MINISTRY OF DEVELOPMENT AND NEW COMMUNITIES

ARAB REPUBLIC OF EGYPT

REHABILITATION AND MODERNIZATION OF EXISTING PORT AT PORT SAID

final report

technical report - volume III
book 1 - appendicies

OCTOBER 1978

FREDERIC R. HARRIS, INC.,
CONSULTING ENGINEERS NEW YORK CAIRO, EGYPT

associated with:

DR HASSAN ISMAIL & ASSOCIATES
CONSULTANTS CAIRO EGYPT

ENGINEER MARSHALL MORSI A MORSI

HARRIS

PN-AAM-618/62
ISN-27970

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HARRIS

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CORROSION SURVEY REPORT

NORTON CORROSION LIMITED, INC.
WOODINVILLE, WASHINGTON
U.S.A.

NORTON CORROSION LIMITED, INC.

ENGINEERING REPORT

E-6032

TO: FREDERIC R. HARRIS, INC.
3003 NEW HYDE PARK ROAD
LAKE SUCCESS, NEW YORK 11040

SUBJECT: PORT SAID SEAWALL
PORT SAID, EGYPT

REGISTERED PROFESSIONAL ENGINEER
DENNIS RAY HELGESON
NO. C347
CORROSION
STATE OF CALIFORNIA

DENNIS R. HELGESON, P.E., PROJECT ENGINEER

JUNE 30, 1978

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PORT SAID SEAWALL
PORT SAID, EGYPT

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PORT SAID SEAWALL
PORT SAID, EGYPT

1.0 INTRODUCTION:

This report presents results of our corrosion survey conducted on the Port Said Seawall. The intent of the engineering survey was to determine if the facilities, as designed, have been adversely affected by corrosion. Additionally the survey was to collect basic engineering information in preparing plans concerning corrosion mitigating procedures.

2.0 GENERAL DISCUSSION:

The principal marine structure for Port Said is the Quay wall, which extends from the southwest corner of Abbas Basin, through Sherif Basin, and into the Arsenal Basin. Water depths, wall configuration, and structural systems vary along the Quay wall.

The steel sheet piling, being investigated, under the scope of this survey is continuous beginning at the south end of Abbas Basin and extending to the northwest corner of Sherif Basin. A continuous length of approximately 1,560 meters of the Quay wall is exposed to the marine environment.

The wall was constructed in 1963 utilizing 24 meter long Yawata No. A45 sheet pilings. The sheet piling wall is supported by various tieback systems. Most of the tiebacks utilized 7.6 centimeter diameter tie rods, anchored either to an existing concrete Quay wall or to Larssen sheet piling 20 to 25 meters in back of the sheet pile wall.

Water depths along the bulkhead vary from 6 to 10 meters. The tidal fluctuations from LLW to HHW are small. The tidal range from 50 years of records indicates a variation of 140 centimeters maximum change. Offshore currents are usually parallel to the Egyptian Coast from west to east with surface speeds of .4 meters per second. North-south currents induced in the Suez Canal by the tidal and density effects, do not exceed .4 meters per second at Port Said. The maximum measured wave height is 4.0 meters. However, the waves generally do not penetrate the port, which is inside the Suez Canal. During severe storms the wind comes predominately from the north-west direction.

During Frederic R. Harris' initial investigation and preparation of an interim report for the rehabilitation of Port Said, a visual inspection of the existing sheet piling and tie rods was made. This investigation included the cutting of two samples from the sheet piling, along Abbas Basin. One sample was removed from the web of the piling and one from the flange. The report indicates that the two samples have fairly uniform general corrosion, averaging approximately 8 to 10 percent of the wall thickness. Excavation and inspection of two existing bollards and of the tie rod anchored connections of the sheet piling was also made. The two excavations, behind the Quay wall indicate that general corrosion has not substantially reduced the cross section of the tie rods. However, serious deterioration has occurred at rod connections.

During the initial construction of the bulkhead in 1963, Nakagawa C. Ping Company, Limited of Tokyo, Japan, installed a cathodic protection system to mitigate corrosion activity on the sheet piling. No records were available from either Frederic R. Harris, Port Said Officials, or the Suez Canal Authority. However,

several of the rectifier buildings are still standing, and contain 400 ampere, 100 volt rectifier units. Although all cathodic protection installations are not intact, it is estimated that the 2,400 ampere capacity system was employed to provide protection for the sheet piling sea face.

The seawall spans a lineal length of approximately 1,540 meters. The piling is driven with 24 meter long sections of piling with approximately 10 meters exposed in the water zone, 2½ meters in the splash zone, and the remainder below mud line penetration. The Larssen sheet piling, used as tiebacks, is approximately 3½ meters long and extends the entire length of the seawall. The Quay wall exposes approximately 365,000 square feet of metal surface, in the mud zone, and approximately 300,000 square feet, in the water zone, to corrosion environments. The backside of the seawall is subject to corrosion damage from the earth side of the Quay wall. A total of 665,000 square feet of metal surface area is exposed to soil side corrosion. Additionally, the Larssen sheet piling tiebacks represent 200,000 square feet of metal surface subject to corrosion damage.

Our corrosion survey and investigation was prepared to be consistent with the ongoing rehabilitation plans for the Port. Careful evaluation was made to assure the design was consistent with physical limitations of the existing port. The evaluation was also made with the understanding that it is anticipated a new port will be in operation by approximately 1985 (at which time the majority of the Port Said operations will be relocated to the new port). In other words, the corrosion investigation was directed towards evaluating the nature of corrosion activity which will occur in the subsequent eight years, and in determining what corrosion

control methods should be employed to maintain the structural integrity of the Quay wall for that period.

3.0 SURVEY PROCEDURE:

In considering the extent and nature of corrosion activity at Port Said, appropriate tests were made to determine the properties of the soil (behind the seawall) and sea water in contact with the seawall. This testing determined the relative rate of corrosion activity in the absence of cathodic protection, as well as to localize possible areas of serious corrosion activity. Specific tests included the resistivity and pH of the soil and water. The Wenner 4 Pin Method was used for the soil resistivity tests, behind the Quay wall. An Associated Research Vibroground, Model 293, was utilized for these tests. Tests were made for 10 and 20 foot depths.

A potential profile was conducted of the entire Quay wall in an attempt to localize areas of serious corrosion.

A copper-copper sulfate reference electrode in conjunction with a Miller B3 High-Resistant Potentiometer Voltmeter was used for the potential tests. Stray current investigations utilized the Miller Multimeter and two copper-copper sulfate reference electrodes. Structure-to-water potentials were recorded from several vessels, in Port Said at the time of this survey, to determine if the vessels trafficking Port Said employed cathodic protection, and how they might influence the corrosion activity on the Quay wall. NCL Drawing C-10,023 shows the approximate location of all soil and potential tests.

Continuity testing was conducted along the entire bulkhead

to ensure that electrical continuity existed throughout the structure. Individual piling joints as well as spans of five to twenty-five meters were tested. Continuity testing was made between the sheet piling and rebar in the pile caps. In addition to the testing, careful inspection of the sheet piling construction was made and notes on the extent of corrosion in the splash zone.

4.0 DISCUSSION OF DATA:

All field data collected during this survey is tabulated in the enclosed Appendices.

Electrolyte resistivity measurements are made to ascertain the relative corrosive properties of the environment of the buried/submerged steel structures. Seawater resistivities throughout the world vary from 15 to 20 ohm-cm as experienced in the Mediterranean and Middle East, and 60 ohm-cm as recorded in Cook Inlet, Alaska. In shore areas, close to areas of fresh water runoff, resistivities are often significantly different from those recorded in the open sea. Resistivity has been recorded varying from 15 ohm-cm to an excess of 3,000 ohm-cm. Resistivity provides a relative indication of the environment's resistance to the conduction of corrosion currents.

Corrosion activity on marine structures is generally extensive and complex. The average overall corrosion rate of mild steel exposed to seawater is reported to be approximately .005 inches per year. However, localized pitting occurs at an average rate of 0.01 inches per year. Therefore, in evaluating a general corrosion loss of 1/16", a consideration should be given to pitting corrosion with penetration up to 1/8". The difference in many cases changes the structural evaluation.

Soil resistivities vary considerably more than those of the

seawater environment. Therefore, generalized corrosion rates cannot be accurately determined. However, soil resistivities higher than 10,000 ohm-cm are generally considered to create minimal corrosion activity. Soils having resistivities below 5,000 ohm-cm are areas where serious corrosion activity will occur. Saturation of the soil by rain or tidal fluctuations greatly accelerates the corrosion rates.

The high corrosivity of seawater and sea air is due to the presence of chloride ion in high concentrations. This ion is small and can defuse rapidly. It confers high electrical conductivity on the electrolyte, and when involved with the hydrolysis reaction, it can provide localized activity and thereby opposes passivation of the metal surfaces.

In most areas soil and water electrolytes have approximately a neutral pH. However, in some locations unusual environmental conditions exist which create either alkaline or acid conditions for buried/submerged steel. Generally alkaline conditions pose no serious difficulty on steel because the environment is not agressive to steel. An alkaline condition at the steel surface is a side effect of the application of cathodic protection. When steel is emerged in a sufficiently caustic solution, it is essentially made to discharge no corrosion current and no metal is lost. Acid conditions around the steel surface have the general effect of making it more difficult to polzrize the metal surface when cathodic protection is applied.

Stray current corrosion can occur when a stray DC current is collected on one portion of the steel structure, travels along the structure, and is discharged in another location. Where the stray

DC current leaves a structure, localized corrosion damage occurs. Stray current corrosion activity is seldom a problem unless a significant source of DC current is within the vicinity of the buried or submerged structure.

Structure-to-water potentials, made on sheet pilings, are indicative of general corrosion conditions. Structure-to-water potentials, as referenced to a copper-copper sulfate reference electrode of -.68 volts, is generally indicative of serious corrosion activity in a marine environment. A more negative potential measurement indicates accelerated corrosion. Potentials recorded in the more positive direction, are indicative of cathodic areas with reduced corrosion activity.

An area in which cathodic protection is not effective is the wind/splash zone. However, in a tidal zone cathodic protection is partially effective. Corrosion in the splash zone is a very serious problem. Often accelerated corrosion rates are observed because oxygen is continually being presented to the metal surface, to increase the corrosion reaction. Although cathodic protection has not been effective in the wind/splash zone, the utilization of clad materials (i.e., Monel alloy 400) has been an effective means of protecting the splash zone. Other means have been the use of extending the concrete caps below the low water line. Still others have employed high quality, newly developed, coating materials, employing epoxies and glass-reinforced polyester resins. A number of coating manufacturers have developed and gained wide experience in applying a coating system on piles in the splash zone, on a rectrofit basis. Techniques have been developed for applying coatings which cure underwater, when applied by divers. They have

been reported to be exceptionally effective.

The data recorded during this survey indicates the following: The pipe-to-soil potential profile indicates the southeast end of the Sherif Basin wall to be the area of most active corrosion. This is indicated by the higher potentials recorded and additionally by the visual inspection of the splash zone. Over the majority of the sheet pile corrosion products between 1/4" and 3/8" thick could be removed easily from the steel face in the splash zone and active corrosion was observed beneath. In the southeast corner of the Sherif wall, corrosion products between 1/2" and 5/8" thick were removed. The corrosion reaction creates corrosion products which occupy 2½ to 3 times the volume of that on the base metal. Therefore, a corrosion product measuring 1/2" thick is indicative of a metal loss of approximately 1/8".

This west wall of Sherif Basin was suspected of being the area most subject to corrosion damage, because the majority of the storms and winds come from the northwest direction. The southeast wall of the Sherif Basin provides maximum exposure to the winds and storms. The winds and storms increase the dissolved oxygen in the seawater by increasing the wave action and turbulance of the water.

The remainder of the seawall generally has potentials indicative of average corrosion rates, of steel in seawater, and it can be expected that corrosion losses on the submerged portion of the seawall are in the range of 1/16" to 1/8" at present. However, areas of serious localized corrosion can still occur. Localized corrosion damage can result in serious structural problems, as indicated on the enclosed drawing, A-10,325. This sketch indicates an area where corrosion has penetrated the seawall. Penetration of the seawall,

as shown, can result in erosion of the earth, behind the wall from tidal fluctuations, winds, and storm activity.

Serious corrosion damage in the splash zone will provide detrimental effects to the structure, because all the tiebacks are anchored in this area. The tiebacks are connected to the seawall by a small bearing surface as shown on drawing A-10,324. The exposure of crevices, as in threaded bolted connections, are areas of accelerated corrosion. This was noted during an inspection of the splash zone. Also, the present sheet piling fendering is secured to the sheet piling wall by flange plates which are bolted to the wall. A small number of the fenderings have been damaged and are presently missing from the seawall. A contributing factor to the failure of these fenders is the corrosion which has reduced the structural security of the fasteners.

In evaluating all the corrosion data, serious consideration should be given to the corrosion activity that is occurring on both faces of the seawall, and both sides of the tieback rods. While corrosion loss on the back side of the wall can be projected (based upon environmental conditions measured) as being significantly less, metal loss is also occurring from this side of the piling. Therefore, a loss of 1/32" from the back side and 1/8" from the seawater side, would total a metal loss of 5/32".

Another serious observation, from the data recorded, is the corrosion cell which exists at the mud line. That portion of the surface, imbedded in the mud, is in a higher resistant environment and potentials are more electronegative. Those portions of the metal surface, exposed to the seawater, are more electropositive. Therefore, the seawater areas are acting as anodic areas, attempting

to provide cathodic protection to those areas below the mud line. This phenomenon is consistent and uniform along seawall at Port Said, as indicated in the potential profile. The effect becomes more localized and serious very close to the mud line. Corrosion within one foot of mud line will be twice the general corrosion rates measured.

5.0 CONCLUSIONS:

Our conclusions, following our field inspection, testing, and review of the developmental planning are as follows:

1. Very serious corrosion damage has occurred, and is continuing to occur in the splash zone of the sheet piling at Port Said. The continued corrosion activity potentially will result in serious structural questions being raised, concerning the tieback rods and connections. If structure life is extended beyond 1985, serious deterioration of the pile caps are expected if no control action is taken.

2. The potential profile combined with the electrolyte resistivities indicates that serious submerged corrosion activity is occurring along the entire seawall. The most serious corrosion activity is localized along the entire mud line of the seawall. The specific area in which actual metal loss is probably the greatest is the eastern end of the south wall of the Sherif Basin.

3. Soil resistivity data indicates that serious corrosion

activity is also occurring on the backside of the sheet piling. This presents serious structural questions with regard to the tiebacks supporting the wall. Although inspection indicated that general corrosion loss and tieback rod reduction are not large at this time, it does indicate fittings and connections to be areas of accelerated corrosion.

4. To ensure structural integrity of the seawall through 1985, corrosion control methods must be employed. Different corrosion control techniques must be employed for the submerged/buried surfaces than for the splash zone.

5. Ultrasonic testing data will not add significantly to the conclusions. Ultrasonic data will indicate the general corrosion losses, as reported above, and also the most serious corrosion is occurring at the mud line and south wall of Sherif Basin.

6.0 RECOMMENDATIONS:

The following recommendations are made concerning the physical conditions of the seawall and its present operating procedures, in conjunction with the planned rehabilitation, as described in Frederic R. Harris interim report.

1. Corrosion control must be installed to reduce the corrosion activity in the splash zone. A number of techniques can be employed to mitigate this problem and they include, Monel cladding, concrete facing, and

epoxy or resin coating. It is NCL's recommendation, considering the future plans for Port Said, that the best method is a cold tar epoxy coating applied to the splash zone. This coating installation would require blasting of the splash zone prior to the application of the coating.

2. To ensure structural integrity of the bulkhead wall to 1985, and perhaps beyond, it is imperative that cathodic protection be restored. Cathodic protection on the sea-water face must be restored by the installation of an impressed current system. This system should have a capacity of 2,000 amperes. The system should be designed for a ten year life, to allow for a transition period between Port Said and the new port.

3. In the event the Ministry of Housing and Reconstruction, Republic of Egypt, decides that a new port is not feasible, and extensive rehabilitation of Port Said is to proceed for a period extending significantly beyond 1985, it is strongly recommended that an impressed current cathodic protection system also be installed on the back side of the seawall. Although corrosion rates on the backside are less than the seawater side, serious corrosion damage is occurring, which affects the structural integrity of the facilities over an extended life. The system for the backside should be designed for approximately 700 amperes and a 20 year life. If anticipated use of the

port is expected beyond 1985, the system to be designed for the seawater side should also be designed for a 20 year life.

7.0 ESTIMATED COSTS:

The following costs are estimates for completing the installation of corrosion control. The estimates provided are based on U. S. dollars and upon conventional U. S. construction practices. However, allowances must be made for the labor intensive Egyptian work force, which would increase the cost of installation labor.

ITEM	ESTIMATED MATERIAL COSTS	ESTIMATED LABOR COSTS	ESTIMATED ENGINEERING COSTS
Coating of the Splash Zone	$100,000	$150,000	$10,000
Cathodic Protection Seaside	$120,000	$150,000	$30,000
Cathodic Protection Backside	$ 50,000	$110,000	$15,000

PORT SAID QUAY WALL
PORT SAID, EGYPT

Data Sheet No. 1
DRH:E6032 (Page 1 of 3)

STRUCTURE-TO-WATER POTENTIALS
Cu-$CuSO_4$ VOLTS (NEG.)

LOCATION	POTENTIALS -2' DEPTH	POTENTIALS -25' DEPTH
1. South end of Abbas Basin Piling - Point "A"	.72	.74
2. 50' north of "A"	.68	69
3. 100' north of "A"	.58	63
4. 150' north of "A"	.62	66
5. 200' north of "A"	.64	66
6. 250' north of "A"	.66	70
7. 300' north of "A"	.67	69
8. 350' north of "A"	.64	68
9. 400' north of "A" NOTE: Damaged fender	.68	73
10. 450' north of "A" NOTE: (Ship)	.64	70
11. 650' north of "A" NOTE: Damaged fender	.56	60
12. 700' north of "A" NOTE: Damaged fender	.74	.76
13. 750' north of "A" NOTE: (Ship)	.60	.64
14. 950' north of "A"	.67	.70
15. 1000' north of "A"	.68	.72
16. 1050' north of "A"	.60	.64
17. 1100' north of "A"	.67	.70
18. 1150' north of "A"	.62	.66
19. 1200' north of "A"	.63	.66
20. 1250' north of "A"	.72	.76

STRUCTURE-TO-WATER POTENTIALS
Cu-$CuSO_4$ VOLTS (NEG.)

