_2 : Binder Course
T_3 : Base Course
T_4 : Subbase Course

In the above formula, the thickness conversion factors are determined to meet the Japanese Standard. The thickness of each layer is determined to trial calculation that the TA and total thickness shall not be less than the target thickness as shown in Table 3.4-1-8.

Table 3.4-1-8 Target Thickness of TA and Total Thickness

Unit : cm

Design	Class. L		Class. A		Class. B		Class. C		Class. D	
C.B.R.	TA	Total	TA	Total	TA	Total	TA	Total	TA	Total
6	12	27	16	32	21	38	28	47	37	55
8	11	23	14	27	19	32	26	39	34	46
12	-	-	13	21	17	26	23	31	30	36

Requirements for the minimum thickness of the asphalt pavement layer are as summarized in Table 3.4-1-9.

Table 3.4-1-9 Minimum Thickness of Asphalt Pavement Layer

Pavement Classification	Minimum Thickness of Asphalt Pavement Surface + Binder Course (cm)
L, A	5
B	10
C	15
D	20

Proposed thicknesses of asphalt pavements are shown in Table 3.4-1-10 as a conclusion.

(c) Road Markings, Traffic Signals and Traffic Signs

1) General

Road markings, traffic signals and traffic signs are proposed. These facilities should be provided according to the suitable Egyptian standards and/or regulations. In this regard, the study at the detailed design stage is limited to provide basic design for these provisions.

Details will be determined during a construction stage according to the Egyptian standards and/or regulations. These matters will be described in the Specifications.

2) Road Marking

Road markings will be carried out according to the Egyptian Standards and/or regulations. Basic ideas are as shown in the design drawings. Detailed description can be referred to the design drawings.

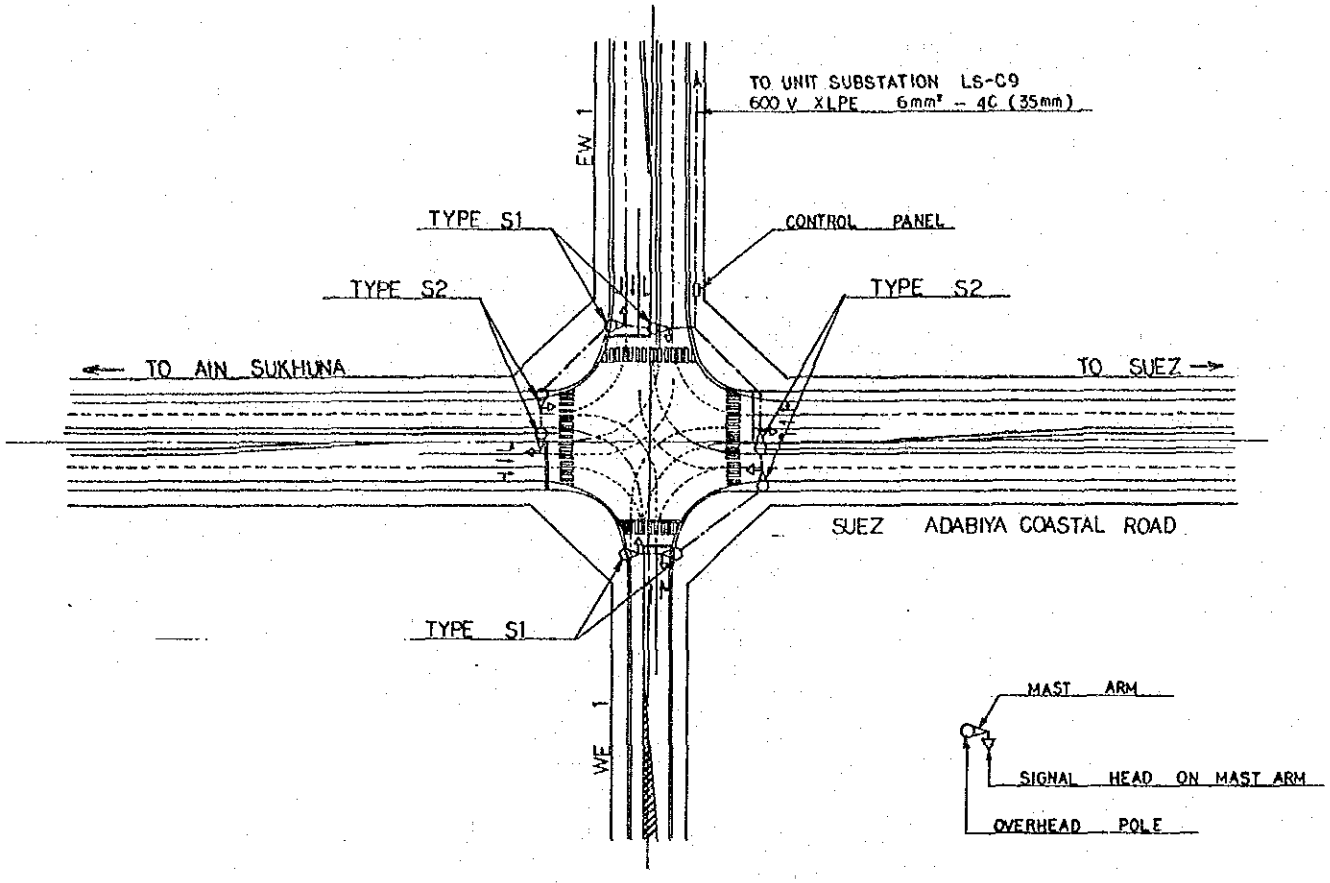
3) Traffic Signal

Traffic signals will be installed at the intersection at Suez dabiya Coastal Road and Road EW1 (hereinafter called C1). Proposed wiring plan of traffic signal, and phasing movements at intersection C1 are shown in Figure 3.4-1-5 and 3.4-1-6 respectively.

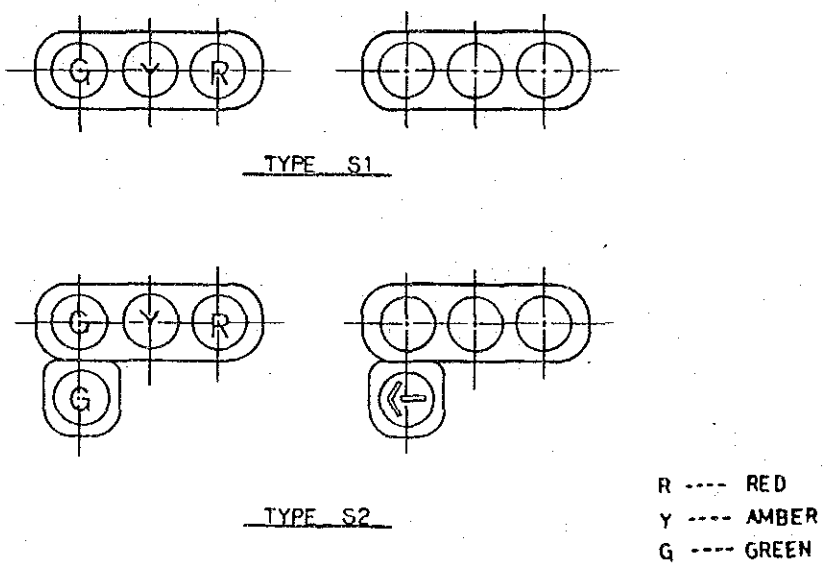
Table 3.4-1-10 Thickness of Pavement

	Pavement Classification	Design C.B.R.	Target TA (cm)	Asphalt Pavement		Bese Course c (cm)	Subbase Course d (cm)	Calculated TA (cm)	Total Thickness (cm)
				Surface Course a (cm)	Binder Course b (cm)				
Suez Adabiya Coastal Road	D	6	37	5	15	35	20	37.25	75
Ataqa I.E.(Land Area) Adabiya I.F.Z.	D	12	30	5	15	15	25	30.3	60
	C		23	5	10	10	25	23.5	50
	B		17	5	5	10	20	17.5	40
	A		13	5	-	10	25	13.5	40
Ataqa I.E. (Coastal1)	D	8	34	5	15	20	35	34.0	75
	C		26	5	10	15	30	26.3	60
	B		19	5	5	10	30	19.5	50
	A		14	5	-	10	30	14.5	45

Note: Typical cross section is shown in Figure 3.4-1-3.