LOCATION	POTENTIALS -2' DEPTH	-25' DEPTH
21. 1300' north of "A"	.60	.64
22. 1350' north of "A"	.68	.70
23. 1400' north of "A"	.64	.68
24. 1450' north of "A"	.67	.69
25. 1500' north of "A"	.67	.70
26. 1550' north of "A"	.62	.66
27. 1600' north of "A"	.66	.69
28. 1650' north of "A" NOTE: Around "OB Server"	.68	.72
29. 250' south of Point "B"	.67	.69
30. 200' south of "B"	.67	.69
31. 150' south of "B"	.66	.67
32. 100' south of "B"	.67	.68
33. 50' south of "B"	.66	.68
34. Corner Point "B"	.64	.68
35. 50' west of Point "B"	.68	.72
36. 100' west of "B"	.72	.74
37. 150' west of "B" NOTE: (Ship)	.69	.73
38. 550' west of "B"	.72	.74
39. 700' west of "B"	.69	.70
40. 750' west of "B"	.72	.74
41. 850' west of "B"	.72	.74
42. 900' west of "B"	.77	.79
43. 950' west of "B"	.72	.74

STRUCTURE-TO-WATER POTENTIALS
Cu-$CuSO_4$ VOLTS (NEG.)

LOCATION	POTENTIALS -2' DEPTH	-25' DEPTH
44. 1000' west of Point "B"	.63	.67
45. 1050' west of "B"	.67	.69
46. 650' east of Point "C"	.68	.72
47. 600' east of "C"	.69	.74
48. 400' east of "C"	.74	.77
49. 350' east of "C"	.72	.76
50. 300' east of "C"	.70	.74
51. 250' east of "C"	.75	.78
52. 200' east of "C"	.70	.74
53. 150' east of "C"	.70	.71
54. 100' east of "C"	.74	.78
55. 50' east of "C"	.74	.76
56. Point "C"	.68	.72
57. 50' north of Point "C"	.72	.74
58. 100' north of "C"	.68	.71
59. 250' north of "C"	.72	.74
60. 300' north of "C"	.72	.76
61. 350' north of "C"	.68	.70
62. 500' north of "C"	.68	.70
63. 200' south of Point "D"	.66	.68
64. 150' south of "D"	.67	.68
65. 100' south of "D"	.67	.67
66. Point "D"	.66	.67

NORTON CORROSION LIMITED

PORT SAID QUAY WALL
PORT SAID, EGYPT

Data Sheet No. 2
DRH:E6032 (Page 1 of 1)

RESISTIVITY
WATER/SOIL SAMPLES

SAMPLE NO.	RESISTIVITY OHM-CM	pH
1	5000	7.0
Saturated with seawater	55	7.1
2	4600	7.1
3	4200	6.9
4	23	7.2
5	17	7.4
6	19	7.2
7	18	7.3
8	17	7.2
9	16	7.4

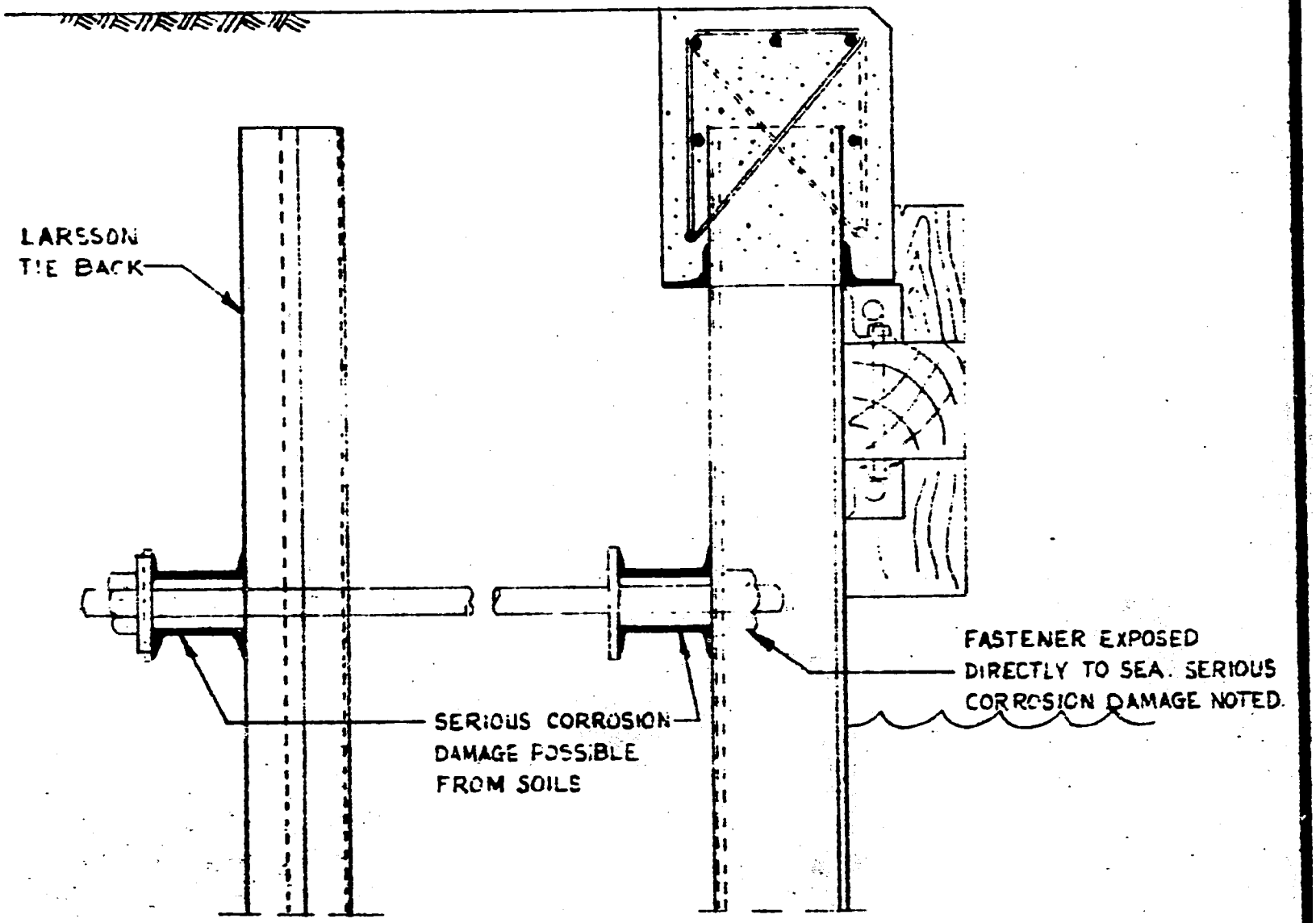
NORTON CORROSION LIMITED

PORT SAID QUAY WALL
PORT SAID, EGYPT

Data Sheet No. 3
DHR:E6032 (Page 1 of 1)

RESISTIVITY
WENNER -4 PIN METHOD

TEST LOCATION	DEPTH FEET	RESISTIVITY OHM-CM
1. 30 meter behind bulkhead and parallel to wall	10	12,500
	20	6,600
2. 30 meter behind Quay wall and parallel	20	5,800
3. 40 meter behind Quay wall and parallel	10	11,400
	20	7,500
4. Open area adjacent to roadway	10	15,700
	20	6,400
5. Parallel to roadway by fence	10	12,200
	20	8,400

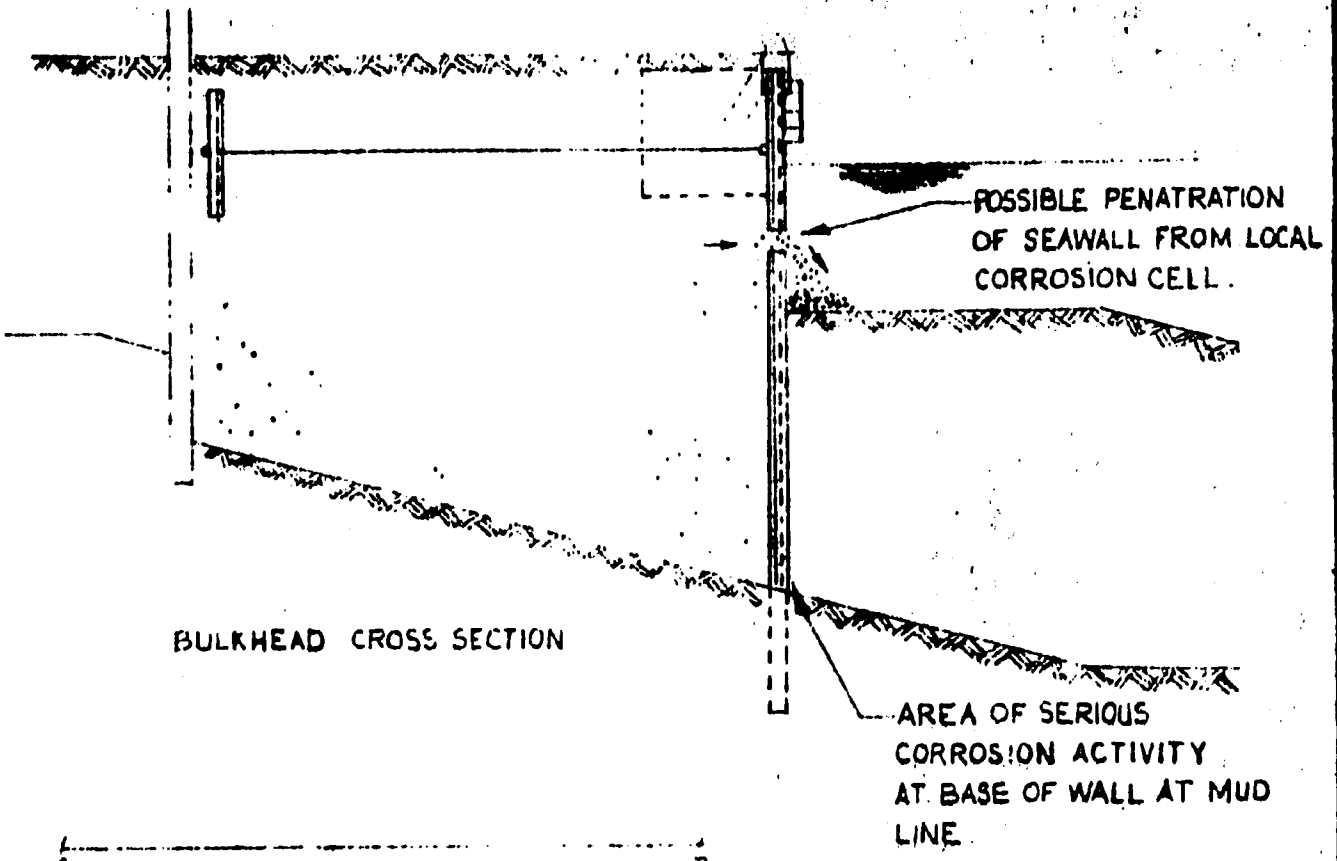


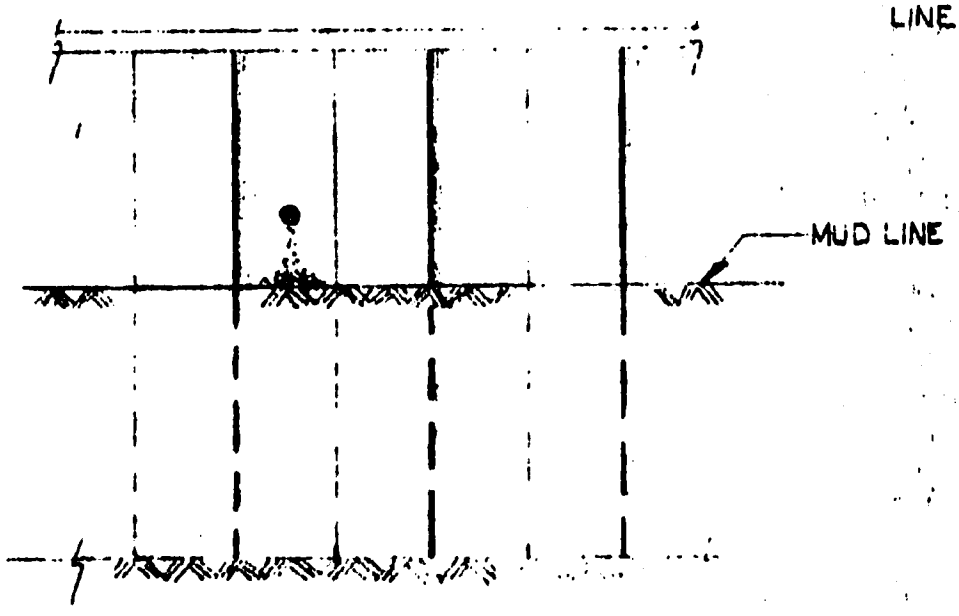
TYPICAL CAP SECTION

NORTON CORROSION LIMITED
WOODINVILLE, WASHINGTON

SPLASH ZONE CORROSION
PORT SAID QUAY WALL
PORT SAID, EGYPT

DATE: 6 28 '83
DWN.
APP.
A.N. 324



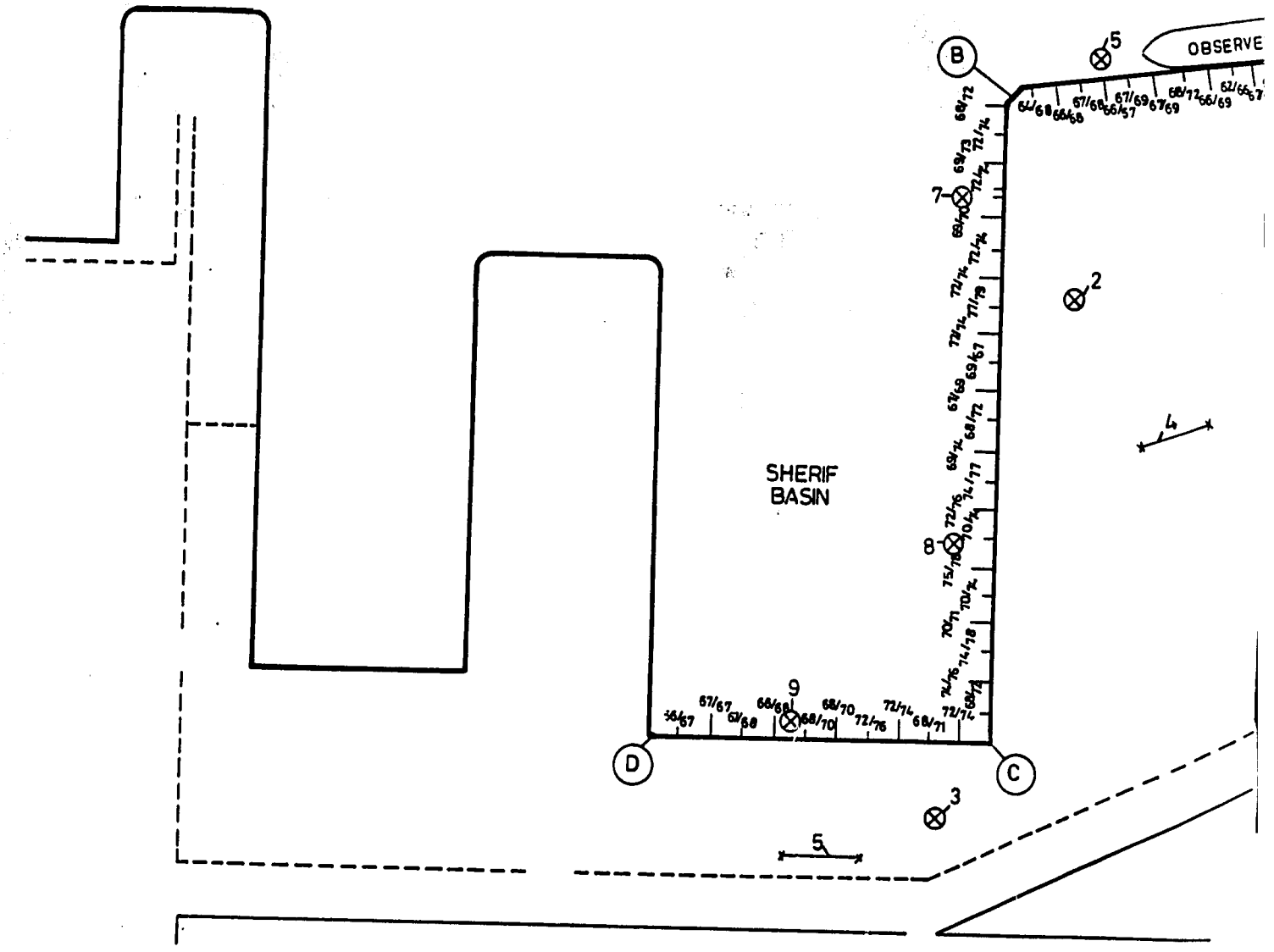


BULKHEAD FRONT VIEW

NORTON CORROSION LIMITED
WOODINVILLE, WASHINGTON

POSSIBLE CORROSION FAILURE
PORT SAID QUAY WALL
PORT SAID, EGYPT

DATE: 6-28-78	DWN. CP APP. TEH	A 10,325


OBSERVE
SHERIF
BASIN
B
C
D
2
3
4
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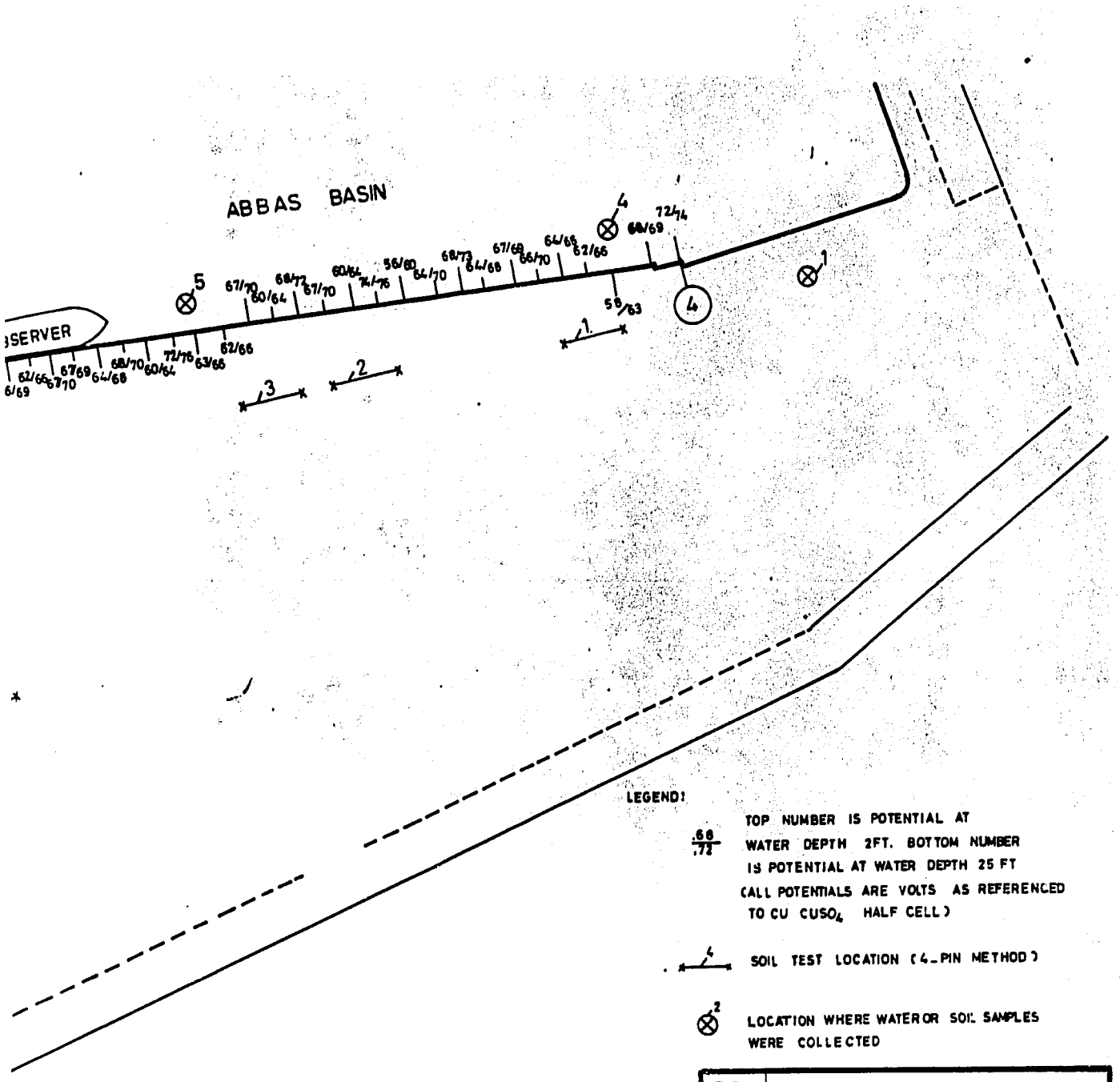
7
8
9



NORTON CORROSION LIMTED WOODINVILLE . WASHINGTON		
LOCATION TEST POINTS PORT SAID QUAY WALL PORT SAID . EGYPT		
DATE:	DWN. APP. PRH	C-10023

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27

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APPENDIX B

SHIP HANDLING AND MANEUVERING GRAIN VESSELS FOR MOORING ALONGSIDE OBSERVER

CAPTAIN ALISTER CROMBIE
RESTON, VIRGINIA
U.S.A.