(1) TRAFFIC SIGNAL WIRING PLAN



(2) SIGNAL ASPECTS

Figure 3.4-1-5 Traffic Signal Wiring Plan and Signal Aspects.

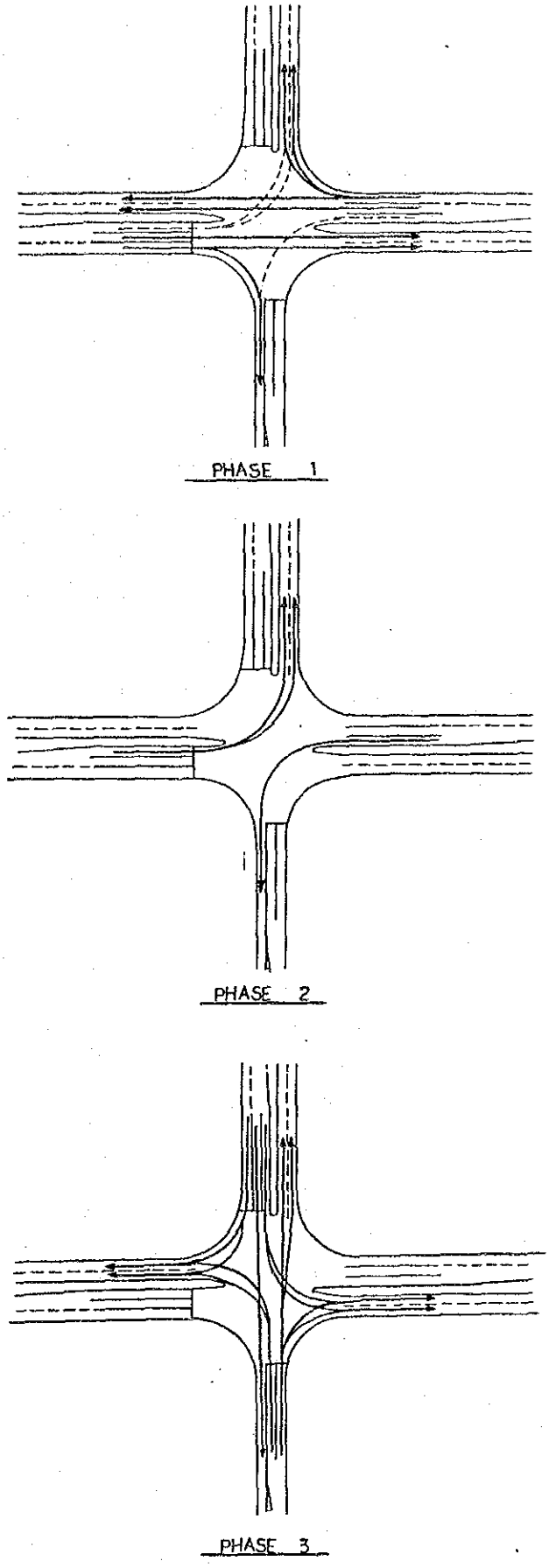


Figure 3.4-1-6 Phasing Movements of Intersetion C1

Other intersections in the industrial areas will be operated by stop signs as mentioned below.

4) Traffic Signs

Details of signs, sign boards and frames will be determined during the construction stage. The following is the some of the ideas relevant to the installation of traffic signs.

- Stop signs

Installation of stop signs is proposed at every intersection in the industrial areas except intersection C1. The locations of stop signs to be installed will be according to the priority of the roads for traffic movements. Basically East-West direction roads have higher priority than the North-West directions. The detail locations can be referred to the design drawings.

- Warning signs

Installation of the following signs is proposed.

- Curve ahead
- Intersection ahead
- Railway ahead

- Speed check signs and others

Speed check signs are installed at suitable locations, and additional signs will be installed, if necessary, during the construction stage.

(d) Road Lighting

Road lighting system will be provided at all roads and walkways in the industrial areas. Lighting intensity of each road is planned as follows.

- Suez Adabiya Coastal Road	:	11 Lx
- 30m Width Road	:	15 Lx
- Other Roads	:	12 Lx
- Walkways	:	3 Lx

The interval of the lighting poles is 40m on all roads, and the height of the lamps is 13m measured from the ground level. More detailed descriptions are referred to the Electrical work in section 3.9 of this report.

3.4.2 Earthwork

(1) Design Conditions

(a) Topographic Conditions

According to the results of topographic survey, the topographic features of the project area can be considered as follows:

1) The surface has a gentle slope extending toward the Suez Bay.

2) The surface gradient regarding the road network plan is shown in Figure 3.4-1-1, and estimated approximately as shown in Table 3.4-2-1:

Table 3.4-2-1 Estimated Surface Gradients

Road Direction	Gradients (Approx.)	
	Ataqa I.E.	Adabiya I.F.Z.
North to South	less than 0.5 to 1.0%	less than 0.5 to 2.5%
East to West	1.5 to 2.5%	2.0 to 3.5%

3) A slight depression can be seen between Ataqa I.E. and Adabiya I.F.Z. The main connection road from Adabiya-Suez/Cairo to Suez Coastal Road is located along this depression.

(b) Land Grading Plan

In considering the topographic conditions as mentioned above, three (3) alternatives of the land grading plans are taken into account. Their planning concepts and features are mentioned below:

1) Land development work will not be carried out. (Plan-1)

Planning concepts:

- Roads will be built according to the existing topography in the project area.
- The grading work of the factory lots will not be carried out.

Merits:

- More flexible land use will be materialized.
- Initial investment costs are minimized among the (3) plans.

Demerit:

- Factory lot development may be necessary at investors' own expense.

2) Factory lots will be developed into flat level. (Plan-2)

Planning Concept:

- Each factory will be developed at a flat level as shown in Figure 3.4-2-2. (See Note 1) & 2))

Merit:

- No factory lot development work may be necessary by investors except road connection.

Demerits:

- Elevations of factory lots and that of their surrounding roads are different each other.

- A development will be necessary to provide an access to the factory lot from the adjoining road.

3) Factory lots will be developed to meet the road elevations. (Plan-3)

Planning Concepts:

- All the factory lots will be developed at the same level with north-south direction road, to avoid the demerit of the Plan-2.

- Grading work will be carried out to provide two terraces which are flat in east west direction at every lot as shown in Figure 3.4-2-3 (See Note 1) & 2)).

Merit:

- Access between factory lots and roads will readily be available.

Demerits:

- Factory lots have a gentle slope same as the gradient of roads in north-south direction.
- Steep slope in the middle part of each factory lot will exist in east-west direction.
- Secondary development work may be necessary when one factory extends over the two terraces.

Note 1): The land development at the east of Ataqa I.E. will not be carried out in accordance with any of three plans because of the existing factories, i.e. Graphite Factory, Saim Darby and MISR. Oil Company.

2): Land grading plans in Figure 3.4-2-2 and 3.4-2-3 are determined by the preliminary design study for the earthwork volume in the following clause (2).

(2) Preliminary Design Study

(a) Design Concept

Preliminary design study to estimate the earthwork volume is carried out on the Plan-2 and Plan-3. The concepts of the study are summarized below:

- Road elevations are designed same as original ground levels as much as possible.

- Cut and fill volumes are to be balanced in one lot, and earthwork is to be minimized at each lot as much as possible.

- The fill volume is targeted to maintain slightly smaller than the cut volume to remedy secondary excavation for drainage ditch, pipeline facilities and other embedded structures.

(b) Design Conditions and Calculation Method

1) Topographic map

A lopographic map prepared to a scale of 1/5000, which is prepared by the topographic survey, is used for the design. The map supplied by MODANC is used to supplement the survey activities outside the survey area.

2) Swell and Shrinkage Factors

According to the grain size distribution, the soil conditions in the project area can be considered containing the medium sand and gravel. In this regard, the following swell and shrinkage factors are used.

C = 0.90
L = 1.25

where,

C = Compacted Soil Volume / Bank Volume
L = Excavated Soil Volume / Bank Volume

3) Slope Gradient

To meet the soil conditions, the following slope gradients are considered:

- Cut Slope 1 : 1.0
- fill Slope 1 : 1.2

4) Calculation Method

The earthwork volume is calculated on the basis of the difference between the original ground elevation and the proposed land grading elevation on the spots with square grids 20m by 20m.

Cut or fill volume of each mesh is calculated by the following equation:

$$dV = (dA/4) \times (dh_{i,j} + dh_{i,j+1} + dh_{i+1,j} + dh_{i+1,j+1})$$

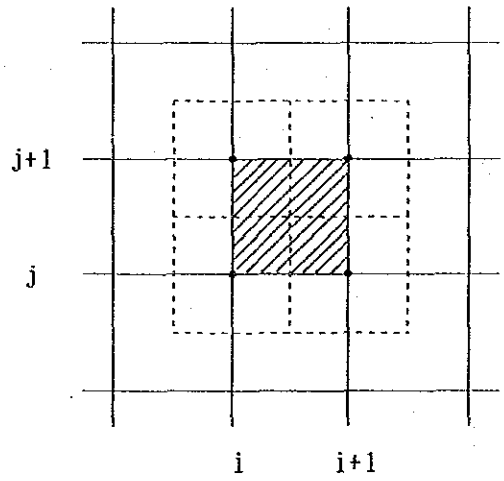
where,

dV : Volume of cut or fill of mesh unit (m3)

dA : Area of mesh unit (m2)

dh : Difference between original ground elevation and proposed land grading elevation on the spots of square grids (m)

The general idea of the calculation is as shown in the following figure.



Figur 3.4-2-1 Square Grids for Earthwork Volume Calculation

(c) Calculated Results

The land grading plans and cross sections subjected to the preliminary study are shown in Figure 3.4-2-2 to 3.4-2-5. The calculation results of Plan-2 and 3 are summarized in Table 3.4-2-2 and 3.4-2-3 respectively. According to these results, the earthwork volume is nearly same between the two (2) Plans.

Cut and fill are balanced when land excavation in situ is approx. tree (3) million cubic meter.

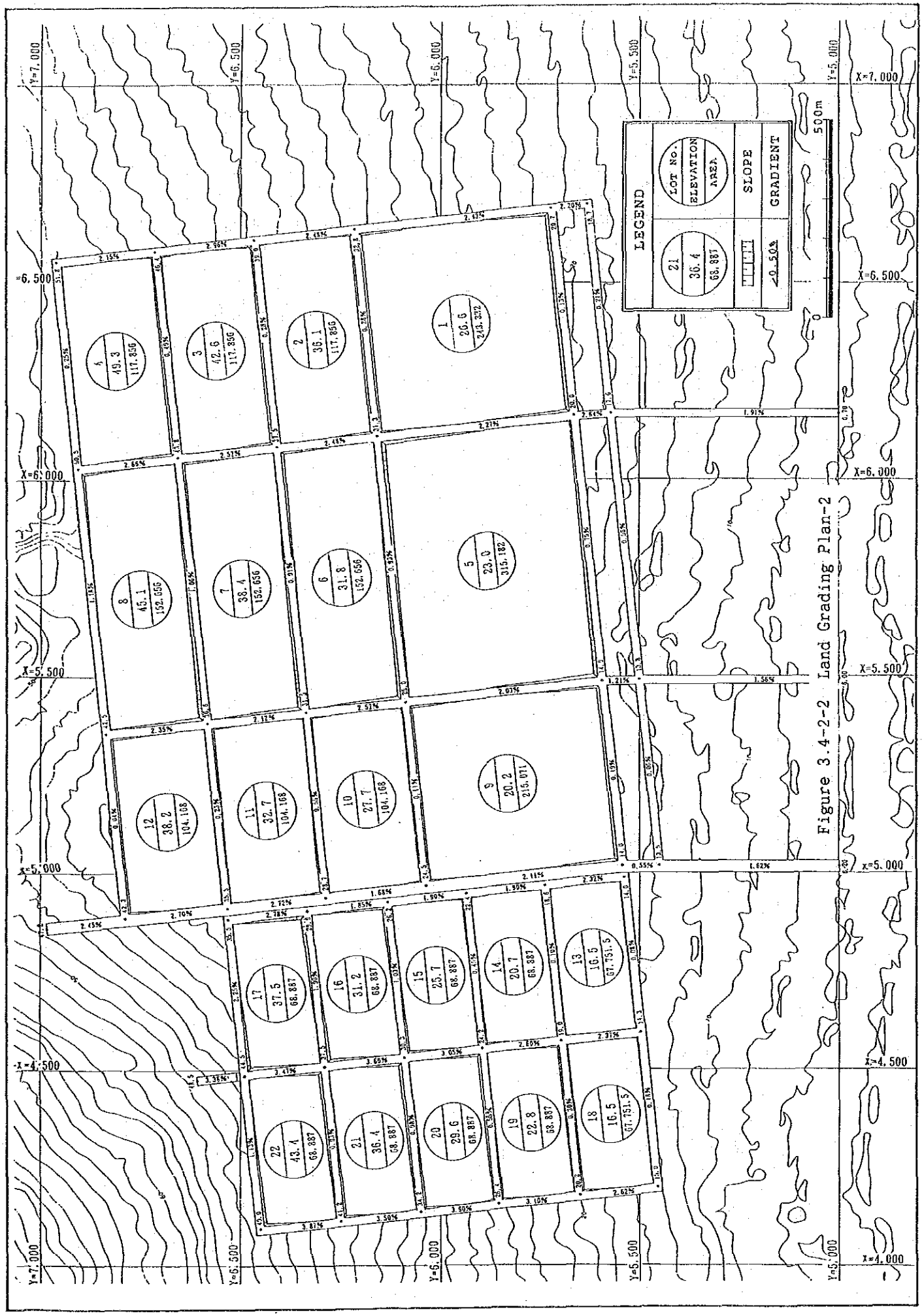


Figure 3.4-2-2 Land Grading Plan-2

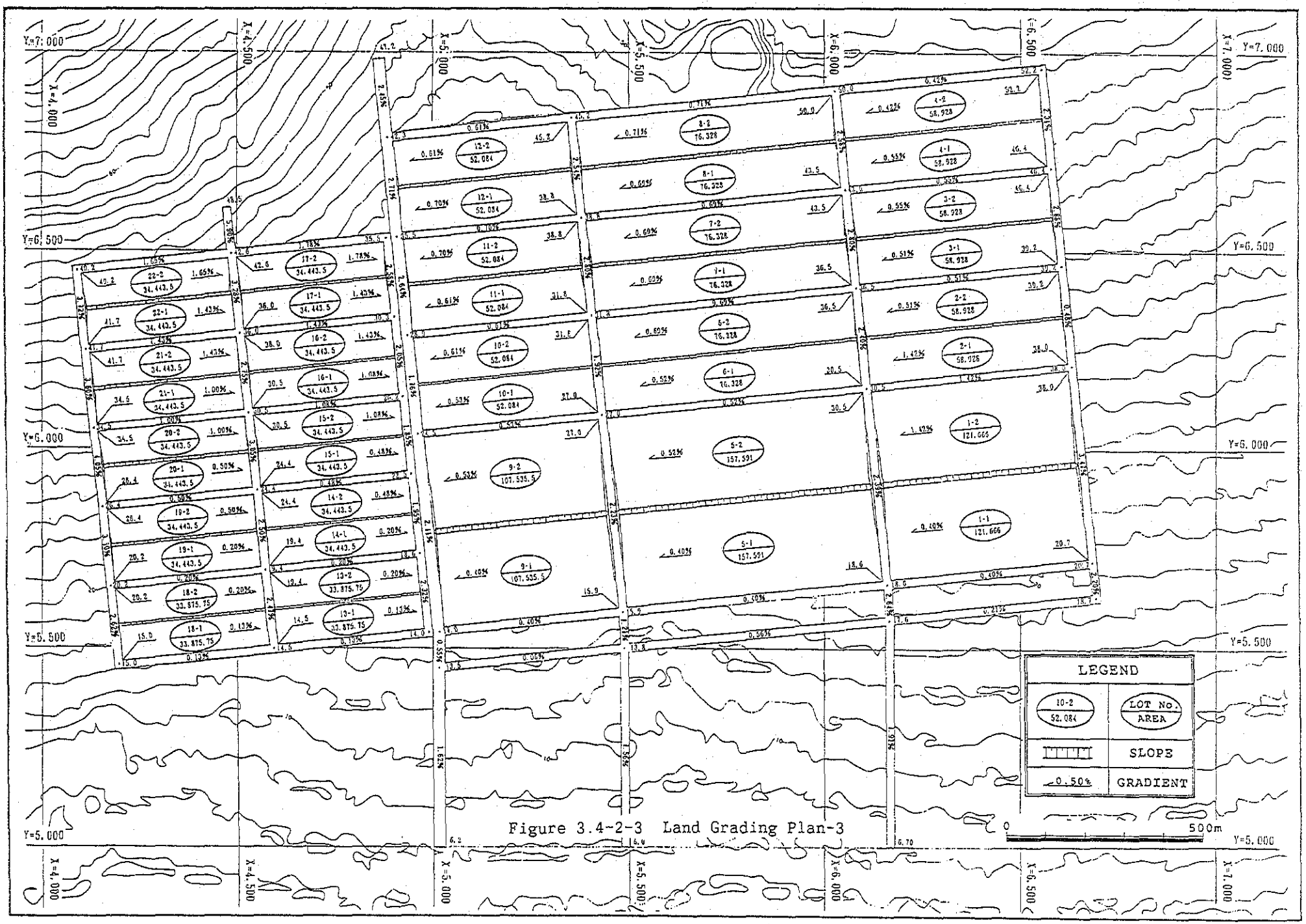
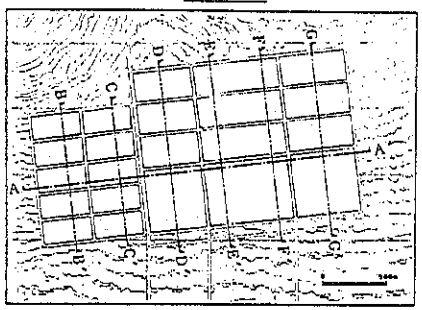
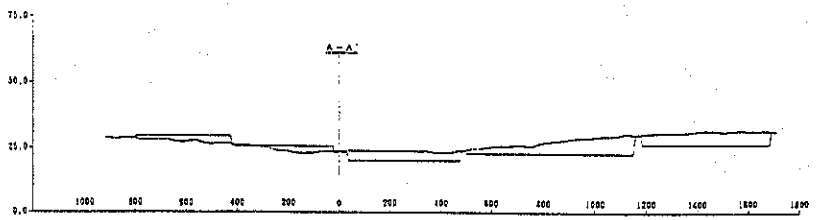
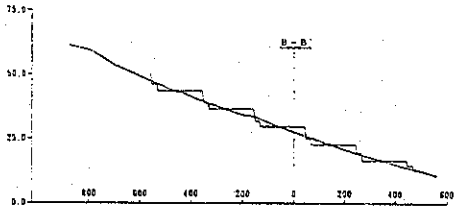