1803 Cranberry Lane
Reston, Virginia 22091

1st August 1978

Frederick R. Harris, Inc.
Consulting Engineers
3003 New Hyde Park Road
Lake Success, New York 11040

Attn: Mr. F. Wilson

RE: RECONSTRUCTION OF PORT WORKS
PORT SAID, ARAB
REPUBLIC OF EGYPT

Gentlemen:

In reference to your request, I have examined the problems of shiphandling and maneuvering of grain laden vessels alongside the craft OBSERVER when that craft is eventually relocated and moored at the southern end of ABBAS BASIN.

1-1 You did not specifically ask me to comment on the merits of the proposal to relocate OBSERVER but I would point out that the presence of OBSERVER in her present location, together with a large bulk carrier moored alongside her, would inhibit movement of ships to the projected berths at the South end of the Basin. In any event, OBSERVER is really a static floating structure rather than a ship and logic, together with sound operational practice, dictates that static floating structures be located where they cause least obstruction to navigation. If this principle is not observed, much potential for damage, both to structure and other craft, is created raising associated issues of liability and insurance.

1-2 In considering possible maneuvering techniques for bulk vessels berthing at ABBAS BASIN, I have used the ship dimensions given by you, overall length 260 meters plus with the largest ship contemplated being MANHATTAN of 306 meters in length. The limiting draft given to me is 38 feet (11.6 meters) and I assume that this value allows for adequate under keel clearance, say one meter, in the approaches to and at the proposed berth. It is obvious that a limiting draft of 38 feet in ships where the loaded draft is greater will increase the freeboard or windage. In the extreme case of the MANHATTAN, the loaded draft is 52.781 feet (16.08M) with an equivalent freeboard of 15.083 feet (4.6M). If the draft of this ship is limited to 38 feet (11.6M), the corresponding freeboard is increased by 14.7 feet (4.5M).

1-3 An increase in the windage or side shell area exposed would have considerable influence on maneuvering abilities. While the average wind force within Port Said is generally moderate, the undersigned knows that wind conditions in excess of Beaufort 3 (10 knots - 18.5Kph) occasionally occur and vessel movement in those circumstances might have to be restricted or prohibited.

1-4 The significant tidal drift within the harbour is believed to be 0.75 knot (0.4M/sec) in a southerly direction. This should not affect vessel movements to any great extent and may even assist some of the maneuvers described later.

1-5 It has been assumed by me that qualified pilots and suitable tugs are available. For the size of ship being discussed here, at least 7000 tug horsepower is required in not less than two units.

2-1 Assuming that OBSERVER has been relocated at the southern end of ABBAS BASIN, head to the North and port side alongside two mooring platforms extending from the shore, there are two methods which can be utilized in berthing large bulk carriers alongside OBSERVER on her outboard side.

2-2 Using the first method, the bulk carrier would enter the port, traverse the approach fairway at a suitable speed and, assisted by tugs, approach OBSERVER bow first heading South. The ship would be brought up or stopped approximately abeam of OBSERVER and then pushed or warped alongside.

2-3 The advantage of this method is that it is fairly simple and, if nothing goes wrong, can be carried out in the minimum of time. Additionally, when deberthing to proceed outwards, the ship is swung in a light condition which is theoretically easier to do unless in excessive wind conditions when it might become impracticable.

2-4 The disadvantage of this method is that even a small error of judgment in assessing speed can have severe consequences. In this type of ship, the reduction of speed, which is obviously necessary in approaching berth, causes an impairment of steering ability. If, in addition, it is necessary to work the engines astern to correct excessive headway, the ship may develop a violent swing of bow to starboard, towards OBSERVER. It is also obvious that there would be a possibility of running aground in the shallow water at the south end of the Basin.

2-5 It is the experience of the undersigned that the conditions described in the previous paragraph have contributed more to damaged ships and piers than any other cause. In ships of this deadweight at slow speeds the reaction to rudder and screw is slow and occasionally unpredictable. An error in judging speed requiring an astern engine movement can have serious consequences.

3-1 For these reasons, the undersigned recommends that the alternative method, described in succeeding paragraphs, is more suitable for this location and conditions.

3-2 Using the second method, the bulk carrier would enter the port, traverse the approach fairway at a suitable speed gradually decelerating to about one knot (51.5 cm/sec) upon reaching a position off the SHERIF BASIN.

3-3 At this point, with the tugs already secured, the ship is swung and then towed stern first towards OBSERVER. The area available for the swinging operation is estimated to be completely adequate, especially if the ship's bow was entered into the outer part of SHERIF BASIN. In this case, the southerly tidal stream in the main harbour would push on the ship's starboard quarter and assist the swing.

3-4 After having been swung, the ship would have to be towed stern first over a distance of approximately 3,250 feet (1000M). At a speed of about 0.5 knots, the operation would occupy about 30 minutes.

3-5 The advantage of this method is that it is safer. If the ship develops too much sternway on approaching OBSERVER, the engine can be used ahead in which condition maximum screw effect is exerted on the rudder and directional stability controlled. In addition, any excess headway which may be present when approaching the SHERIF BASIN swinging area is eliminated by the process of swinging. There is an additional bonus in the subsequent deberthing operation when the ship leaves as she is heading in the correct direction thus enabling some economy in the use of tugs and time.

3-6 The main disadvantage of this method is that it takes longer to carry out and requires that the tug secured aft to have considerable power for the stern first towing operation. Two tugs of lesser horsepower are really more useful than a single unit of similar ability.

3-7 It is difficult to quantify actual performance times as these would vary according to the abilities of individual pilots and tugs. However, if the conspicuous Dome at Commercial Basin and the center of OBSERVER's new berth are taken as reference points, the distance between them is about 5,200 feet (1,584M).

3-8 In the head first bow South berthing method, if the average speed between Dome and in position abeam of OBSERVER is 0.75 knots (38.6cm/sec) the elapsed time is 38 minutes.

3-9 In the stern first berthing method, the ship can cover the distance between Dome and swinging area at about 1 to 1.5 knots (51.5 to 77 cm/sec) in 16 minutes. Assuming about 15 minutes to swing and (as stated in Paragraph 3-4) about 30 minutes to back up stern first to abeam of OBSERVER, the elapsed time between Dome and OBSERVER would total 61 minutes.

3-10 Thus the stern first berthing method provides a much safer operation for a penalty of 23 minutes.

3-11 Any time penalty caused by relocation of OBSERVER from existing to proposed position would be negligible whilst berthing/deberthing operations would not be, in any way, made more complex or costly in terms of tug employment, etc.

4 With regard to the actual mooring of bulk carriers alongside OBSERVER the proposed arrangements appear to be satisfactory up to a point. Some advantage might be gained by installing quick release hooks instead of bollards on the pier and the proposed arrangement of Bow/stern/breast lines would not prevent the bulk carrier from ranging due to Canal movements. A shore wire from the south wall of the Basin and a similar long lead at the other end of the ship would be necessary to prevent ranging movement. Alternatively, long springs on OBSERVER would eliminate ranging but in this case, the permanent moorings of OBSERVER itself might have to be strengthened. Some form of fendering between the two craft would be necessary.

5 I have discussed berthing methods at some length in order to emphasize that relocating OBSERVER at the proposed new berth raises no problems so far as ship maneuvering is concerned. I have not dealt with actual timing of movements to or from ABBAS BASIN as I understand that you have already completed a study into this area of operation.

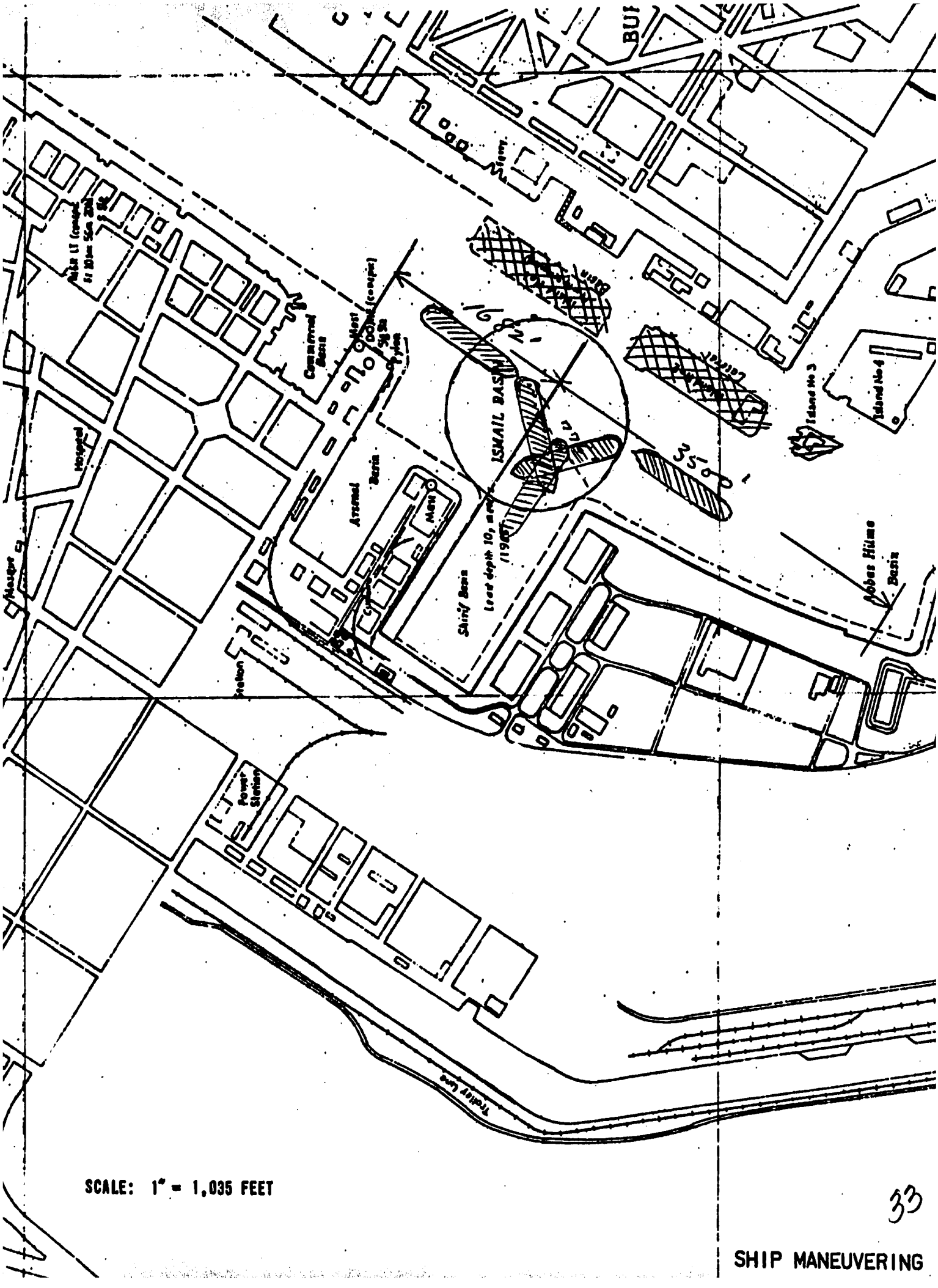
Please feel free to contact me if you have any queries on the substance of this report.

Very truly yours,

Alister Crombie

Captain Alister Crombie

CAC/jkp



SCALE: 1" = 1,035 FEET

SHIP MANEUVERING

APPENDIX C

PLANNING AND ARCHITECTURE

PORT SAID DEVELOPMENT

During the ten years of construction of the Suez Canal (from 1859 to 1869) Port Said was the focus of world-wide attention; many of the dramatic diagrams, maps and etchings were produced at that period.

As the Suez Canal was being constructed a new harbor was growing at Port Said. It was essential to have adequate facilities for unloading construction equipment, food, medicine, and other supplies. In addition to the construction of breakwaters, the harbor itself had to be dredged to a greater depth. Between 1859 and 1892 other work was in various stages of progress, the lighthouse was rising and the town of Port Said was taking shape on a length of land.

In the years since its completion, the Suez Canal and Port Said in particular, has occasionally been the scene of conflict, as in the 1956 crisis in which Great Britain, France and Israel stood on the brink of war with the Arab Republic of Egypt over possession of the waterway. But more frequently the hundred mile long channel beginning with Port Said in the north and ending with Suez in the south, has been the route of profitable commerce and peaceful travel between East and West, and thus has been a force for world unity.

To keep up with this heritage of the port of Port Said is not an easy task. The goal was here to maintain the past location with an upgraded port operation optimally efficient, looking towards a peaceful and fruitful future.

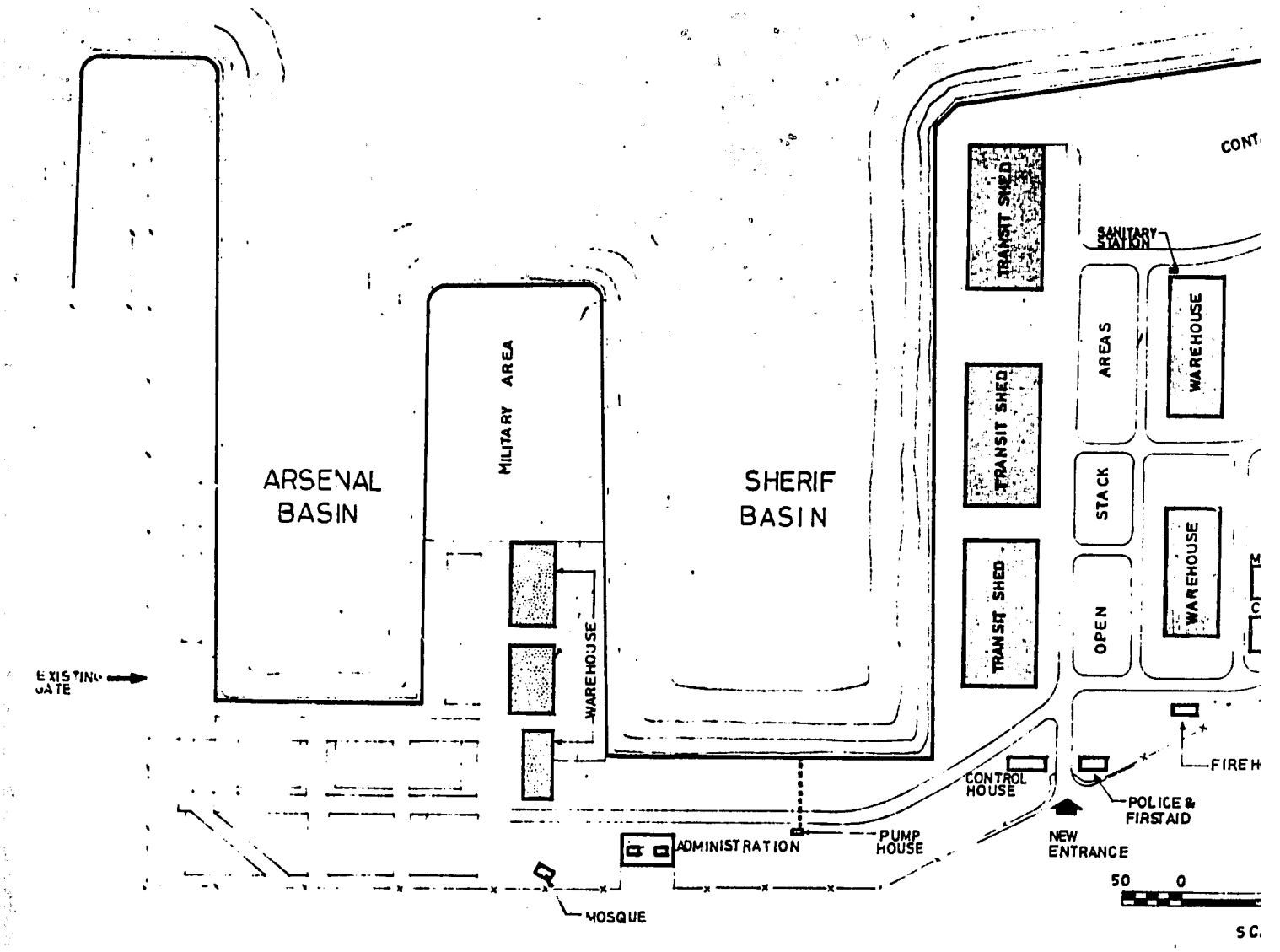
Site Plan and Circulation

The final design layout and site plan for the port of Port Said is shown in Figure A. This comprises the spatial distribution of the various architectural components together with the circulation network. The site plan is characterized by the clarity of distribution of the various activity zones and the simplicity of the overall structure, function and circulation.