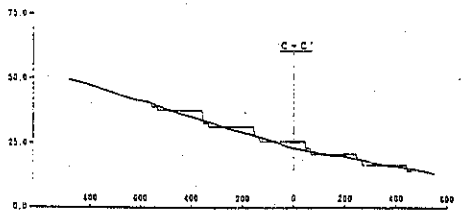
Figure 3.4-2-3 Land Grading Plan-3

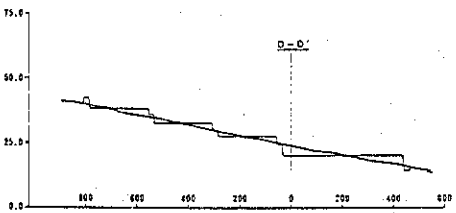
KEY MAP

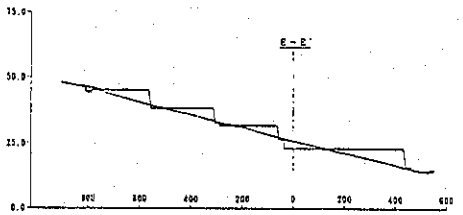


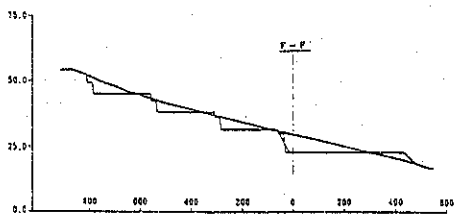












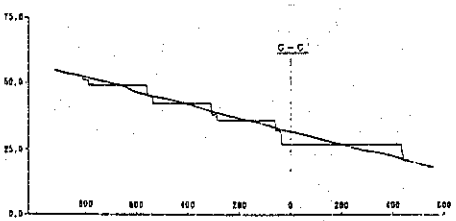


Figure 3.4-2-4 Cross Section of Land Grading Plan-2

GENERAL NOTES

DESCRIPTIONS	DWG. NO.
REFERENCE DRAWINGS	

NO.	DATE	DESCRIPTIONS	BY	APP'D
REVISIONS				

ARAB REPUBLIC OF EGYPT

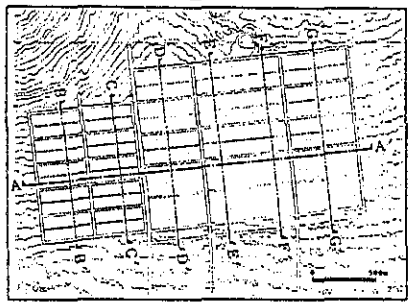
MINISTRY OF DEVELOPMENT,
NEW COMMUNITIES, HOUSING AND PUBLIC UTILITIES

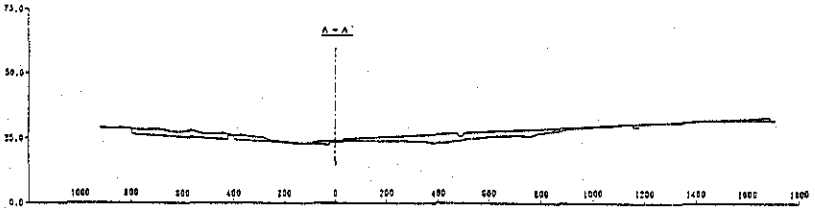
THE DETAILED DESIGN ON THE URGENT DEVELOPMENT PLAN
OF
THE SUEZ BAY COASTAL AREA DEVELOPMENT

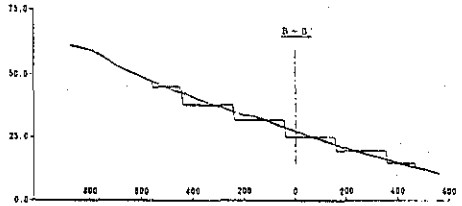
JICA JAPAN INTERNATIONAL COOPERATION AGENCY

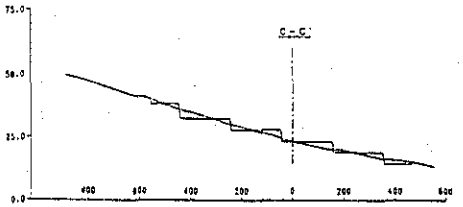
SUBMITTED	APPROVED	SCALE	REV. NO.
DATE		DWG. NO.	A – 2.5

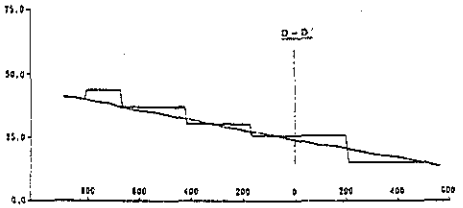
KEY MAP

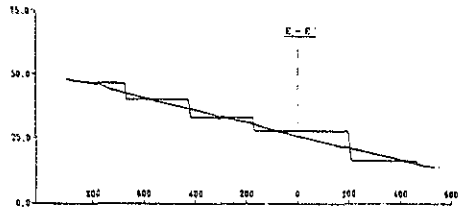












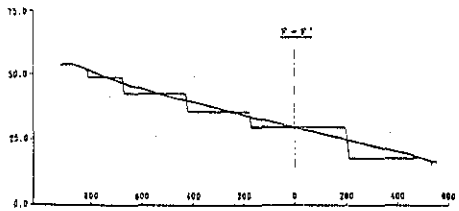


Figure 3.4-2-5 Cross Section of Land Grading Plan-3

GENERAL NOTES

DESCRIPTIONS	DWG. NO.
REFERENCE DRAWINGS	

NO.	DATE	DESCRIPTIONS	BY	APP'D
REVISIONS				

ARAB REPUBLIC OF EGYPT

MINISTRY OF DEVELOPMENT,
NEW COMMUNITIES, HOUSING AND PUBLIC UTILITIES

THE DETAILED DESIGN ON THE URGENT DEVELOPMENT PLAN
OF
THE SUEZ BAY COASTAL AREA DEVELOPMENT

JICA JAPAN INTERNATIONAL COOPERATION AGENCY

SUBMITTED	APPROVED	SCALE	REV. NO.
DATE		DWG. NO.	A – 26

Table 3.4-2-2 Estimated Volume of Cut and Fill for Land Grading Plan-2

(1) Ataqa Industial Estate

Unit: Qubic Meter

Lot No.	In Situ Volume of Actual Land Excavation ①	Volume of Excavated Soil ②=①x1.25	In Situ Volume of Actual Land Fill ③	Required Volume of Exca. Vol. for Land Fill ④=③/0.9	Required Volume of Transport for Land Fill ⑤=③x1.25	Balance(1) ① - ④	Balance(2) ② - ⑤
1	440,086.9	550,108.6	361,033.6	400,747.3	500,934.1	39,339.6	49,174.5
2	101,317.8	126,647.3	97,645.5	108,386.5	135,483.1	-7,068.7	-8,835.8
3	101,251.3	126,564.1	110,387.8	122,530.5	153,163.1	-21,279.2	-26,599.0
4	105,595.6	131,994.5	107,421.0	119,237.3	149,046.6	-13,641.7	-17,052.1
5	598,048.2	748,810.3	469,185.0	520,795.4	650,994.3	78,252.8	97,816.0
6	180,555.2	225,694.0	155,879.7	173,026.5	216,283.1	7,528.7	9,410.9
7	175,667.5	219,584.4	173,729.3	192,839.5	241,049.4	-17,172.0	-21,465.0
8	218,868.5	273,585.6	211,422.0	234,678.4	293,348.0	-15,809.9	-19,762.4
9	298,283.6	372,854.5	251,790.0	279,486.9	349,358.6	18,796.7	23,495.9
10	68,481.5	85,601.9	76,953.6	85,418.5	106,773.1	-16,937.0	-21,171.2
11	65,462.2	81,827.8	71,869.0	79,774.8	99,718.3	-14,312.4	-17,890.5
12	69,879.0	87,348.8	101,133.2	112,257.9	140,322.4	-42,378.9	-52,973.6
Sub Total	2,424,497.3	3,030,621.8	2,188,449.7	2,429,179.3	3,036,474.1	-4,682.0	-5,852.3

(2) Adabiya Industial Estate

Unit: Qubic Meter

Lot No.	In Situ Volume of Actual Land Excavation ①	Volume of Excavated Soil ②=①x1.25	In Situ Volume of Actual Land Fill ③	Required Volume of Exca. Vol. for Land Fill ④=③/0.9	Required Volume of Transport for Land Fill ⑤=③x1.25	Balance(1) ① - ④	Balance(2) ② - ⑤
13	30,582.2	38,227.8	35,526.3	39,434.2	49,292.8	-8,852.0	-11,065.0
14	38,882.8	48,603.5	45,267.5	50,246.9	62,808.6	-11,364.1	-14,205.1
15	53,804.7	67,255.9	55,767.2	61,901.6	77,377.0	-8,096.9	-10,121.1
16	62,963.3	78,704.1	63,577.9	70,571.5	88,214.4	-7,608.2	-9,510.3
17	75,312.1	94,140.1	78,622.1	87,270.5	109,088.1	-11,958.4	-14,948.0
18	47,309.0	59,136.3	51,255.4	56,893.5	71,116.9	-9,584.5	-11,980.6
19	57,114.0	71,392.5	61,083.5	67,802.7	84,753.4	-10,688.7	-13,360.9
20	62,480.5	78,100.6	64,784.2	71,910.5	89,888.1	-9,430.0	-11,787.5
21	58,712.9	73,391.1	62,182.8	69,022.9	86,278.6	-10,310.0	-12,887.5
22	63,869.2	79,836.5	62,702.0	69,599.2	86,999.0	-5,730.0	-7,162.5
Sub Total	551,030.7	688,788.4	580,768.9	644,653.5	805,816.9	-93,622.8	-117,028.5
Total	2,975,528.0	3,719,410.2	2,769,218.6	3,073,832.8	3,842,291.0	-98,304.8	-122,880.8

Table 3.4-2-3 Estimated Volume of Cut and Fill for Land Grading Plan-3

(1) Ataqa Industial Estate

Unit: Qubic Meter

Lot No.	In Situ Volume of Actual Land Excavation ①	Volume of Excavated Soil ②=①x1.25	In Situ Volume of Actual Land Fill ③	Required Volume of Exca. Vol. for Land Fill ④=③/0.9	Required Volume of Transport for Land Fill ⑤=③x1.25	Balance(1) ① - ④	Balance(2) ② - ⑤
1-1	510,754.9	638,443.6	0.0	0.0	0.0	510,754.9	638,443.6
1-2	8,313.4	10,391.8	296,185.3	328,765.7	410,957.1	-320,452.3	-400,565.3
2-1	168,607.8	210,759.8	0.0	0.0	0.0	168,607.8	210,759.8
2-2	10,932.6	13,665.8	40,481.9	44,934.9	56,168.6	-34,002.3	-42,502.8
3-1	182,810.3	228,512.9	0.0	0.0	0.0	182,810.3	228,512.9
3-2	2,185.4	2,731.8	71,883.0	79,790.1	99,737.6	-77,604.7	-97,005.8
4-1	153,955.8	192,444.8	0.0	0.0	0.0	153,955.8	192,444.8
4-2	11,564.3	14,455.4	37,361.5	41,471.3	51,839.1	-29,907.0	-37,383.7
5-1	519,404.1	649,255.1	12,475.2	13,847.5	17,309.4	505,556.6	631,945.7
5-2	3,473.6	4,342.0	501,797.1	556,994.8	696,243.5	-553,521.2	-691,901.5
6-1	125,646.4	157,058.0	3,657.6	4,059.9	5,074.9	121,586.5	151,983.1
6-2	5,901.2	7,376.5	91,610.0	101,687.1	127,108.9	-95,785.9	-119,732.4
7-1	197,720.2	247,150.3	0.0	0.0	0.0	197,720.2	247,150.3
7-2	1,597.0	1,996.3	128,394.7	142,518.1	178,147.6	-140,921.1	-176,151.3
8-1	149,720.1	187,150.1	2,720.3	3,019.5	3,774.4	146,700.6	183,375.7
8-2	17,747.7	22,184.6	106,062.2	117,729.0	147,161.3	-99,981.3	-124,976.7
9-1	327,345.3	409,181.6	2,757.3	3,060.6	3,825.8	324,284.7	405,355.8
9-2	0.0	0.0	385,579.4	427,993.1	534,991.4	-427,993.1	-534,991.4
10-1	36,552.3	45,690.4	11,696.6	12,983.2	16,229.0	23,569.1	29,461.4
10-2	219.6	274.5	95,739.3	106,270.6	132,838.3	-106,051.0	-132,563.8
11-1	55,287.1	69,108.9	2,968.8	3,295.4	4,119.3	51,991.7	64,989.6
11-2	0.0	0.0	196,111.9	217,684.2	272,105.3	-217,684.2	-272,105.3
12-1	7,616.7	9,520.9	52,732.2	58,532.7	73,165.9	-50,916.0	-63,645.0
12-2	0.0	0.0	255,244.8	283,321.7	354,152.1	-283,321.7	-354,152.1
Sub Total	2,497,355.8	3,121,695.1	2,295,459.1	2,547,959.4	3,184,949.5	-50,603.6	-63,254.4