The functions and activities within a port are considered as an industrial process. Its constituent elements are cargo receiving and cargo shipping. The more cargo and the faster it moves in and out of the port, the more efficient the port becomes. According to local labor time standards for each job and daily production rates, the type and amount of equipment and/or work area needed for each operation has been considered. With these two things optimized, a smoother flow of cargo through the port can be achieved.

In designing the port layout all factors were considered to be interdependent. Because of the wide scope and the deep interaction involved, no general approach to an optimal layout was considered. Instead, rules, principles, and approaches which have proved valuable in the past were utilized. The development of a good layout was the result of a series of primary decisions that included location of zones, capacity of each, handling methods, followed by a multitude of less basic, but nevertheless important decisions on the position and arrangement of architectural components, flow of cargo, cargo handling, climatic effects on cargo, equipment and labor, production control, and functional expression.

Some of the aspects that were considered vital in designing the layout, such as function and climate, are discussed in detail.


ARSENAL BASIN
MILITARY AREA
WAREHOUSE
SHERIF BASIN
TRANSIT SHED
TRANSIT SHED
TRANSIT SHED
SANITARY STATION
AREAS
WAREHOUSE
STACK
OPEN
WAREHOUSE
EXISTING GATE
CONTROL HOUSE
POLICE & FIRST AID
NEW ENTRANCE
ADMINISTRATION
PUMP HOUSE
MOSQUE
50
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HARRIS

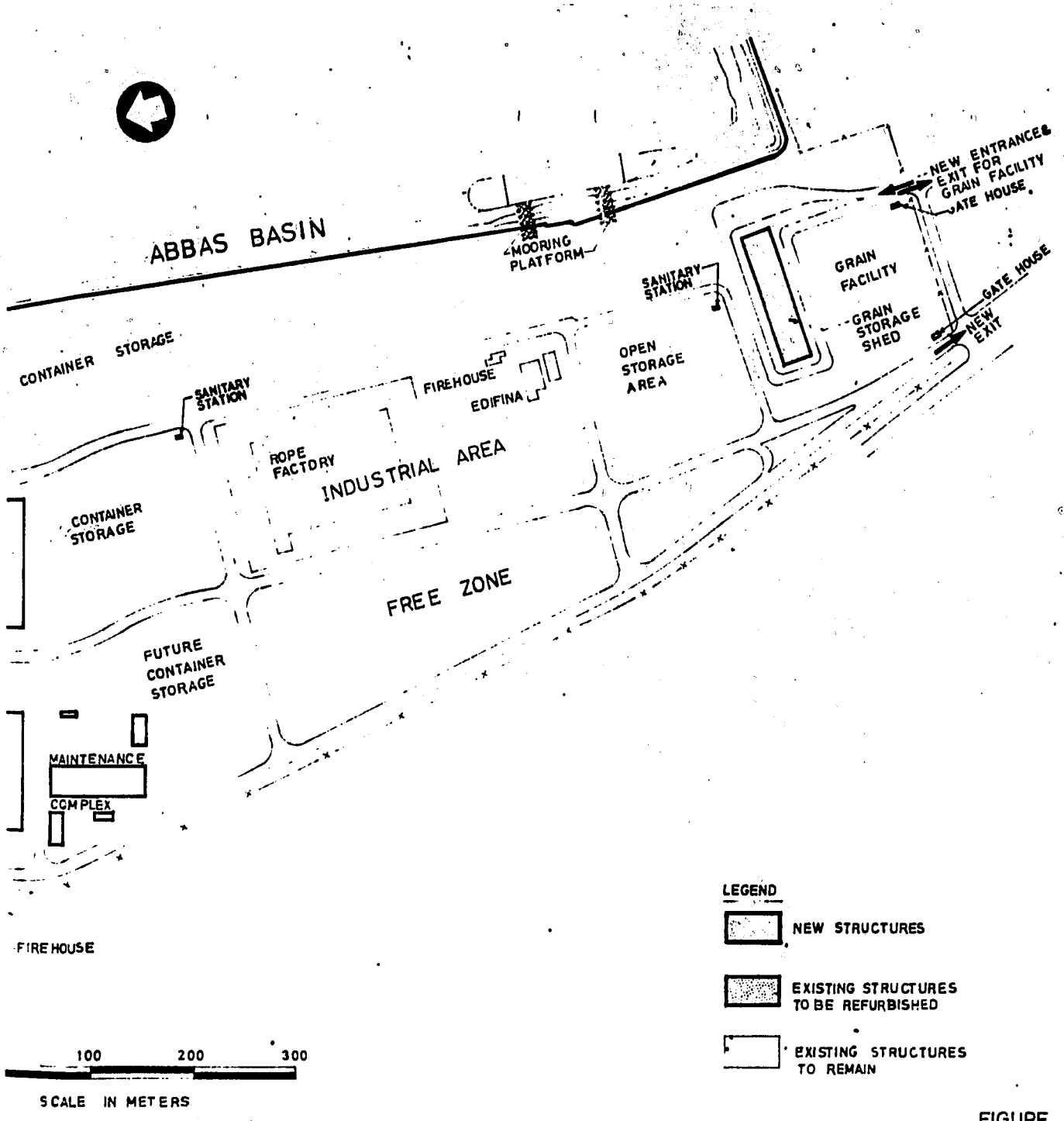

FIGURE A

RECOMMENDED REHABILITATION 38
ALTERNATE 5—A 39

The Visual Form

In designing the various buildings and architectural components for the port, the following principles and visual criteria were adhered to.

1. The buildings are designed from the inside-out with full consideration given to the functional requirements of the building.

2. Functions were never sacrificed to achieve a predetermined form.

3. The interrelationships of the structures, both visual and functional, was given utmost attention. Thus the spaces between these buildings are visually satisfactory in terms of proportions, shapes, enclosure and scale.

4. Alternative structural systems were analysed and an optimum system was chosen for each structure. Functional suitability and economy were given priority in the evaluation of alternative systems. This ultimately resulted in a prevailing sense of unity and harmony between the various buildings in spite of the variety of structural systems used (steel frames, flat slabs, etc.).

5. Linear geometry and rectilinear forms were most suitable in terms of functions and flexibility of design.

6. Due respect was given to climatic factors in

designing the various port structures.

7. All architectural components are simple in form. Simplicity is important to achieve visual clarity and congruency to the functional and rational character of the buildings and to optimize maintenance efficiency.

8. Careful choices of materials, finishes and colors (to enhance the clarity of form, simplicity of architectural expression and unity) was observed throughout the design process.

The unity and harmony among the architectural components of buildings is evident from an examination of the structures shown in the contract drawings.

The style and visual forms of the various buildings are discussed in some detail in the following review of the various architectural components.

A Climatic Analysis

A detailed analysis of the climate of Port Said (longitude 82° 14', latitude 81° 17', altitude = 1 m.) was undertaken to determine the impact of the climate elements on the design of the various buildings of the port. The analysis was based on published meteorological data.

Port Said is located in the maritime climatic zone of Egypt, characterized by a combination of the desert and Mediterranean climates: hot dry summers, cool and relatively wet winters, a high diurnal range -- hot days in summer, cool winter days, strong solar radiation, high humidity causing discomfort by preventing sufficient evaporation.

Tables 1, 2, 3 and 4 at the rear of the text combine the main features of Port Said climate and turn such basic data from a diagnosis to indicators, and finally into specific design criteria and recommendations covering a wide range of design elements such as layout, spacing between buildings, air movements, sizes of openings, etc.

Solar Radiation

Total radiation intensities for various surfaces were also compiled and taken into consideration in designing various buildings and in the choice of building materials and finishes.

Sun Shading

The climatic analysis of Port Said gave special attention to the question of solar control by means of orientation of buildings as well as through the careful use of shading devices.

The sun path diagram for the latitude 30° N was used with facades facing cardinal points superimposed on them. Critical times when shading is needed are also indicated on the diagrams, See Figures 3 thru 12. Vertical and horizontal shadow angles for the various facades were carefully studied. The results of these studies were taken into consideration in the design of port structures.

Architectural Components

The port of Port Said has a wide range of buildings. The present work covers newly designed structures and those requiring extensive rehabilitation work. The chief architectural components are as follows:

1. Three new transit sheds.
2. Two new warehouses.
3. A new fire station and training yard area.
4. A new police and first aid station.
5. A new administration building and port facilities area.
6. A new maintenance and repair shop.
7. A new security and control building and control houses at each gate.
8. Repairs to the existing mosque; landscaping to the surrounding area.

The main features of these components are outlined below and the design principals followed in developing their forms are highlighted.

Transit Sheds

The major function of the three (3) new transit sheds are to provide temporary storage space for goods off-loaded from vessels, and for goods arriving to the port by land that are to be loaded onto vessels. Transit sheds are designed for short term storage. Long term storage is provided by warehouses. Hence the new transit sheds were designed as interchange points between goods transported by water and by land; their prime function is to provide a temporary store for these goods during the short time available between receiving and discharging them.

In designing the new transit sheds the following factors were considered:

1. The importance of the truck in land transport requires that loading and unloading areas and access roads be well defined, and that turning points and curbs be carefully designed.

2. The increasing cargo carrying capacity of ships requires adequate storage and berth space.

3. The labor saving devices for cargo handling, forklifts, mobile cranes, etc., requires careful design of structural bays, width of bays, doors and gateways, adequate heights, etc.

Design Features

Transit sheds have the following features:

-- Covered area = 7200 sq. m.

-- External dimension = 60 x 120 sq. m.

-- Toilets, lockers, secured storage and offices (on two levels)

-- Structural system: Prefabricated steel frames spanning 60 m. with three meters overhang on each end parallel to the aprons and the loading area. This is a very useful feature as it protects the northern facade from rain, and the southern facade from sun.

-- Structural grid: The structural grid is spaced 8 meters on center and is 60 meters wide.

-- Space features vs. function: The covered space is divided into 15 bays (five groups of three bays). For each group the central bay is to have access and exit doors opposite each other, i.e. direct circulation feeding the flanking bays. For economic reasons the total span was divided into three equal spaces.

-- Doors are located along the apron and directly opposite on the rear of the sheds, and at both ends of the shed. Heights were taken to be not less than 4.5 m. for forklift clearance.

Warehouses

Two new warehouses are to be built in the new port complex. Their main function is to provide adequate storage space for goods to be stored for longer periods than permitted in the transit sheds.

The buildings are similar in design to the transit sheds. Simple rectangular buildings covered with prefabricated sheets. Toilets, lockers and offices are provided in the warehouses.

Main features of the warehouses:

-- Area covered = 45 x 120 m. = 5400 sq. m.

-- Structural system = steel frames:
spans - 15 m.
width of bays - 8 m.
Structural grid - 8 x 15 m.

The buildings run in an east-west direction with logitudinal sides facing north and south. This is the best orientation to minimize solar radiation and exposure to direct sunlight. The structure extends beyond the facade to provide shelter from rain and sun along the northern and southern facades, respectively.

Roof slopes are 1:12 to allow for effective rainwater runoff, and to reduce concentration of hot air at the top of the ceiling.

The storage space is interrupted by intermediate columns. Bay dimensions and the generous provision of access and exit points on three sides of the warehouse make the building an efficient and economic one for its purpose.

It should be noted that because goods are stored for a relatively long period of time, handling and moving of goods will occur infrequently and therefore column free storage space is not a significant requirement for the warehouse design.

Fire Station

Main elements:

1. Apparatus room for three (3) trucks, triple combination pumping engine: length (28') 840 m., width (8') 2.4 m., height (6'11") 2.10 m., dimensions 9 x 12 m. covered area. The floor is to be of concrete and walls are of a material that can be easily cleaned. Floors have sufficient drains for water runoff.

2. Hose dry area and training yard: Area 6 x 12 m. -- two stories in height. Inclined hose racks are to be installed on side walls and a hose dry area is provided.

3. Offices and toilets are at ground level and officers and fire brigade quarters are at the mezzanine level.

Building features:

Structural system: concrete frames spanning 12 m. and panelling beams

Structural grid: 3 x 3 m. grid

Materials and finishes: exterior walls are to be poured-in-place 150 mm concrete walls. The building is a simple rectangle with the apparatus room in the middle flanked by offices and the training yard.

Police and First Aid Center

This structure is a simple rectangular building divided in plan into three separate sections. There are three bays provided for parking police and ambulance vehicles. The north side is to be occupied by the police station, the south by the first aid center.

The building is a single story structure constructed of concrete frames, each frame has a span of 12.0 m.

Administration Building

This structure is a two story building with two internal open courts. It has two distinct zones:

-- an area accessible to the public

-- an area solely for employees where public access is strictly controlled

Both areas are contained within one space and the plan is designed to emphasize this functional articulation.

At the ground level two distinct compartments can be identified -- 8 x 24 m. rectangular compartment providing accommodations for staff entrance facilities and vertical circulation, and a public compartment designed around an open courtyard. The two compartments are separated by a landscaped passage providing physical articulation and linkage between the two zones. The top floor contains office spaces overlooking the two courtyards.

The structural system consists of square columns and 8 x 8 m. flat slabs. The building is designed using an eight meter structural grid as a basis, hence the 3 x 5 bays are interrupted by two 64 sq. m. (8 m. x 8 m.) courts.

The roof and first floor slabs project 1.0 m. all around to provide shelter and protection from the sun. On the first floor it also creates an enclosure which will be used for shelves, lockers and cupboards.

Furthermore, the two courts with their carefully designed proportions will provide shaded outdoor spaces inducing air movement and improving the quality of the internal environment of the building.

Other Architectural Components

The following buildings, which were not included in the list presented earlier because of their relative unimportance architecturally, have also been included in the design package.

-- Wash racks
-- Toilets and lavatories
-- Pumphouse
-- Police booths

A comprehensive list of new structures provided for the rehabilitated port is shown in Section 6, Volume II, Technical Report.

TABLE 1

TABLE 1

Location	Port Said
Longitude	32° 14'
Latitude	31° 17'
Altitude	0.8 M

Air temperature C

	J	F	M	A	M	J	J	A	S	O	N	D	High	AMT
Monthly mean max	18	19	20	23	26	29	30	31	29	27	24	20	31	21
Monthly mean min	11	12	14	16	20	22	24	25	24	22	18	14	11	20
Monthly mean range	9	7	6	7	6	7	6	6	5	5	6	6	Low	AMT

Relative humidity %

Monthly mean max a m	--	--	--	--	--	--	--	--	--	--	--	--
Monthly mean min p m	--	--	--	--	--	--	--	--	--	--	--	--
Average	73	71	69	72	71	72	74	73	70	64	72	74
Humidity group	4	4	3	4	4	4	4	4	3	3	4	4

Humidity group	1	If average RH. below 30%
	2	30 50%
	3	50 70%
	4	above 70%

Rain and wind

Rainfall, mm	11.2	11.8	8.6	1.4	3.5	--	--	--	0.1	2.4	9.1	17.7	66.3	Total

Wind, prevailing	SW	W	W	N	N	N	N	N	N	N	NE	SW
Wind secondary	W	NE	NE	NW	NE	NW	NW	NW	NW	NE	N-NE	NE
	J	F	M	A	M	J	J	A	S	O	N	D

TABLE 2

Comfort limits		AMT over 20°C		AMT 15-20°C		AMT below 15°C	
		Day	Night	Day	Night	Day	Night
Humidity group:	1	26-34	17-25	23-32	14-23	21-30	12-21
	2	25-31	17-24	22-30	14-22	20-27	12-20
	3	23-29	17-23	21-28	14-21	19-26	12-19
	4	22-27	17-21	20-25	14-20	18-24	12-18

TABLE 2
Diagnosis: °C

	J	F	M	A	M	J	J	A	S	O	N	D		
Monthly mean max.	18	19	20	23	26	29	30	31	29	27	24	20	21	AMT
Day comfort upper	27	27	27	29	27	27	27	27	29	29	27	27		
lower	22	22	22	23	22	22	22	22	23	23	22	22		
Monthly mean min.	11	12	14	16	20	22	24	25	24	22	18	14		
Night comfort: upper	21	21	21	23	21	21	21	21	21	21	21	21		
lower	17	17	17	17	17	17	17	17	17	17	17	17		
Thermal stress: day	C	C	C	–	–	H	H	H	H	–	–	C		
night	C	C	C	C	–	H	H	H	H	H	–	–		

Indicators

Humid:	H1						x	x	x	x				4 Totals
	H2				x	x					x	x		4
	H3													0
Arid.	A1													0
	A2													0
	A3	x	x	x									x	4

Applicable when Meaning	Indicator	Thermal stress Day	Thermal stress Night	Rainfall	Humidity group	Monthly mean range
Air movement essential	H1	H			4	
		H			2, 3	Less than 10°
Air movement desirable	H2	O			4	
Rain protection necessary	H3			Over 200 mm		
Thermal capacity necessary	A1				1, 2, 3	More than 10°
Out door sleeping desirable	A2		H		1, 2	
		H	O		1, 2	More than 10°
Protection from cold	A3	C				

TABLE 3

TABLE 3
Recommended specificati

Indicator totals from table 2					
H1	H2	H3	A1	A2	A3
4	4	0	0	0	4

Layout

			0-10			x	1	Orientation north and south (long axis east-west)
			11, 12		5-12			
					0-4	x	2	Compact courtyard planning

Spacing

11, 12							3	Open spacing for breeze penetration
2-10						x	4	As 3, but protection from hot and cold wind
0, 1							5	Compact lay-out of estates

Air movement

3-12						x	6	Rooms single banked, permanent provision for air movement
1, 2			0 5					
			6 12				7	Double banked rooms, temporary provision for air movement
0	2-12							
	0, 1						8	No air movement requirement

Openings

			0, 1		0		9	Large openings, 40-80%
			11, 12		0, 1		10	Very small openings, 10-20%
Any other conditions						x	11	Medium openings, 20–40%

Walls

			0 2			x	12	Light walls, short time-lag
			3 12				13	Heavy external and internal walls

Roofs

			0-5			x	14	Light, insulated roofs
			6 12				15	Heavy roofs, over 8 h time-lag

Rain protection

		3-12				x	17	Protection from heavy rain necessary

TABLE 4

Indicator totals from table 2					
H1	H2	H3	A1	A2	A3
4	4	0	0	0	4

TABLE 4

Detail recommendations

Size of opening

			0, 1		0		1	Large 40 80%
					1 12	x	2	Medium 25 40%
			2 5					
			6–10				3	Small 15 25%
			11, 12		0 3		4	Very small 10 20%
					4 12		5	Medium 25 40%

Position of openings

3 12						x	6	In north and south walls at body height on windward side
1 2			0 5					
			6 12				7	As above, openings also in internal walls
0	2 12							

Protection of openings

					0 2		8	Exclude direct sunlight
		2 12					9	Provide protection from rain

Walls and floors

			0 2			x	10	Light, low thermal capacity
			3 12				11	Heavy, over 8 h time-lag

Roofs

10 12			0 2				12	Light, reflective surface, cavity
			3 12			x	13	Light, well insulated
0 9			0 5					
			6 12				14	Heavy, over 8 h time-lag