Table 3.4-2-3 Estimated Volume of Cut and Fill for Land Grading Plan-3

(2) Adabiya Industrial Estate

Unit: Qubic Meter

Lot No.	In Situ Volume of Actual Land Excavation ①	Volume of Excavated Soil ②=①x1.25	In Situ Volume of Actual Land Fill ③	Required Volume of Exca. Vol. for Land Fill ④=③/0.9	Required Volume of Transport for Land Fill ⑤=③x1.25	Balance(1) ① - ④	Balance(2) ② - ⑤
13-1	45,675.8	57,094.8	714.7	793.3	991.6	44,882.5	56,103.2
13-2	0.0	0.0	65,561.7	72,773.5	90,966.9	-72,773.5	-90,966.9
14-1	20,328.2	25,410.3	4,650.9	5,162.5	6,453.1	15,165.7	18,957.2
14-2	0.0	0.0	66,235.5	73,521.4	91,901.8	-73,521.4	-91,901.8
15-1	33,625.0	42,031.3	2,363.4	2,623.4	3,279.3	31,001.6	38,752.0
15-2	32.9	41.1	59,598.3	66,154.1	82,692.6	-66,121.2	-82,651.5
16-1	45,378.2	56,722.8	188.5	209.2	261.5	45,169.0	56,461.3
16-2	2,256.2	2,820.3	33,478.1	37,160.7	46,450.9	-34,904.5	-43,630.6
17-1	92,589.2	115,736.5	0.0	0.0	0.0	92,589.2	115,736.5
17-2	5,475.6	6,844.5	32,784.0	36,390.2	45,487.8	-30,914.6	-38,643.3
18-1	16,930.2	21,162.8	8,032.3	8,915.9	11,144.9	8,014.3	10,017.9
18-2	0.0	0.0	76,437.7	84,845.8	106,057.3	-84,845.8	-106,057.3
19-1	44,111.4	55,139.3	1,171.0	1,299.8	1,624.8	42,811.6	53,514.5
19-2	382.6	478.3	45,665.5	50,688.7	63,360.9	-50,306.1	-62,882.6
20-1	78,398.8	97,998.5	0.0	0.0	0.0	78,398.8	97,998.5
20-2	975.2	1,219.0	53,863.6	59,788.6	74,735.8	-58,813.4	-73,516.8
21-1	70,461.6	88,077.0	0.0	0.0	0.0	70,461.6	88,077.0
21-2	1,756.3	2,195.4	44,673.9	49,588.0	61,985.0	-47,831.7	-59,789.6
22-1	92,401.7	115,502.1	40.1	44.5	55.6	92,357.2	115,446.5
22-2	4,438.5	5,548.1	43,712.4	48,520.8	60,651.0	-44,082.3	-55,102.9
Sub Total	555,217.4	694,022.1	539,171.6	598,480.4	748,100.8	-43,263.0	-54,078.7
Total	3,052,573.2	3,815,717.2	2,834,630.7	3,146,439.8	3,933,050.3	-93,866.6	-117,333.1

(3) Comparison of the Land Grading Plans

In accordance with the above mentioned matters, the features of each plan are summarized in Table 3.4-2-4.

Table 3.4-2-4 Features of Land Grading Plans

Item	Plan-1	Plan-2	Plan-3
Factory Lots Gradient	Natural Gradient	Flat	Gentle Gradient
Earth Volume for Land Development (Million m^3)	None	Cut 2.98 Fill 3.07	Cut 3.05 Fill 3.15
Connection with Roads	Good	Bad	Good
Initial Investment Cost	Low	High	High
Remarks	Recommendable	Not Recommendable	Not Recommendable

(4) Conclusions and Recommendations

According to the design study, Land Grading Plan-1 is recommended for the following reasons:

- The plan is the most economical in initial development of the project.

- There will be no significant problem to construct the factories on the natural gradient of the project area. Land development may be carried out by investors at their own expense, if necessary.

- Connection with factory lots and roads can be made at any locations.

- Flexible use of the factory lots will attract investors.

3.4.3 Reconstruction of Existing Facilities

(1) Design Concept

Due to the improvement works of the Suez Adabiya Coastal Road, existing facilities such as drainages and channels must be extended and adjusted to meet the width of the improved road.

There are three existing drainages and one channel which crosses the Suez Adabiya Coastal Road. Making some modifications are necessary to these facilities. Design concepts for improvement of these facilities are mentioned below.

(a) Pipe culvert near Sta. 7+675

These are two pipes are buried underground at site. The distance between these two pipes is approximate 30 to 40cm on the upper stream side, and they join on the lower stream side.

Recommendations to meet the site conditions are as follows.

- Upper stream side:
  Each pipe will be extended by welding a 610 mm diameter pipe to the existing one.

- Lower stream side:
  A single box culvert will be built to replace the existing two pipes.

(b) Pipe culvert near Sta. 8+400

There are two 610mm diameter pipes are buried underground. The distance between these two pipes is about 30 to 40cm on both sides of the stream.

It is recommended to extend the pipes by welding a 610mm diameter pipe to each.

(c) Box culvert near Sta. 1+30

There is a box culvert under the existing road and the dimensions of this culvert to be reconstructed must be exactly same as those of existing culverts, to ensure smooth flow of water through the openings.

(d) Box culvert near Sta. 9+810 (Alternation of existing bridge)

Due to the presence of underground pipes in the vicinity of the bridge, the widening of the bridge is impractical. Therefore, alteration of the bridge to a box culvert is recommended.

(2) Design Criteria

(a) Materials

The following conditions are taken into consideration:

1) Concrete

Table 3.4-3-1 Allowable Stresses

	Compressive Strength	Allowable Bending Compressive Stress	Allowable Shear Stress	Allowable Bond Stress
	Sigma 28	(Kg/cm^2)	(Kg/cm^2)	(Kg/cm^2)
Reinforced Concrete	240	90.0	9.0	16.0
Plain Concrete	180	70.0	8.0	-

*Bond stress is for deformed bars.

Table 3.4-3-2 Allowable Stress Factor

	Normal Condition	Seismic Condition
Reinforced Concrete	1.0	1.5
Plain Concrete	1.0	1.5

Table 3.4-3-3 Unit Weights

	Unit Weight (t/m^3)
Reinforced Concrete	2.5
Plain Concrete	2.3

2) Re-Bars

SD-30 : Allowable tensile stress = 1800 kg/cm^2

(b) Ground Water

The ground water tables considered in the design are shown in the Table 3.4-3-4 below.

Table 3.4-3-4 Ground Water Tables

Facility (Location)	Ground Water Level (Egyptian National Datum Level)
Box Culvert (Sta.7+30)	+3.04
Box Culvert (Sta.7+675)	+2.88
Pipe Culvert (Sta.9+810)	+2.70
Box Culvert (Sta.9+810) (Bridge)	+1.81

(3) Detailed Design Study

Detailed descriptions are provided in the structural calculation sheets (Design Calculation Sheets Volume I, 2 ROADS, PAVEMENT AND EARTHWORK) and design drawings.

3.4.4 Tree Planting

(1) Tree Planting on the Roads and in Utility Zones

(a) Unit Water Quantity for Tree Planting

Unit water quantities to be required by trees are as follows.

Large trees :	70 Liter/each/day
Small trees :	50 Liter/each/day
Shrubs :	15 to 17.5 Liter/m2/day

(b) Arrangement of Trees on the Roads and in Utility Zones

1) 35m Width Road

The 35m width road between the portion in front of the Sewerage Plant to be constructed under this project and the portion in front of existing Graphite Factory will be planted with trees. A unit consisting of a large tree with shrubs (2 m^2) will be placed at each walk way of the road at an interval of 10m. On median strips of 4m width is also to be planted with shrubs in clusters. A planting unit of shrubs is 4.5m in length and 4m in width, and the units are placed at an interval of 10m.

Irrigation length :	Sta.1+400m to Sta.6+200m =	4,800 m
	length of intersections =	- 370 m
	Total Irrigation Length =	4,430 m

2) 30m Width Road

A unit of large tree with shrubs is selected for the planting on each walkway of the road. The planting units similar to that of the 35m road. The median strip of 2m in width is also to be planted with shrubs in clusters for entire area.

3) 21m and 18m Width Roads

A unit of a large tree with shrubs in groups are to be planted on both walkways along the road at a 10m interval.

4) Utility Zones

Utility zones in Ataqa I.E. (existing embedded pipelines area) are to be planted with trees and shrubs in groups. The shrubs are planted in clusters and the size is 3m x 10m. They will be placed along the both edges at an interval of 10m. The large trees will be placed at the location of corners of regular triangle pattern of which one side is 10m.