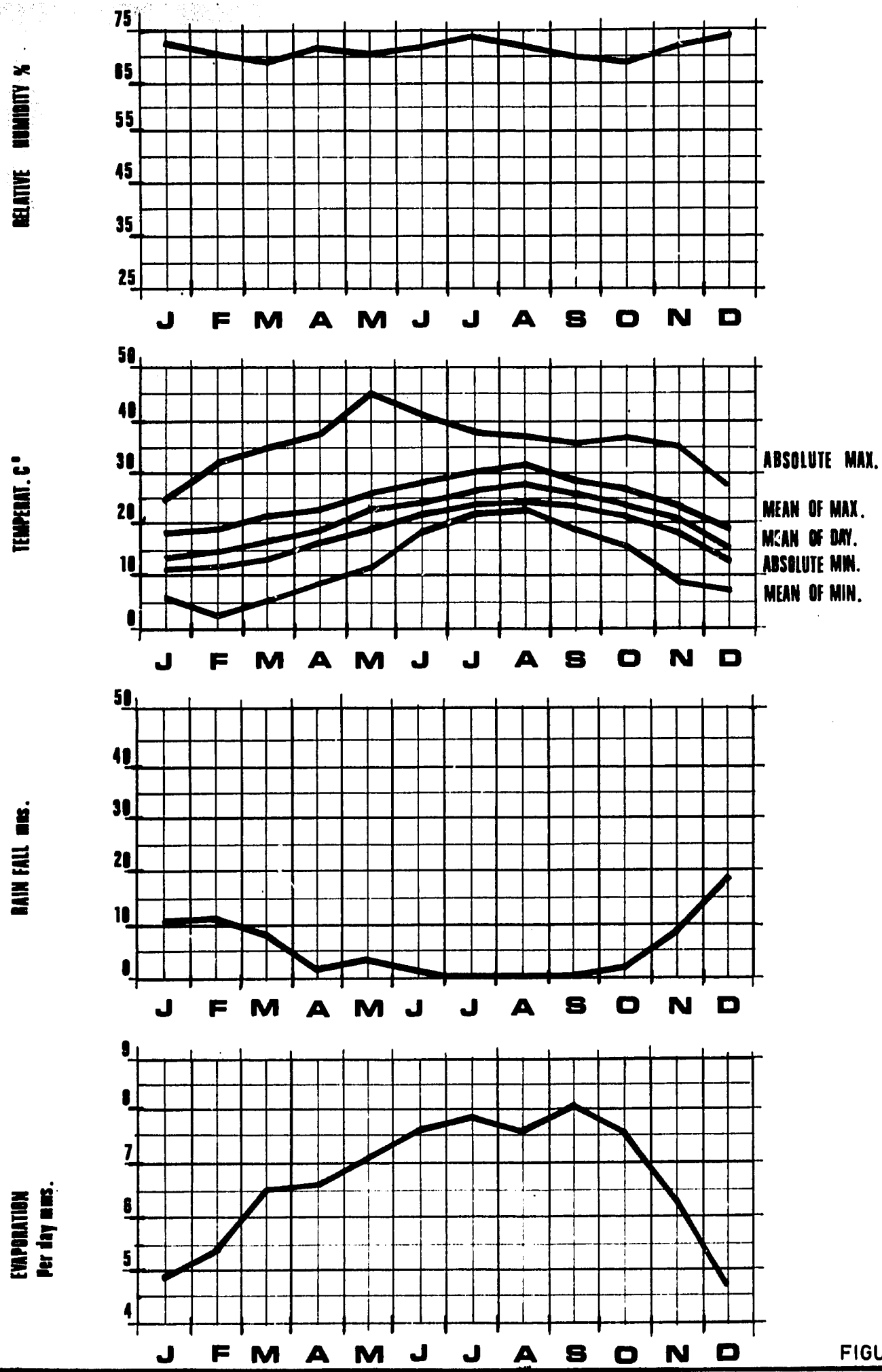

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FIGURE 1

BASIC CLIMATIC DATA

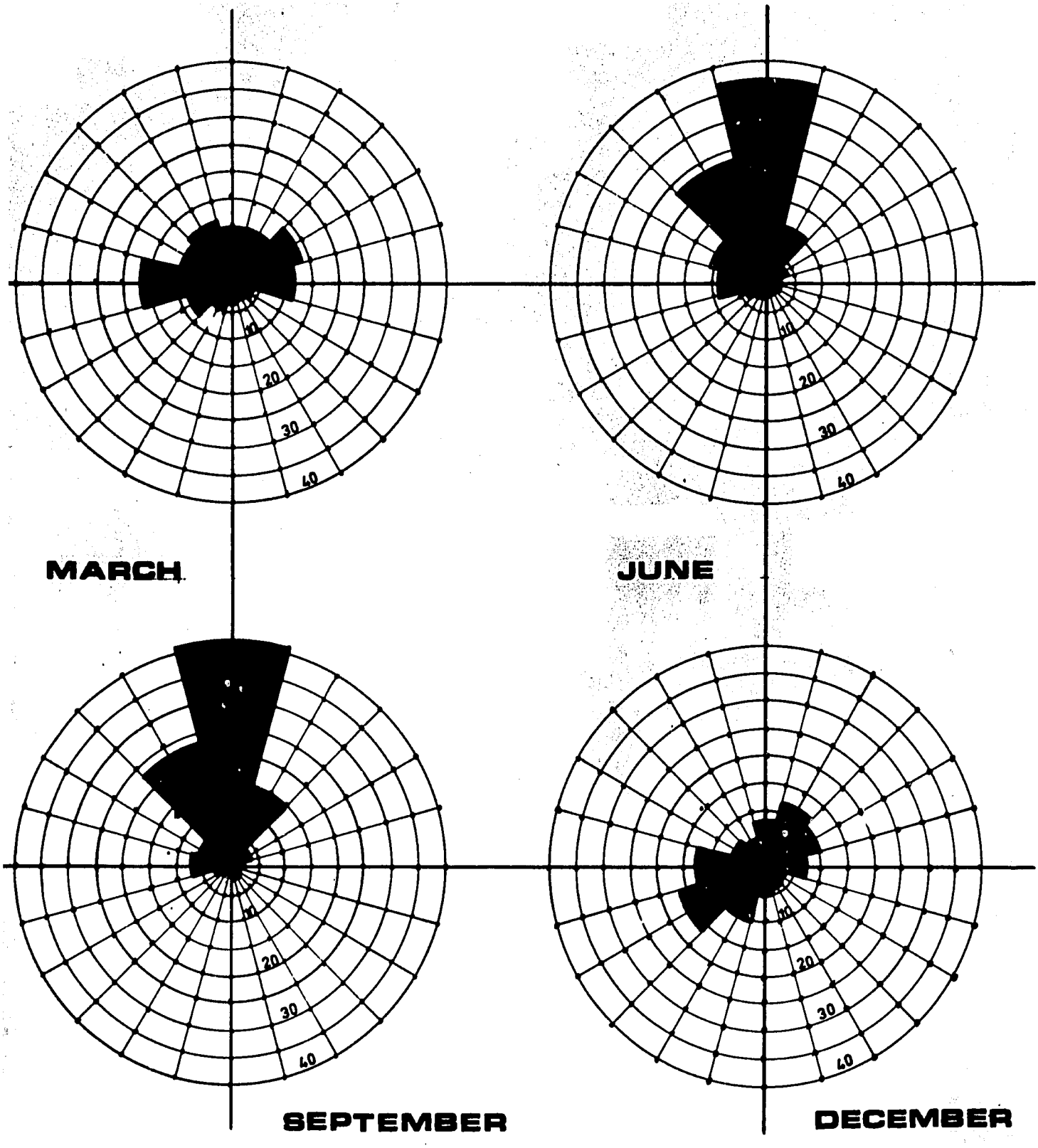


FIGURE 2

HARRIS

WIND ROSES
DIRECTION & FREQUENCY

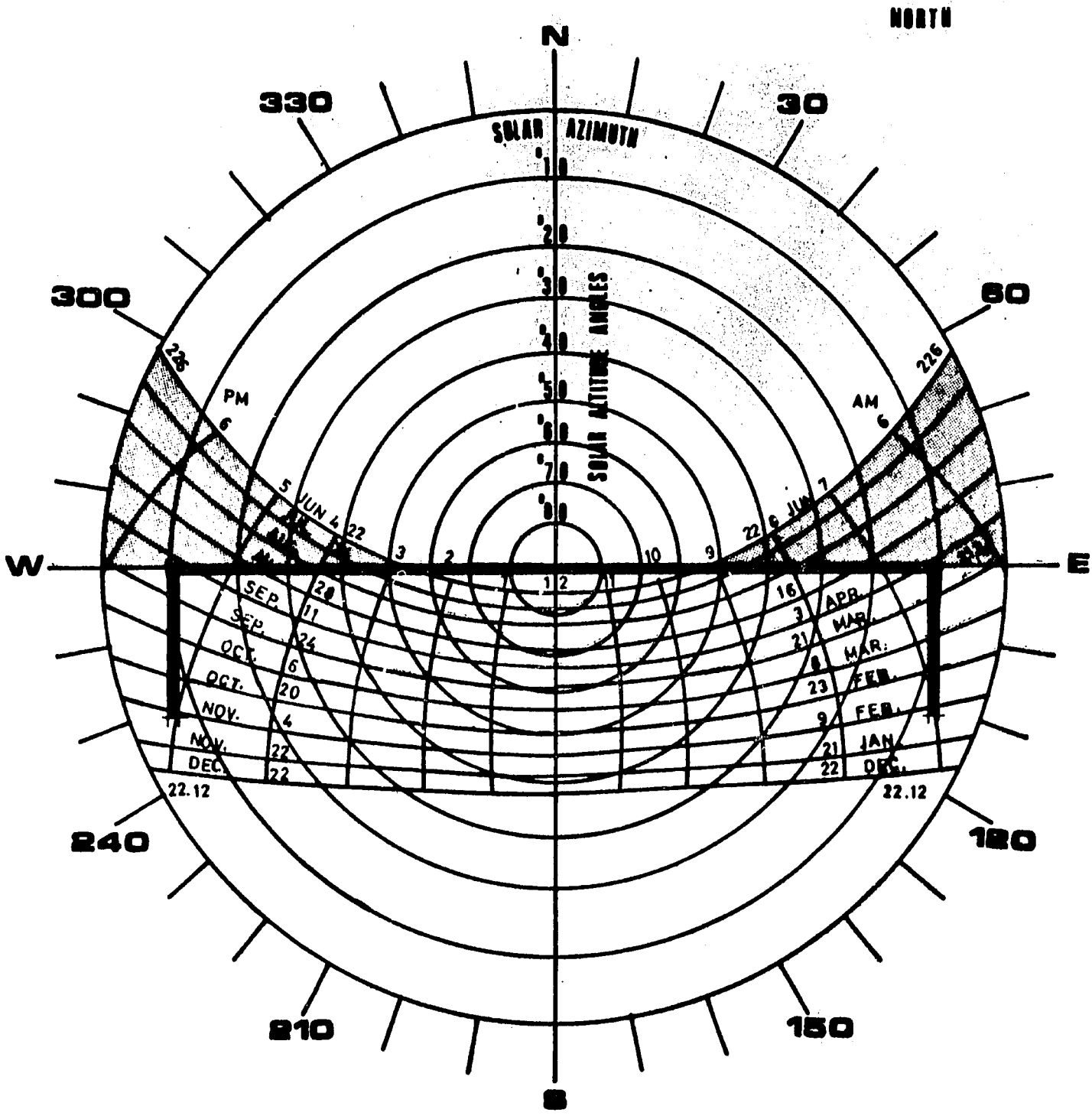


FIGURE 3

HARRIS

SHADING DIAGRAM FOR WEST FACING FACADE

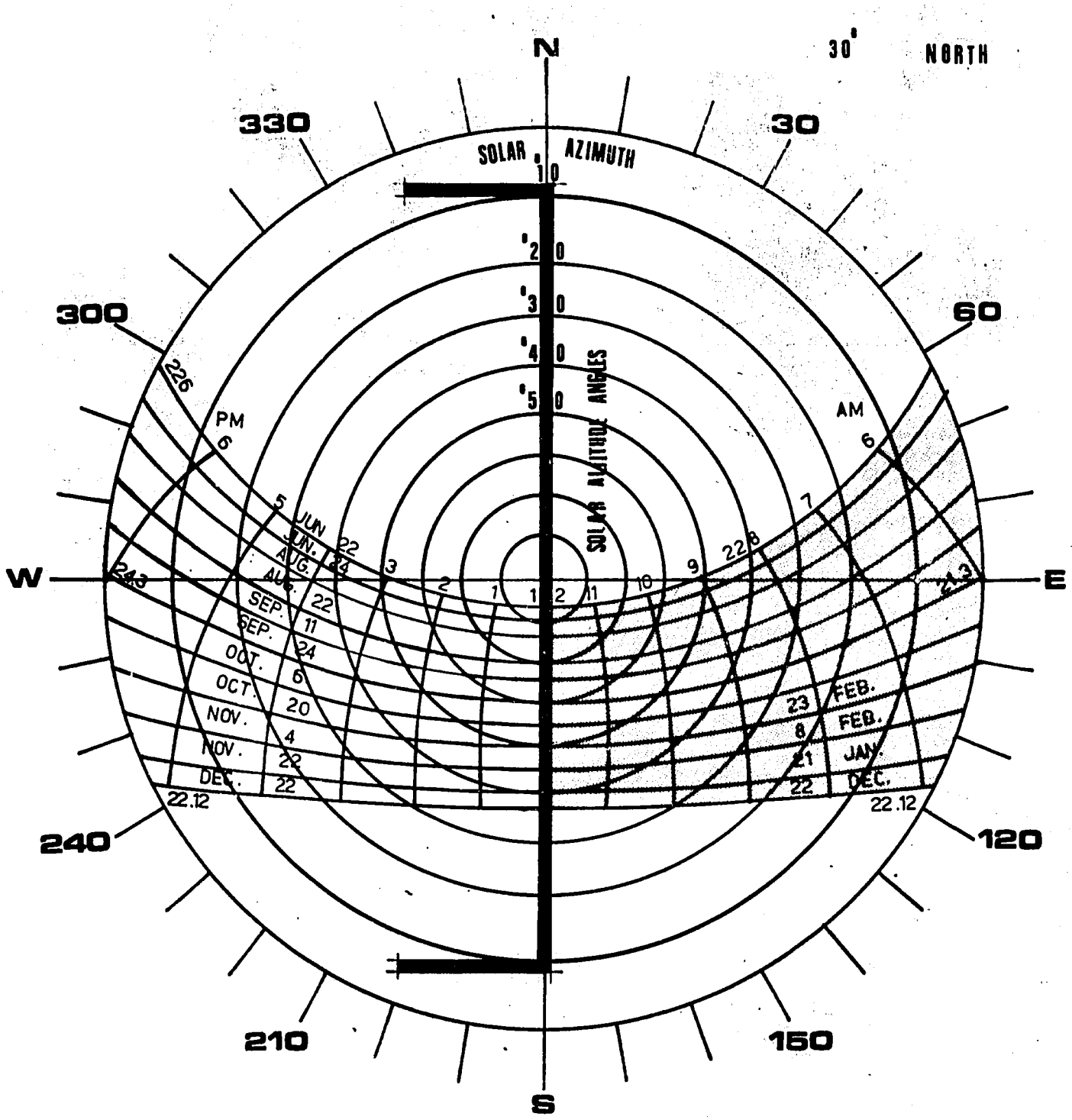


FIGURE 4

HARRIS

SHADING DIAGRAM FOR EAST FACING FACADE

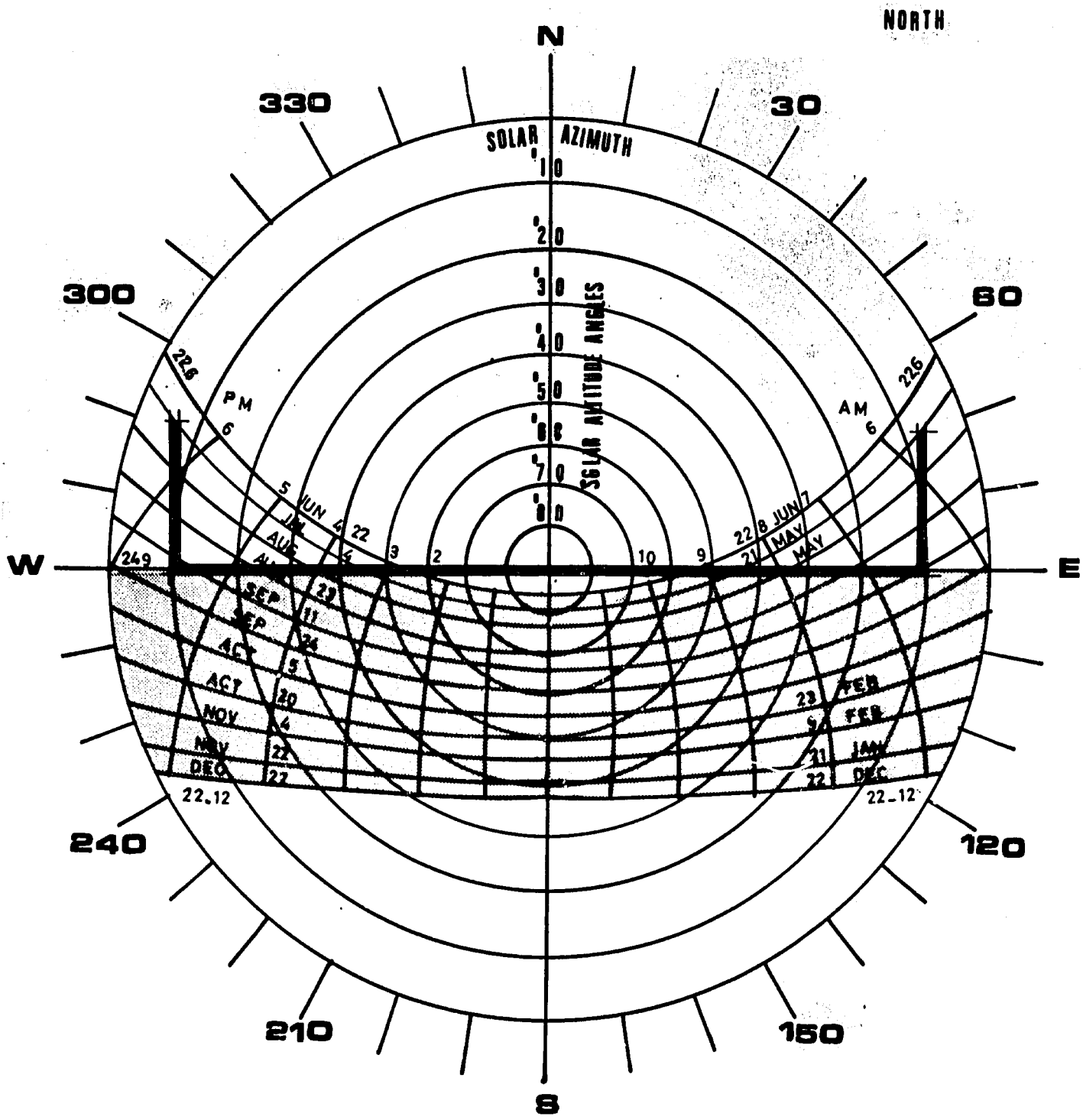


FIGURE 5

HARRIS

SHADING DIAGRAM FOR SOUTH FACING FACADE

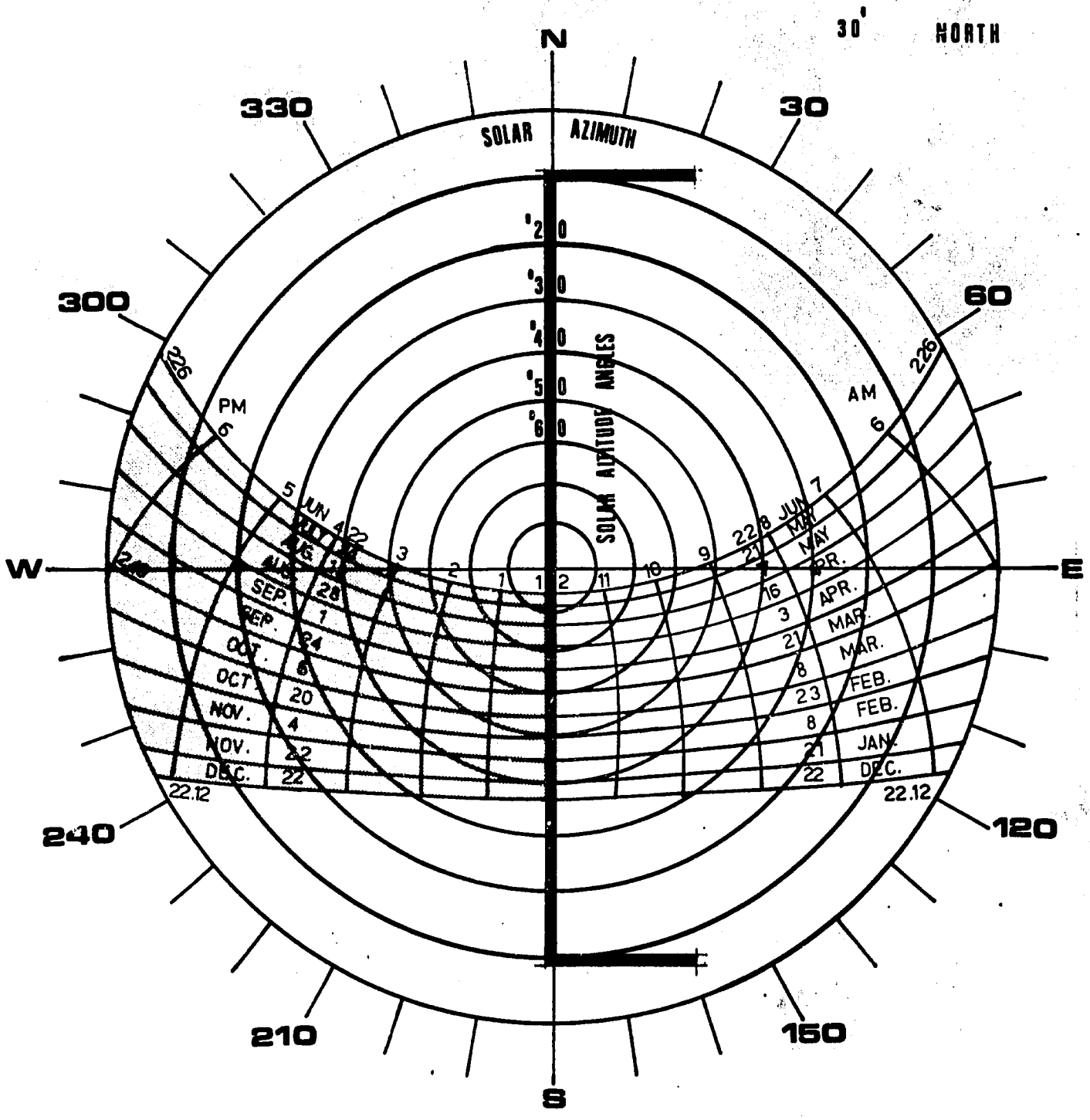


FIGURE 6

HARRIS

SHADING DIAGRAM FOR WEST FACING FACADE

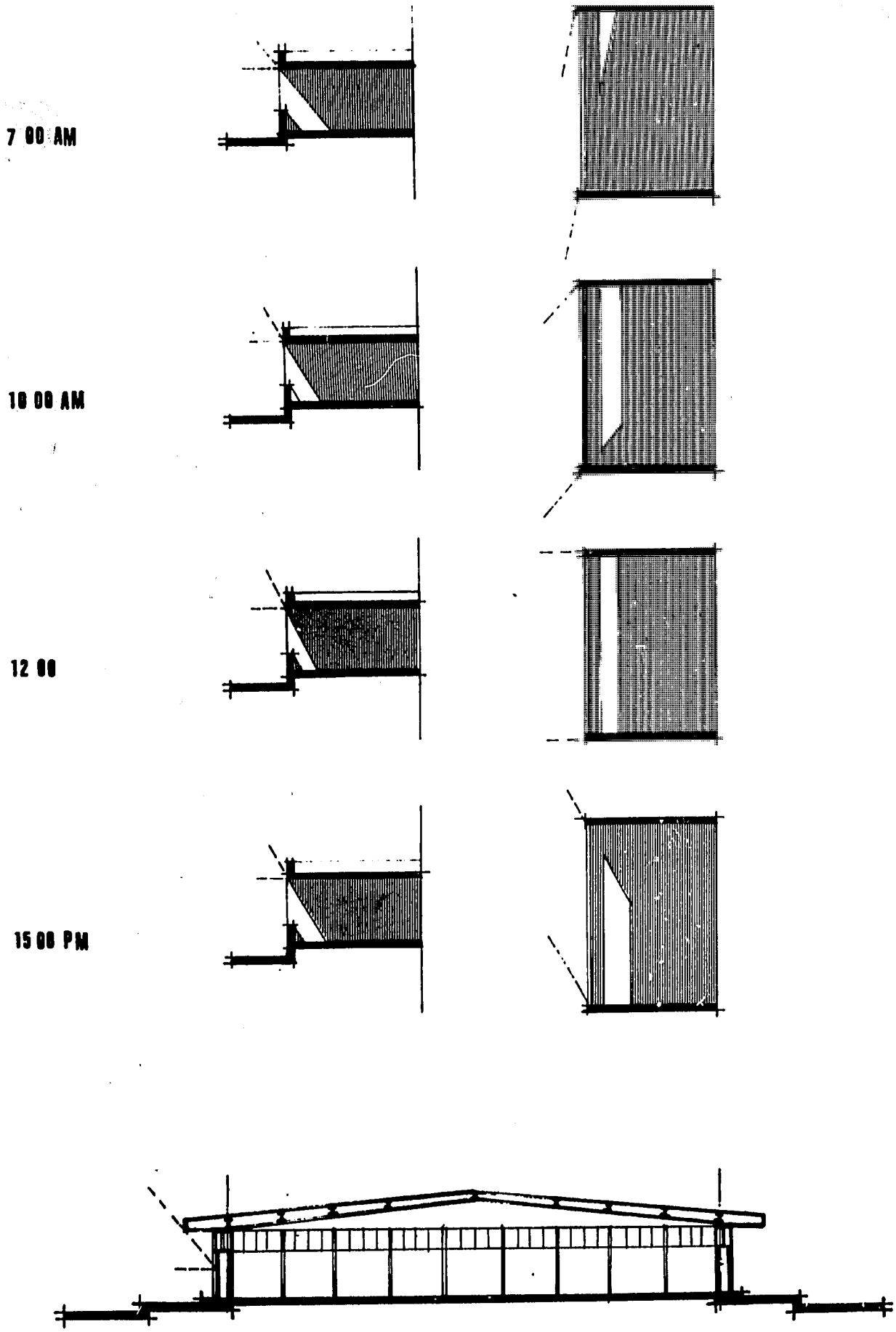
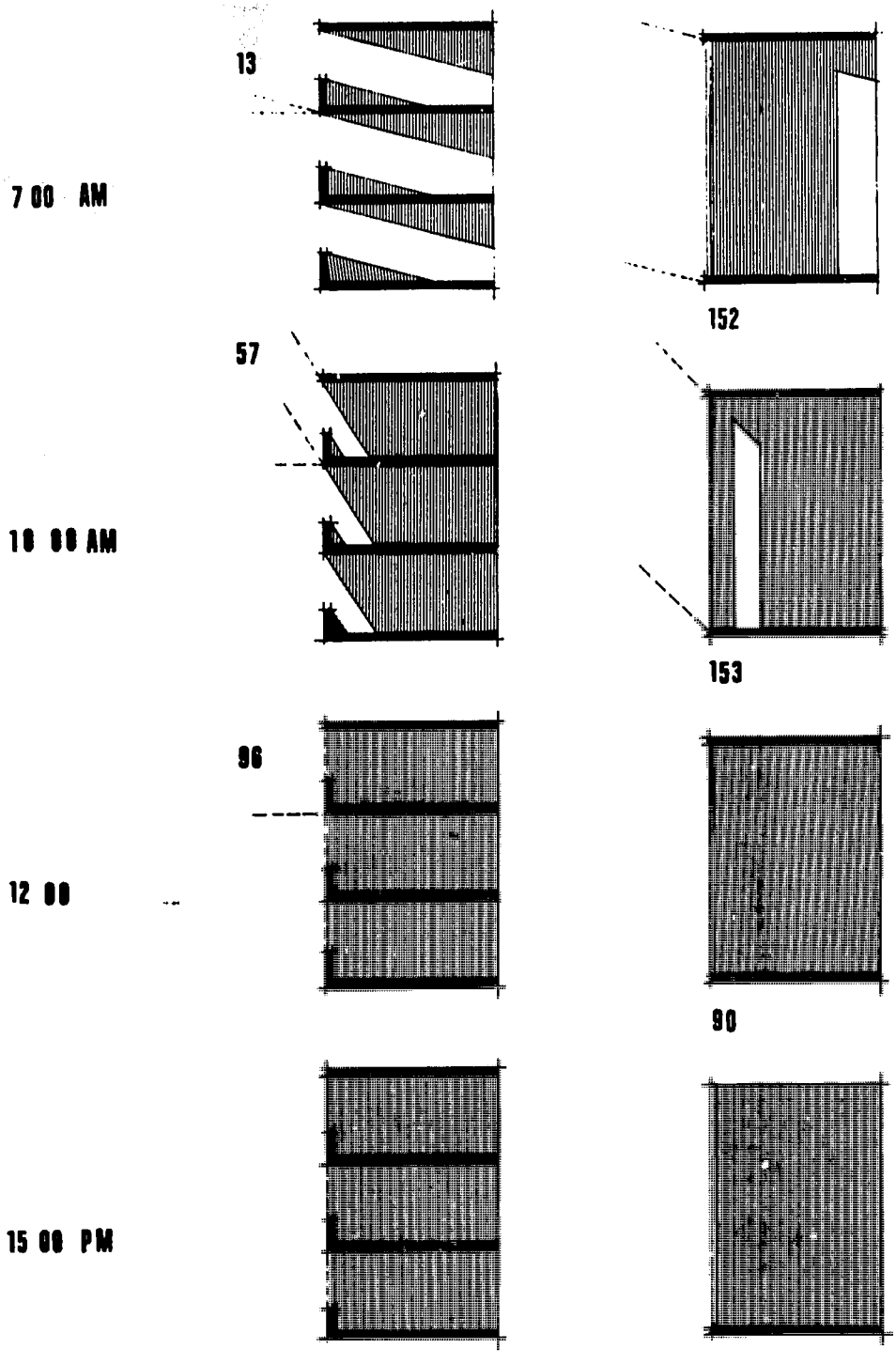


FIGURE 7

HARRIS

SHADOW ANGLES
SOUTH FACADE



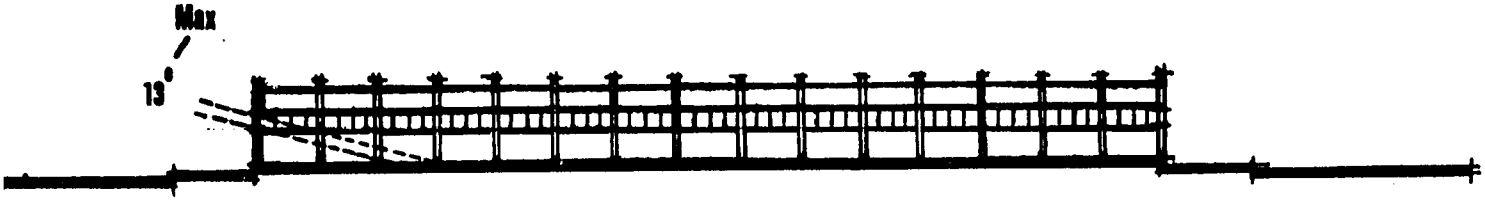


FIGURE 9

HARRIS

SHADOW ANGLES
EAST FACADE

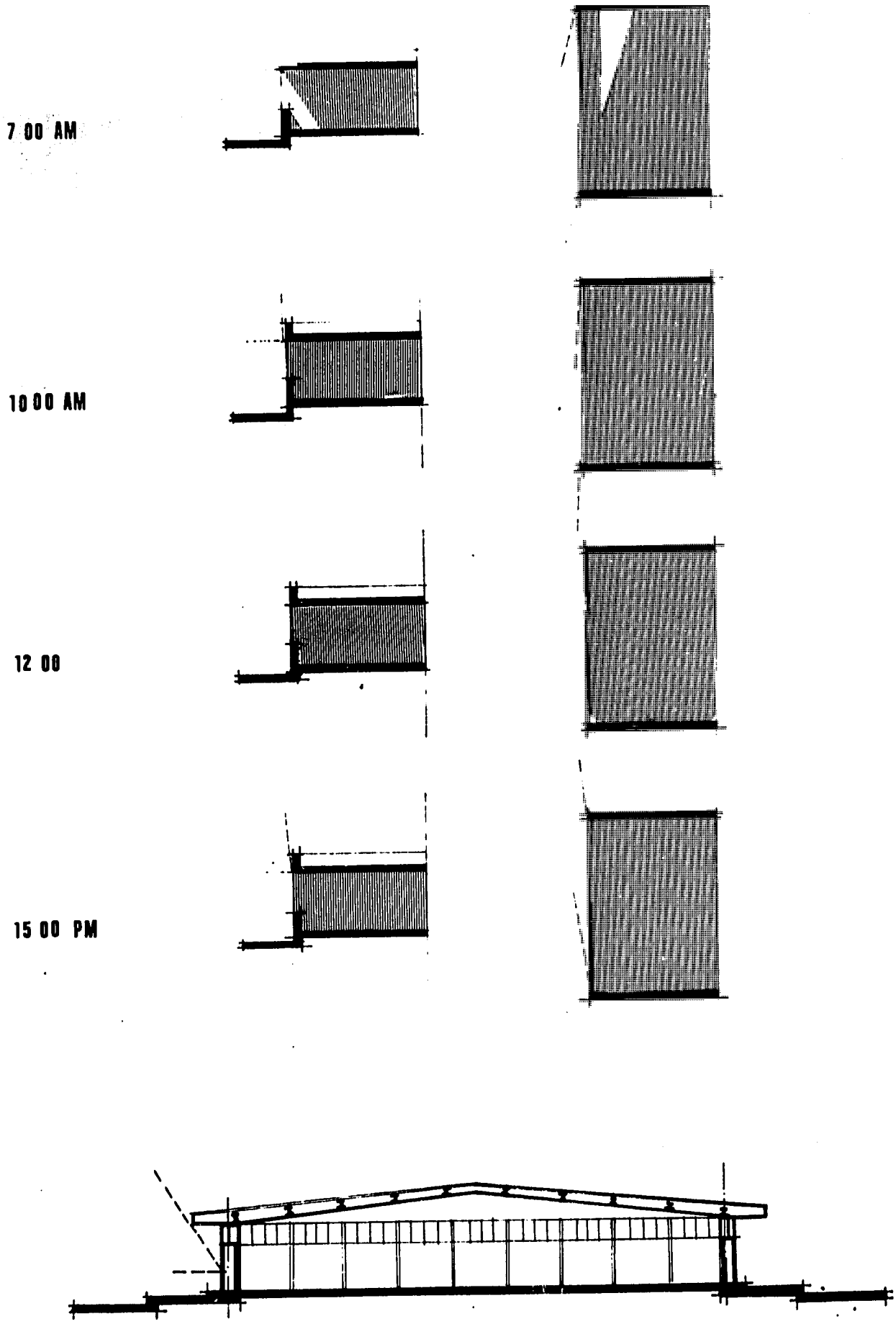
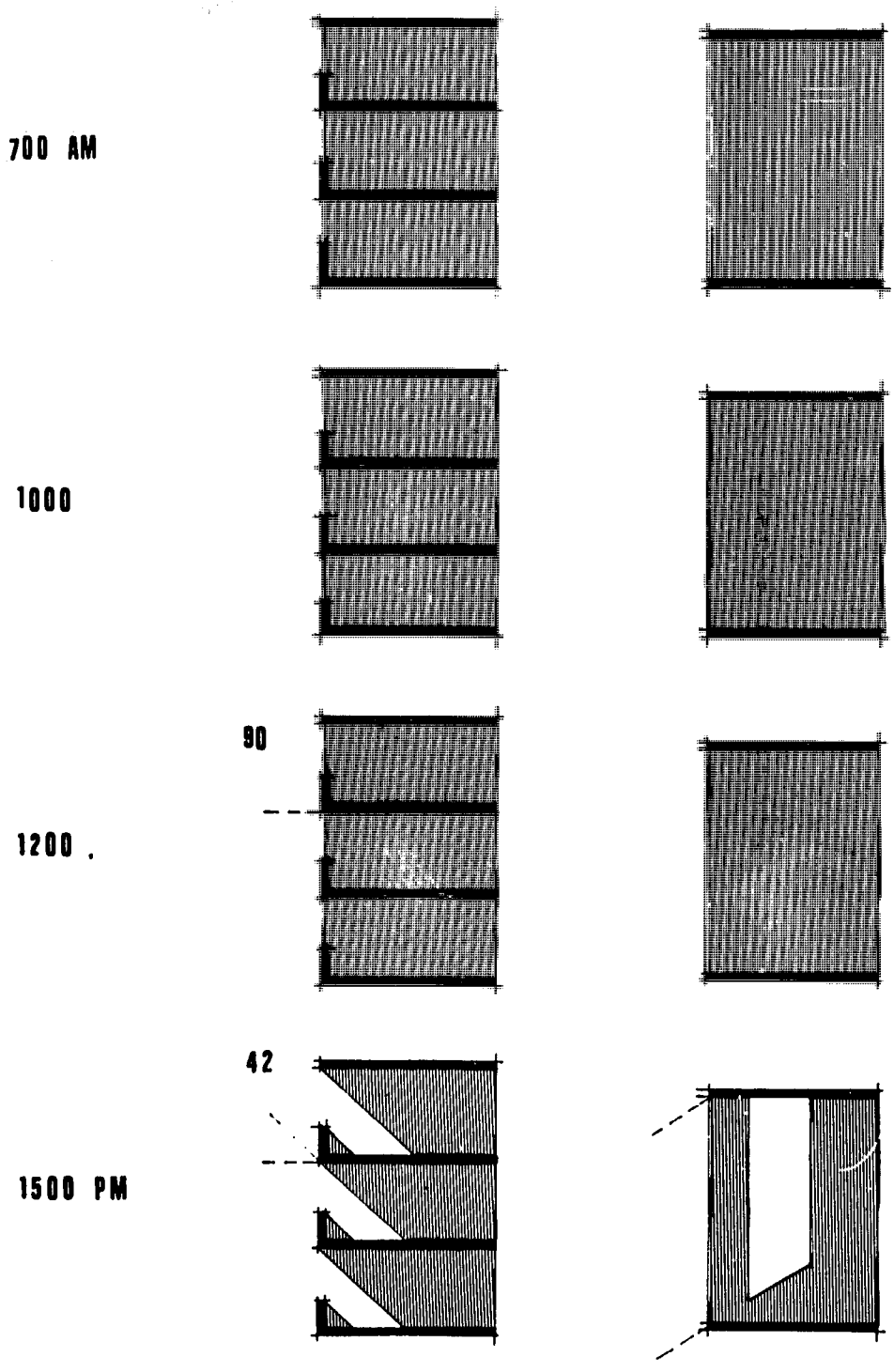