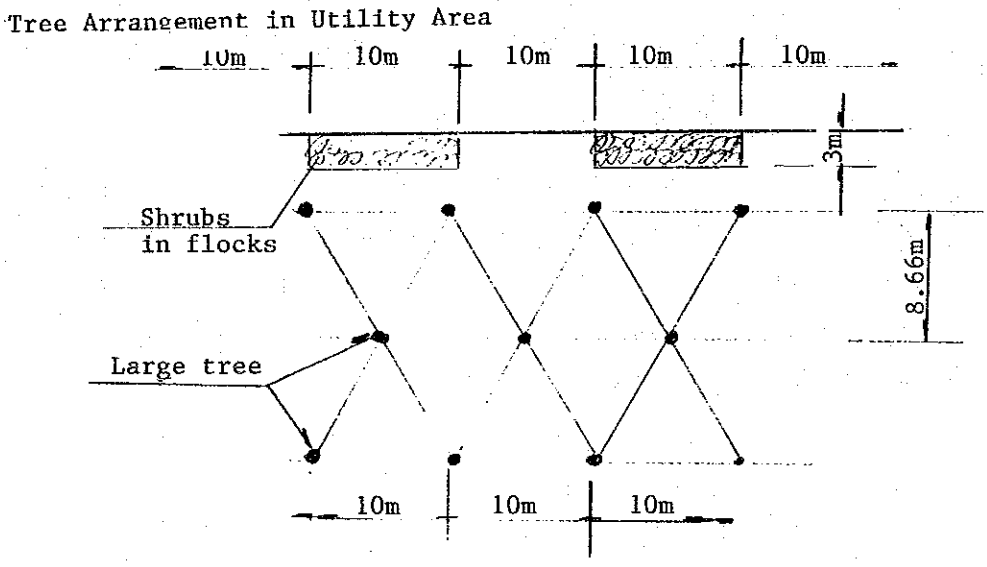


Figure 3.4-4-1 Tree Arrangement in Utility Area

(c) Number of Trees and Water Consumption on Roads

The number of trees and water consumption on the roads are calculated as shown in Table 3.4-4-1. In the calculation, the following water quantities per unit planting area are used:

Walkway of roads	= Large tree + Shrubs
	= (70 Liter + 15 Liter /m2 x 2 m2)
	= 100 Liter/Unit/day
35m Road Median Strips	=Shrubs
	= (17.5 Liter/m2 x 4 x 4.5m)
	= 315 Liter/unit/day
30m Road Median Strips	= Shrubs
	= (17.5 Liter/m2 x 2m x 10m)
	= 350 Liter/unit/day

(d) Number of Trees and Water Consumption in Utility Zones

Calculation of number of trees and water consumption in utility zones are calculated as shown in Table 3.4-4-2, Table 3.4-4-3 and Table 3.4-4-4.

Table 3.4-4-1 (1) Number of Trees and Water Consumption

(1) Suez Adabiya Coastal Road

Name of Road	Trees on		Water Q'ty		
	Walkway (Number of Trees)	Median (m^2)	Walkway (Ton)	Median (Ton)	Total (Ton)
Suez Adabiya Coastal Road	886	7,974	88.6	139.5	228.1
Sub Total(1)	886	7,974	88.6	139.5	228.1

Length for Tree Planting on Suez Adabiya Coastal Road: L=4,430 m

(2) Roads in Industrial Estate

Name of Road	Trees on		Water Q'ty		
	Walkway (Number of Trees)	Median (m^2)	Walkway (Ton)	Median (Ton)	Total (Ton)
EW- 1	336	3,365	33.6	58.9	92.5
EW- 2	622		62.1		62.1
EW- 3	346		34.7		34.7
EW- 4	252		25.1		25.1
EW-10	146		14.5		14.5
EW-11	186		18.5		18.5
EW-12	186		18.5		18.5
EW-13	78		7.8		7.8
EW-14	78		7.8		7.8
SN- 1	332		33.2		33.2
SN- 2	332		33.2		33.2
SN- 3	330		33.2		33.2
SN- 4	330		33.2		33.2
SN- 5	330		33.2		33.2
SN- 6	330		33.2		33.2
SN-10	156		15.6		15.6
SN-11	156		15.6		15.6
SN-12	156		15.6		15.6
SN-13	156		15.6		15.6
SN-14	156		15.6		15.6
SN-20	274		27.4		27.4
SN-21	156		15.6		15.6
			0.0		0.0
WE- 1	128		12.8		12.8
WE- 2	188		18.9		18.9
Sub Total(2)	5,740	3,365	574.5	58.9	633.4

Table 3.4-4-1 (2) Number of Trees and Water Consumption

(3) Utility Zone in Ataqa I. E.

Utility Zones	Group of		Water Q'ty		
	Trees (Number)	Shrubs (m^2)	Trees (Ton)	Shrubs (Ton)	Total (Ton)
1	318	1,530	22.3	23.0	45.2
2	470	2,160	32.9	32.4	65.3
3	405	1,890	28.4	28.4	56.7
Sub Total(3)	1,193	5,580	83.5	83.7	167.2

(4) Total Quantities

	Group of		Water Q'ty		
	Trees (Number)	Shrubs (m^2)	Trees (Ton)	Shrubs (Ton)	Total (Ton)
Total	7,819	16,919	746.6	282.1	1,028.7

Table 3.4-4-2 Number of Trees in Utility Zones

Zone	(1) Length (m)	(2) width (m)	(3) Area (m)	(4) Unit area (m^2)	(5) Number of Trees
1	442-10-3*2=426	80.5-10-3*2=64.5	27,477	86.6	318
2	656-10-3*2=630	80.5-10-3*2=64.5	40,635	86.6	470
3	564-10-3*2=548	80.0-10-3*2=64.0	35,072	86.6	405
Total					1,193

Note: 10m : 5m buffer zone x both side of road
3m: Width of shrubs in groups

Table 3.4-4-3 Area of Shrubs in Utility Zones

Zone	(1) Length (m)	(2) Width (m)	(3) Blocks of Shrub (Nos)	(4) Unit Area (m^2)	(5) Shrub Area (m^2)
1	432	70.5	51	30	1,530
2	646	70.5	72	30	2,160
3	554	70.0	63	30	1,890
Total			186		5,580

(3)=[(1)+(2)]*2/20m

Table 3.4-4-4 Water Consumption in Utility Zones

Zone	(1) Nos. of Trees (each)	(2) Unit Water per tree (L/each/day)	(3) Shrub Area (m^2)	(4) Unit Water per shrub (L/m^2/day)	(5) Water Consumption (L/day)
1	318	70	1,530	15	45,210
2	470	70	2,160	15	65,300
3	405	70	1,890	15	56,700
Total	1,193		5,580		167,210

(say 168 ton)

From Table 3.4-4-1, trees to be planted on the roads are 6,626, whilst the area of shrub is 11,400 m², and the water consumption is 862 ton/day. Table 3.4-4-2 to 3.4-4-4 also show that the number of trees in the utility zones are 1,193, and the area of shrubs is 5,580 m² and the water consumption is 168 ton/day. The total number of the trees on the roads and utility areas are 7,819, and the area of shrubs is 17,000 m² and the total water consumption is about 1,030 ton/day.

(e) Type of Tree to be Planted

The following trees are considered for the road and utility zones.

On walkways on the Roads	:	Large tree	= Casuarina Equisfolia
			= Acacia Sarigna
On median Strips	:	Shrub	= Nerium Oreader
			= Acacia Sarigna
On utility zones	:	Large tree	= Eucalyptus Sp.
		Shrub	= Priky pear or
			Acacia Sarigna

(2) Tree Planting in Green Belt

(a) Planning Concepts and Criteria

Green belt between US-AID Sewerage Treatment project and Ataqa I.E. is to be planted with trees. This tree planting plan has been prepared forms the basis of determing the size of the pipeline from water treatment plant to the green belt. Therefore, the detailed arrangement of the tree planting should be conducted at the time of implementation of the planting on site.

The planting will be carried out by means of utilizing draw-off water. Elevation of the planting area should be lower than that of the water treatment plant since the draw-off water flows in pipe mains by gravity. The planting area is shown in Figure 3.4-4-2.