FIGURE 9

HARRIS

SHADOW ANGLES
NORTH FACADE



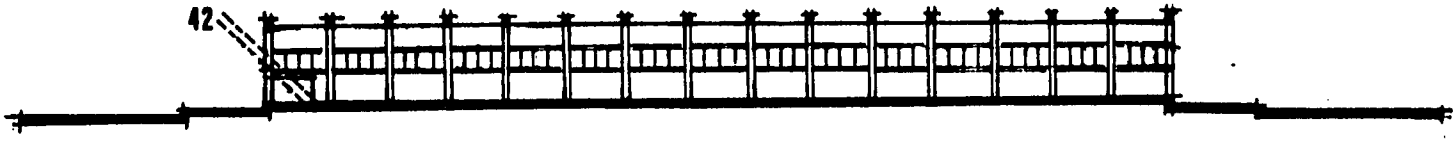


FIGURE 10

HARRIS

SHADOW ANGLES
WEST FACADE

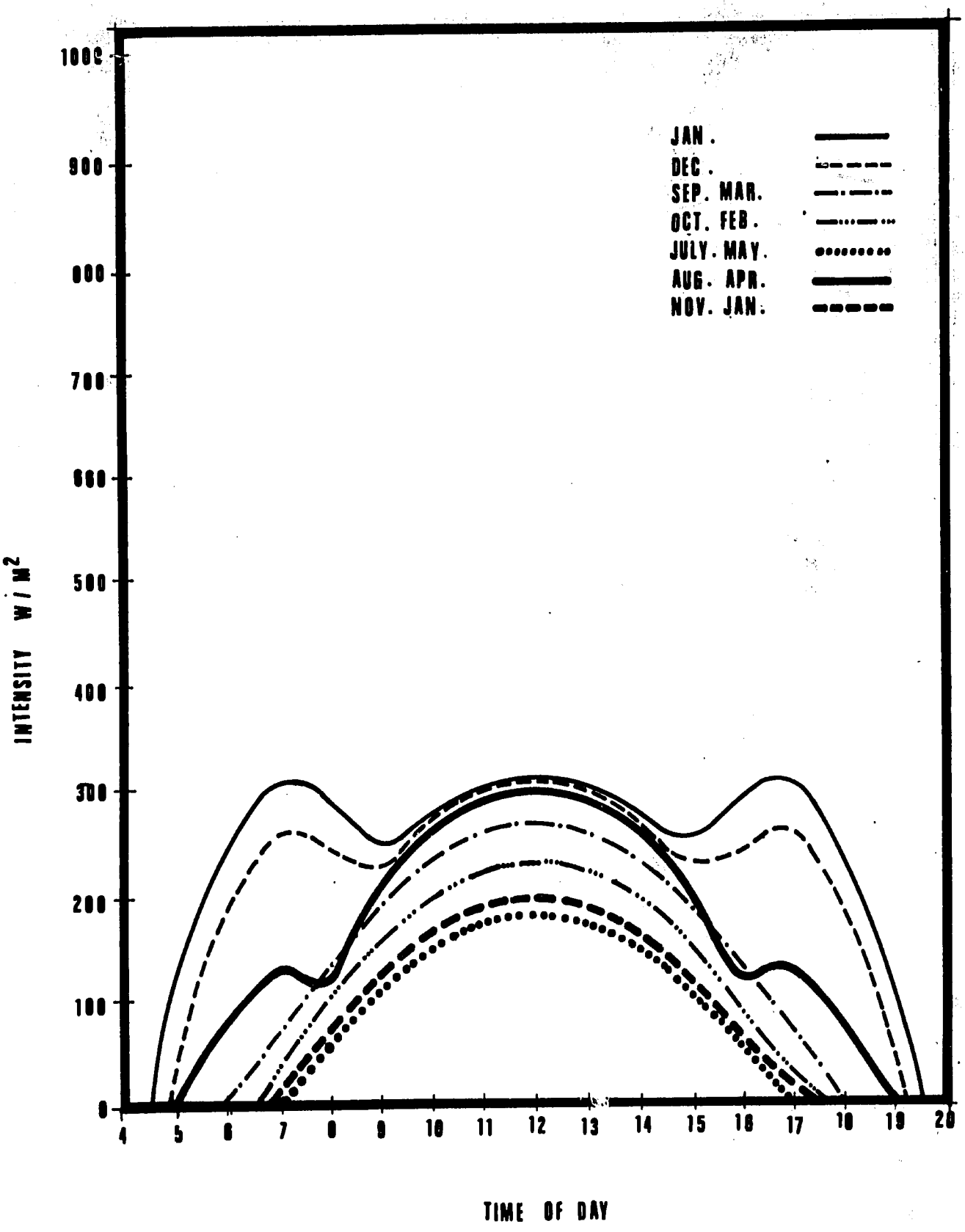


FIGURE 11

HARRIS

RADIATION INTENSITIES ON VERTICAL NORTH FACING SURFACES 30° N

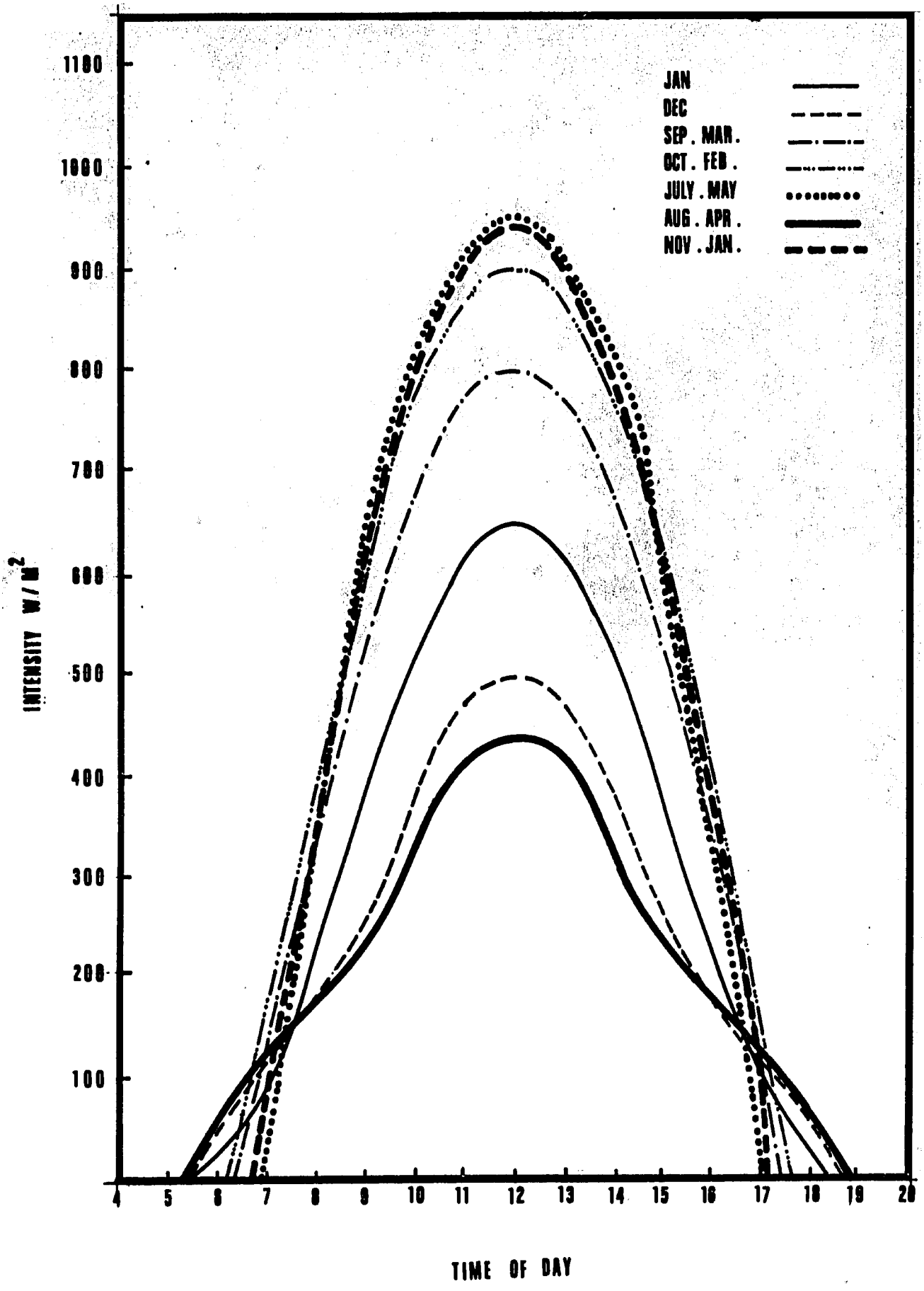


FIGURE 12

HARRIS

RADIATION INTENSITIES ON VERTICAL SOUTH FACING SURFACES 30° N

APPENDIX D

DESCRIPTION

OF

EXISTING BUILDINGS

LIST OF EXISTING BUILDINGS

Building No. Name	Approx. Size (Sq. Mtrs.)	Use
Hensi Warehouse	1,600	Silos Warehouse
Arsenal Warehouse	1,000	
Warehouse	1,000	Silos Warehouse - Upstairs Office Ministry of Supply
UN Storage	1,000	Half used by the UN Forces and half by Silos
Fumigation		Ministry of Agriculture - building not being used now
1 - Storage	--	Use unknown
2 - Customs Building	--	Utilized by Customs
3 - Warehouse "C"	2,700	Silos Warehouse
4 - Warehouse	2,700	Used by Military - formerly used by Customs
5 - Warehouse	2,700	Used by Military - formerly used by Customs
11 - Warehouse	3,600	Silos Warehouse - used for general cargo
12 - Warehouse	3,600	Assigned to Valley Company for Agriculture
13 - Excavation	--	Building excavation started
14 - Warehouse	--	Warehouse under construction
15 - Warehouse	--	Used by Stevedore Company for repair of trucks
16 - Warehouse	--	Warehouse and Repair Shop
17 - Repair Shop	--	Repair and evacuators for Silos Company

LIST OF EXISTING BUILDINGS

(continued)

*Building No. Name	Approx. Size (Sq. Mtrs.)	Use
18 - Warehouse	--	Used by Suez Canal Company for storage of cement
19 - Rope Factory	--	Rope Company - building now being extended
20 - Edfina Building	--	Refrigeration warehouse - fish freezing plant
21 - Grain Storage	--	Marine Shipping Company - grain storage
24 - Fire Station	--	Fire Station

* For layout of buildings see Figure No. 4-18, Volume II. Indicated on the following pages is a more detailed description of buildings located within the limits of the study area.

NOTE: Where not shown, information as to names and/or sizes of existing buildings was not available.

DETAILED DESCRIPTION

BUILDING NO. 3

1.	DESCRIPTION	The building is used as warehouse. Transversely it is divided into three spans each is supported by a steel truss.
2.	STRUCTURE	Concrete columns and beams which support steel trusses, a truss every 4.0 mtrs.
3.	FOUNDATION	Strap footing foundation.
4.	FLOOR	The floor is paved with plain concrete. No repairs are necessary for the floor.
5.	WALLS	The walls are made of brick.
6.	COLUMNS	The columns are constructed of reinforced concrete. Columns need repair.
7.	DOORS	There are 12 timber doors, each 4.5 x 4.0 m.
8.	WINDOWS	Most window glass is broken. However, wire mesh over windows provide protection.
9.	ROOF CONSTRUCTION	Steel truss type construction.
10.	ROOF COVERING	The roof is covered by asbestos corrugated sheets.
11.	LIGHTING	No bulbs. New connections should be provided.
12.	FIRE HYDRANT	There are two fire hydrants around the building. Also hand extinguishers are available.
13.	NOTES	Office space is needed and rest rooms water supply and sewerage disposal are also required.

DETAILED DESCRIPTION

BUILDING NO. 11

1.	DESCRIPTION	This building is used by the Ministry of Supply as a bonded warehouse for general cargo.
2.	STRUCTURE	The steel structure is in good condition.
3.	FOUNDATION	Spread footing foundation.
4.	FLOOR	The floor is cleanly finished by a concrete layer. Basalt block paving provide suitable paths for forklifts.
5.	WALLS	The walls are brick.
6.	COLUMNS	Distance between columns is 11.40 m.
7.	DOORS	There are twenty wooden doors each of which is 4.7 x 4.0. All doors need repair.
8.	WINDOWS	There are glass windows over doors and 10 high windows along the sides.
9.	ROOF CONSTRUCTION	Steel truss type construction.
10.	ROOF COVERING	Red tiles; gutters are clogged.
11.	LIGHTING	Electric bulbs are missing.
12.	FIRE HYDRANT	Two hydrants are located at the corners of the building and twenty hand extinguishers are available.
13.	NOTES	There are no offices in the building.

DETAILED DESCRIPTION

BUILDING NO. 12

1.	DESCRIPTION	This building is used by the Valley Company of the Ministry of Commerce for agricultural exports such as rice oranges etc.
2.	STRUCTURE	The supporting trusses and columns are constructed of structural steel.
3.	FOUNDATION	Spread footing foundation.
4.	FLOOR	The floor is paved with concrete except for forklift paths with basalt blocks.
5.	WALLS	The walls are made of red bricks up to a height of 5.10 mts. The rest is of corrugated sheets which require repairs.
6.	COLUMNS	The distance between columns is approximately 11.5 m. in one direction and 15.0 ms in the other.
7.	WINDOWS	Eight windows are located over the doors and along the sides. Most glass is broken or cracked.
8.	DOORS	There are twenty timber doors. Six doors need light repairs.
9.	ROOF CONSTRUCTION	Steel trusses.
10.	ROOF COVERING	The roof is covered with corrugated asbestos sheets. Replacement of some sheets is required. The gutters are clogged.
11.	LIGHTING	There are nineteen skylight windows on the top of the roof. Electric bulbs are provided.
12.	FIRE HYDRANT	Foam hand fire extinguishers are available.

DETAILED DESCRIPTION

BUILDING NO. 12

13. NOTES	The building is divided longitudinally into two parts by a brick wall, one part is approximately one third of the total area. The building is divided transversely into 3 equal spans. There are no washrooms in the building.

DETAILED DESCRIPTION

BUILDING NO. 14

1.	DESCRIPTION	This building is rented to a private shipping agency. It is divided into two sections. The first section is 30.00 x 25.00. The second is being rebuilt after a fire.
2.	STRUCTURE	Steel construction.
3.	FOUNDATION	Spread footing foundation.
4.	FLOOR	The floor is paved with plain concrete. Holes in the floor are filled with crushed stones.
5.	WALLS	Walls are made of red bricks.
6.	COLUMNS	The distance between the columns is 12 m.
7.	DOORS	There are twelve doors each of which is 3.9 m wide and 4.7 m high.
8.	WINDOWS	Windows are located along the perimeter.
9.	ROOF CONSTRUCTION	The roof is supported by two simply supported trusses.
10.	ROOF COVERING	Corrugated sheets. Gutters need repair.
11.	LIGHTING	The windows provide enough light, but most glass is broken.
12.	FIRE HYDRANT	There is one fire hydrant outside the building but it is out of order.
13.	NOTES	There are no washrooms or offices in the building.

DETAILED DESCRIPTION

BUILDING NO. 15

1.	DESCRIPTION	This building is presently under reconstruction. Length = 48 ms; width = 30 ms.
2.	STRUCTURE	
3.	FOUNDATION	
4.	FLOOR	
5.	WALLS	
6.	COLUMNS	
7.	DOORS	No information on items 2 thru 12.
8.	WINDOWS	
9.	ROOF CONSTRUCTION	
10.	ROOF COVERING	
11.	LIGHTING	
12.	FIRE HYDRANT	

DETAILED DESCRIPTION

BUILDING NO. 16

1.	DESCRIPTION	This building is used as a workshop and garage.
2.	STRUCTURE	Reinforced concrete construction.
3.	FOUNDATION	Spread footing foundation
4.	FLOOR	The floor is plain concrete layer of about 15 cm in thickness; it is in good condition.
5.	WALLS	Walls are brick.
6.	COLUMNS	Reinforced concrete columns. Some of the columns have longitudinal cracks.
7.	DOORS	There are eight doors in this building.
8.	WINDOWS	Openings in walls are provided along all sides of the building.
9.	ROOF CONSTRUCTION	Reinforced concrete slab in good condition.
10.	ROOF COVERING	Reinforced concrete slab.
11.	LIGHTING	The area of the walls at the sides above the lintel beam is open to provide ventilation.
12.	FIRE HYDRANTS	One hydrant and eight hand extinguishers.
13.	NOTES	

DETAILED DESCRIPTION

BUILDING NO. 17

1.	DESCRIPTION	This building is leased from Suez Canal Authority to a private repairs company.
2.	STRUCTURE	The supporting structure is metallic. The building is structurally sound.
3.	FOUNDATION	Spread footings.
4.	FLOOR	The floor is paved with concrete.
5.	WALLS	The walls are brick walls.
6.	COLUMNS	Three intermediate hollow-pipe-columns. The edge columns are S.I.B. No. 20.
7.	DOORS	There are 12 doors, each is 3.9 m wide and 4.7 m high.
8.	WINDOWS	The windows extend over most of the outside perimeter, most of their glass is broken.
9.	ROOF CONSTRUCTION	The roof is carried by two simply supported steel trusses.
10.	ROOF COVERING	Red Tiles.
11.	LIGHTING	The lighting is sufficient to the building.
12.	FIRE HYDRANT	About 10 hand extinguishers can be used for fire fighting.
13.	NOTES	Rain water usually drops inside the building. To overcome this problem in the offices section an intermediate roof has been constructed over the offices only. Gutters need repairs.