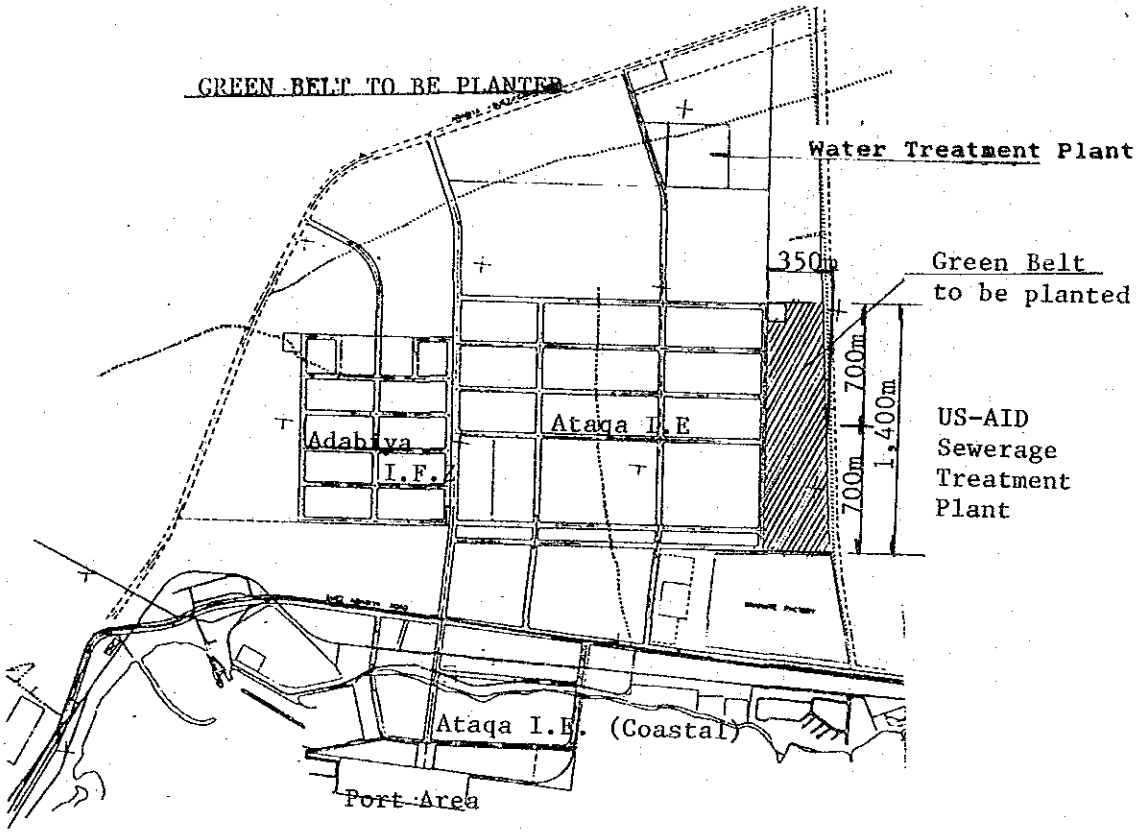


Figure 3.4-4-2 Green Belt Planting Area

The water quantity of irrigation will be estimated by using the following conditions.

Water required for	large trees	:	70 Liter/tree/day
	small trees	:	50 Liter/tree/day
	shrubs in groups	:	15 Liter/m2/day

(b) Irrigation Plan

The Green Belt in terms of the irrigation consists of two blocks, and each block contains three units (Unit A, Unit B and Unit C).

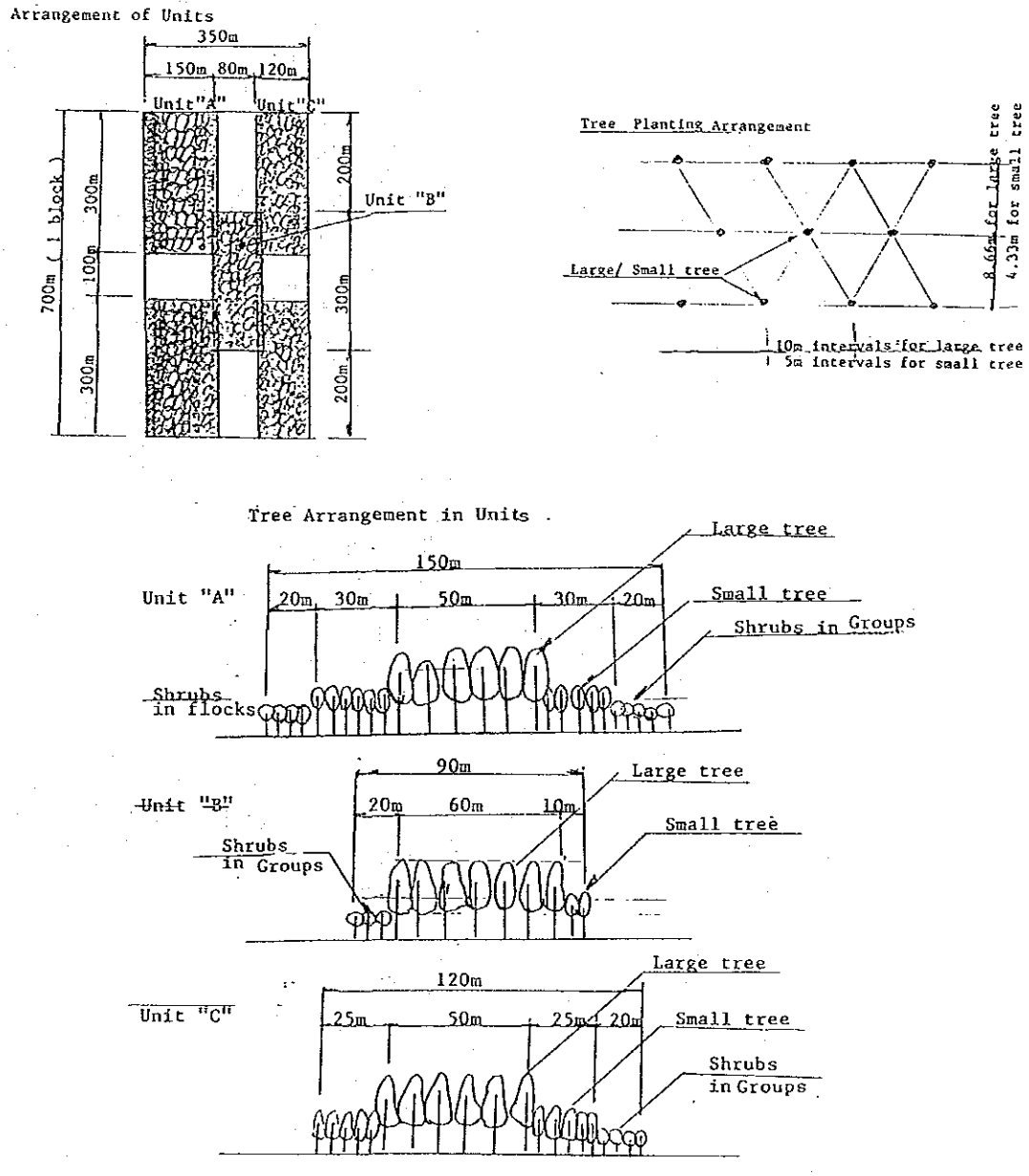


Figure 3.4-4-3 Irrigation Units of Green Belt

(c) Number of Trees and Water Consumption

Number of trees and area of shrubs per each unit are shown in Tables 3.4-4-5. and 3.4-4-6.

Table 3.4-4-5 Number of Trees and Area of Shrubs in Unit Area

Unit	Large tree		Small tree		Shrubs
	Area (m^2)	No. of tree	Area (m^2)	No. of tree	Area (m^2)
A	50x300	174	60x300	831	40x300
	=15,000		=18,000		=12,000
B	60x300	208	10x300	139	20x300
	=18,000				= 6,000
C	50x300	174	50x300	693	45x300
	=15,000				=13,500

Note : No. of Large trees= Area/86.6 ㎡

No. of small trees= Area/21.65 ㎡

Table 3.4-4-6 Water Consumption per unit

Unit	Large Tree		Small Tree		Shrubs		Total
	Tree	W.Q'ty	Tree	W.Q'ty	Tree	W.Q'ty	Tree
	(Nos)	(L/day)	(Nos)	(L/day)	(㎡)	(L/day)	(L)
A	174	12,180	831	41,550	12,000	180,000	233,730
B	208	14,560	139	6,950	6,000	90,000	115,510
C	174	12,180	693	34,650	13,500	202,500	249,330

(d) Total Water Consumption in Green Belt

Water consumption per block is as follows:

Unit A	:	233,730 x 2 units	= 467,460 Liter/block/day
Unit B	:	115,510 x 1 unit	= 115,510
Unit C	:	249,330 x 2 units	= 498,660
Total	:		1,081,630
			(say 1,082 ton)

The irrigation area consists of 2 blocks. Therefore, the total water consumption in the area is calculated as 2,164 ton per day.

(e) Type of Tree (for example)

Following trees are used for planting in the green belt.

Large tree	:	Eucalyptus Sp.
Small tree	:	Casuarina Equistifolia
Shrubs in flocks	:	Acacia Saligna