DETAILED DESCRIPTION

BUILDING NO. 18

1.	DESCRIPTION	The store is divided into 3 equal parts each is about 30 m x 25 m. The western division is used as a workshop. The middle section is used by the Suez Canal Authority as storage area. The northern side is used as storage of ship supplies.
2.	STRUCTURE	Steel construction.
3.	FOUNDATION	Spread footings.
4.	FLOOR	The floor is covered with asphalt and is in good shape.
5.	WALLS	The outside walls are brick walls. The plastering is intact.
6.	COLUMNS	The columns are made of hollow pipes.
7.	DOORS	There are sixteen doors made of wood sliding inside the walls when opened. The doors are in fair condition.
8.	WINDOWS	Glass windows provide enough light to the stores.
9.	ROOF CONSTRUCTION	Nineteen steel trusses.
10.	ROOF COVERING	Corrugated asbestos slabs.
11.	LIGHTING	In the workshop there are 9 hanging bulbs. The interior connections of electricity are available but the connection with the main lines has not been installed.
12.	FIRE HYDRANT	There are two fire hydrants, one just outside the building and the other is 30 m far. Four wheel fire extinguishers are available.

DETAILED DESCRIPTION

BUILDING NO. 18

13. NOTES	The building is in good condition. No repairs are required for lighting.

Building Description

a) Building No. 3, Store

This building is used as a warehouse. The area is approximately 2,500 m (65 by 40 ms). Transversely it is divided into three spans -- each is supported by a steel truss. The roof is covered by corrugated sheets. The columns are reinforced concrete. The walls are made of bricks. The floor is paved with cement. No repairs are necessary for the floor, walls or roof.

There are 12 timber doors, each is 5.0 by 3.5 ms. Windows have most glass broken. However, wire mesh over windows provide protection.

This building is divided into two equal parts and one can say that the building is generally satisfactory. Windows are located along the perimeter; they provide enought light but their glass is broken. No fire equipment is available.

b) Building No. 11, Store

This building is used by the Ministry of Supply as a bonded warehouse for general cargo. It is approximately 3,600 m^2. The steel structure is in good condition with no holes in the roof. The walls are made of bricks covered with cement plastering. The floor has an evenly finished concrete surface which is suitable for forklift operation.

There are fifteen similar timber doors,each of which is 5.25 by 3.75 ms. There are also glass windows over doors and ten high windows along the sides.

Two hydrants are located at the corners of the buildings and twenty hand extinguishers are available.

c) Building No. 12, Store

This building is used by the Valley Company of the Ministry of Commerce for agricultural exports such as rice, oranges, etc. The length is 75 ms and the width is 40 ms. The supporting tresses and columns are made of structural steel. The building is divided transversely into three equal spans. The distance between

columns is 10 ms. The roof is covered by tiles which are free from holes. The walls are made of red bricks. The floor is cement paved and in good condition. The building is structurally safe since little corrosion of steel has occurred.

The building is divided logitudinally into two parts by a brick wall. One part is approximately one third of the total area.

Eight windows are located over the doors and along the sides. Their glass is partially broken. Nineteen skylight windows are available on the top of the roof. Bulbs hanging from the roof provide indirect light. For firefighting, hand extinguishers are used.

d) Building No. 14

This building is rented to a private shipping agency. It is divided into two sections, the first is 19 m by 25 m. The latter is being rebuilt after a fire.

The first part is divided transversely into two spans. The roof is carried by two simply supported trusses. The distance between the columns is 8.5 ms. The height is 6.5 ms. The walls are made of red bricks. The tiles in the roof have many holes. The floor is paved with concrete. The holes in the floor are filled with crushed stones.

e) Building No. 15

This building is presently being reconstructed.

f) Building No. 16, Store

This building is used as a workshop and a garage. The slabs, secondary beams, girders and columns are made of reinforced concrete. The walls are brick. The floor is constructed for an unreinforced concrete slab about 15 cm. in thickness. The roof, the floor and the walls are in good condition. Some of the columns have longitudinal cracks (parallel to the longitudinal steel). These cracks can be attributed to expansion of the steel due to rust.

There are eight doors - two doors for each side. The area of the walls at the sides above the lintel beam is open to provide ventilation and light.

The building has one fire hydrant and eight hand fire extinguishers.

g) Building No. 17, Store

This building is leased from the Suez Canal Authority to a private repairs company. The area is approximately 875 m^2 (25 by 35 ms). The supporting structure is steel. The roof is carried by two simply supported steel trusses. The walls are brick walls. The minimum height insidethe building is 5.5 ms. The floor is paved with concrete. There are 12 doors, each is 5.0 ms wide and 3.5 ms high. The lighting is sufficient in the building. The windows extend over most of the outside perimeter and most glass is broken.

The gutters are blocked and have holes in them caused by rust. Rain water usually falls into the building. To overcome this problem in the office section, an intermediate (Mezanine) roof has been build over the offices only. The building is structurally sound. Washrooms are available.

About ten hand extinguishers can be used for firefighting.

h) Building No. 18, Store

The store is divided into three equal parts - each is 30 ms by 25 ms. The western division is used as a workshop. Twp steel trusses form the main supporting element for the roof. The columns are made of builtup sections. The minimum height of the columns above the ground surface is 6.5 ms. The exterior walls are constructed of brick. The floor is covered with asphalt and is in good condition.

The structure is sound; there is visible damage. There are fifteen doors made of wood sliding inside the walls when opened. The doors are in fair condition. Glass windows provide enough light for the stores. In the workshop, there are about ten hanging bulbs. There is one fire hydrant just outside the building. Two wheel fire extinguishers are available.

i) Building No. 19, Rope Factory

This factory produces ropes for exportation and domestic consumption. It consists of a large hall for the factory and has three floors for the offices. In the hall there is one row of columns in the middle dividing the hall into two spans.

The main supporting elements in the roof are two separate polygonal arches which support inclined secondary beams. Concrete slabs span the distance between the secondary beams. The foundations for the columns are constructed of a 50 cm thick unreinforced concrete footing under a reinforced concrete slab which varies in thickness according to the column load. The floor of the factory is a plain concrete covered with a 3 cms layer of cement. The building is structurally sound and free of cracks or damages. The building presently is being extended southward. Fresh water, washrooms, lighting and electrical power are all available and in sufficient supply. There are about 20 hand fire extinguishers in the building.

This factory is considered an important source of income for Port Said. About 600 persons are employed here.

j) Building No. 20, Refrigeration Building and Edfina Canning Building

Both buildings have concrete frames. They appear to be in good condition.

k) Building No. 24, Fire Brigade Station

The building is made of a concrete frame with masonary walls. It consists of one ground floor. The building is in fair condition.

l) Building No. 25, Store

This building is presently under construction. Plastering, flooring and electrical wiring is still in progress. The structure is in very good condition. No one at the site know what the store is built for, or who will use it.

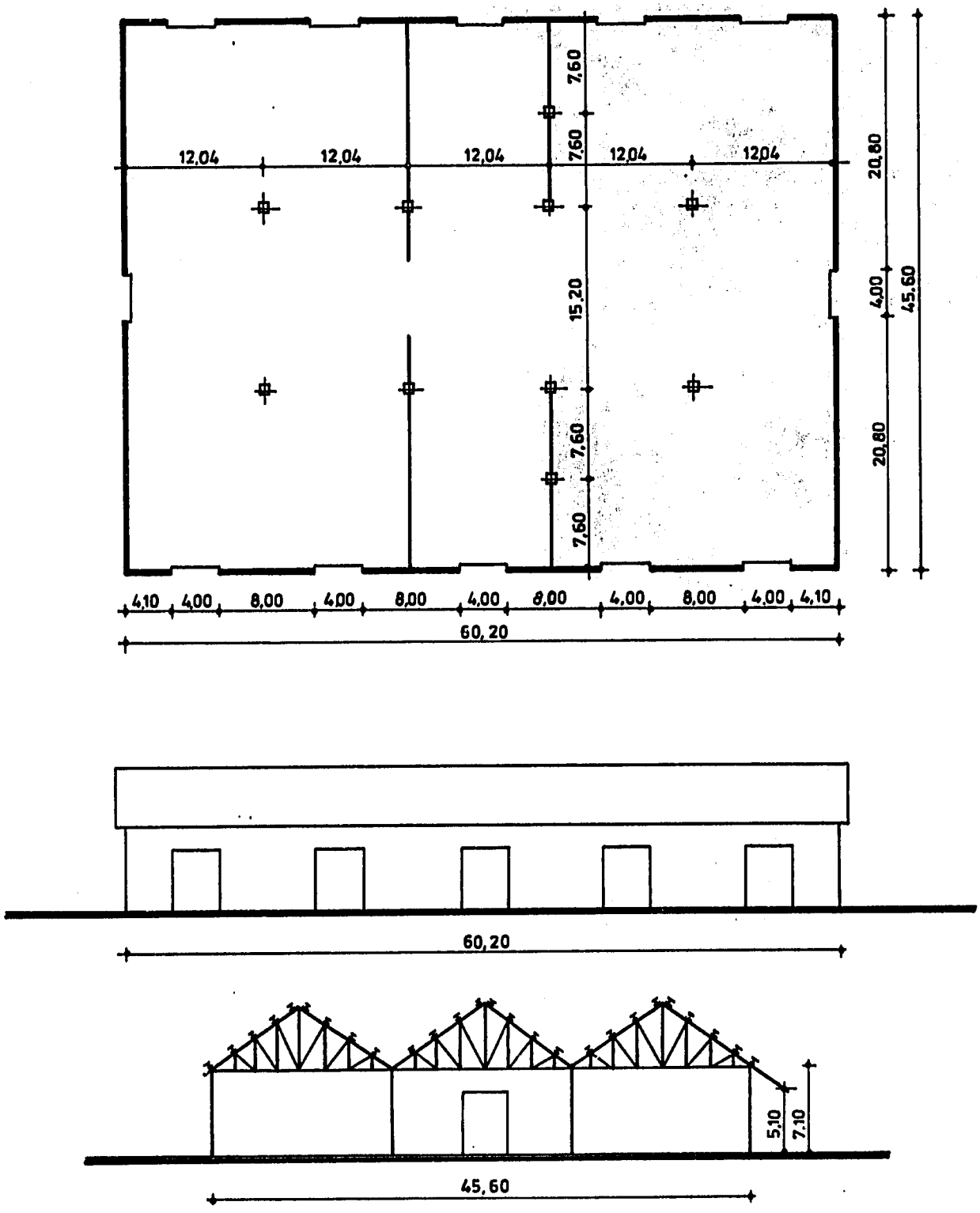


FIGURE D-1

TYPICAL DETAILS
BUILDING № 6

HARRIS

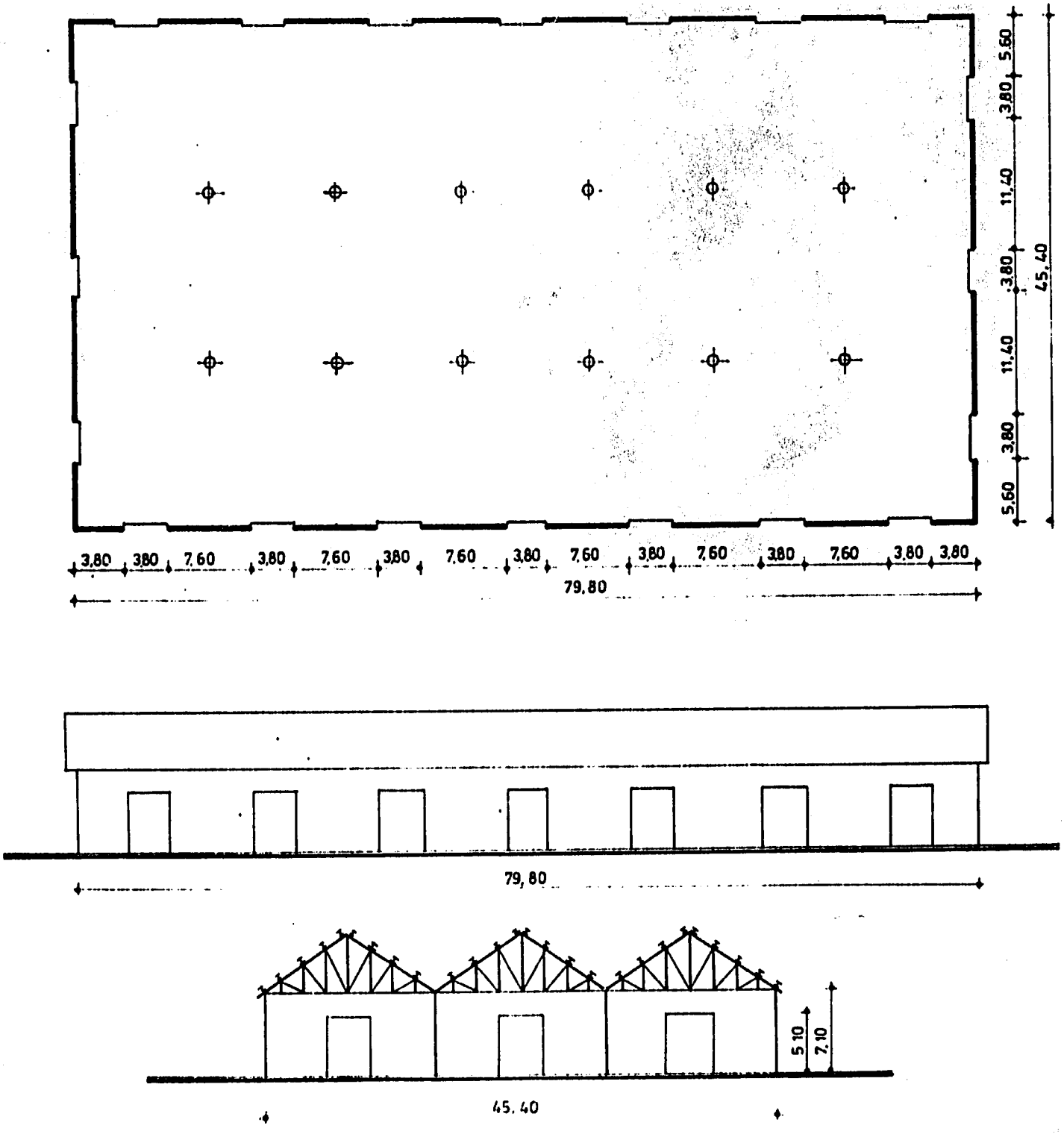


FIGURE D-2

HARRIS

TYPICAL DETAILS
BUILDING Nº 11

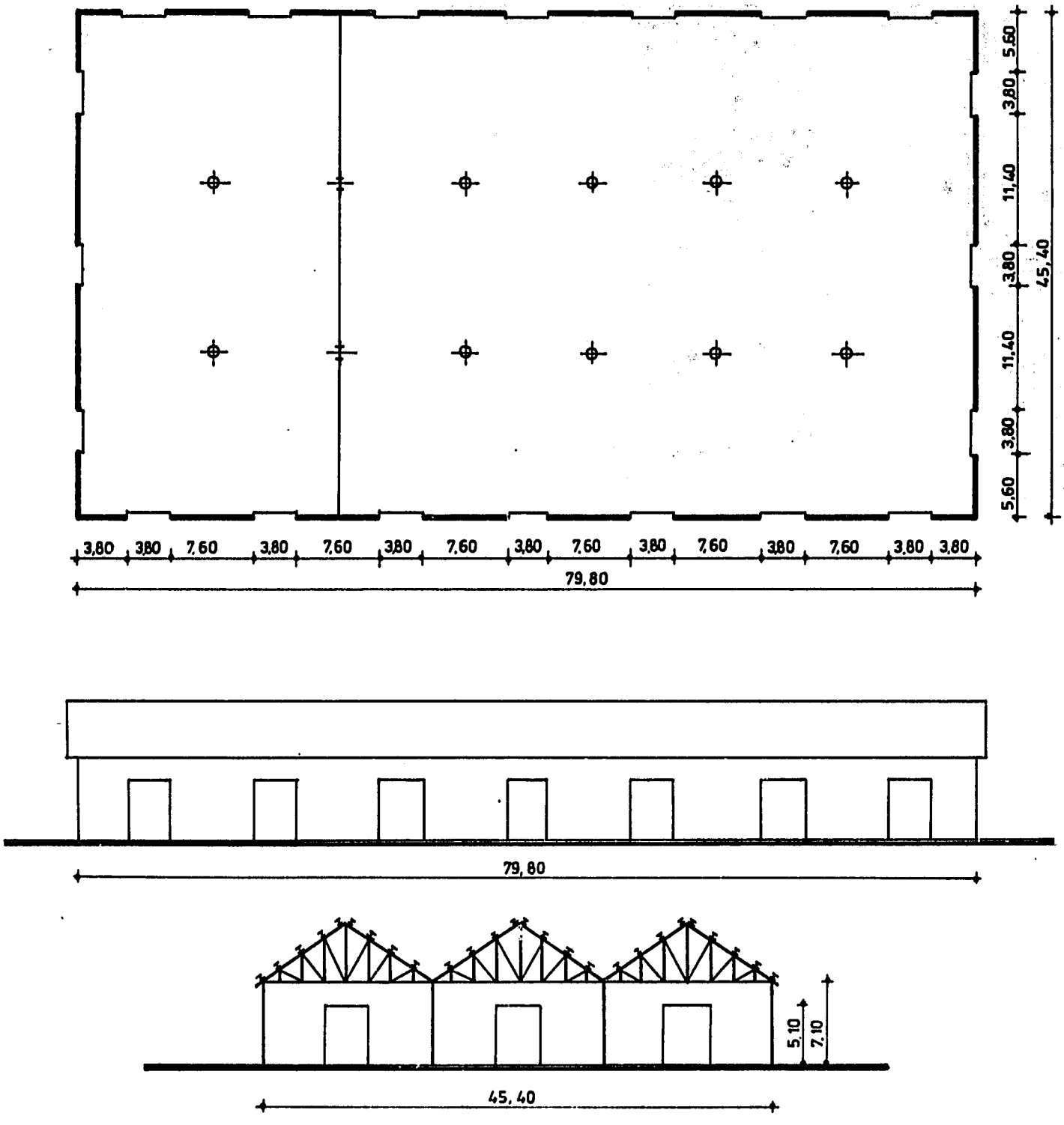


FIGURE D-3

HARRIS

TYPICAL DETAILS
BUILDING Nº 12

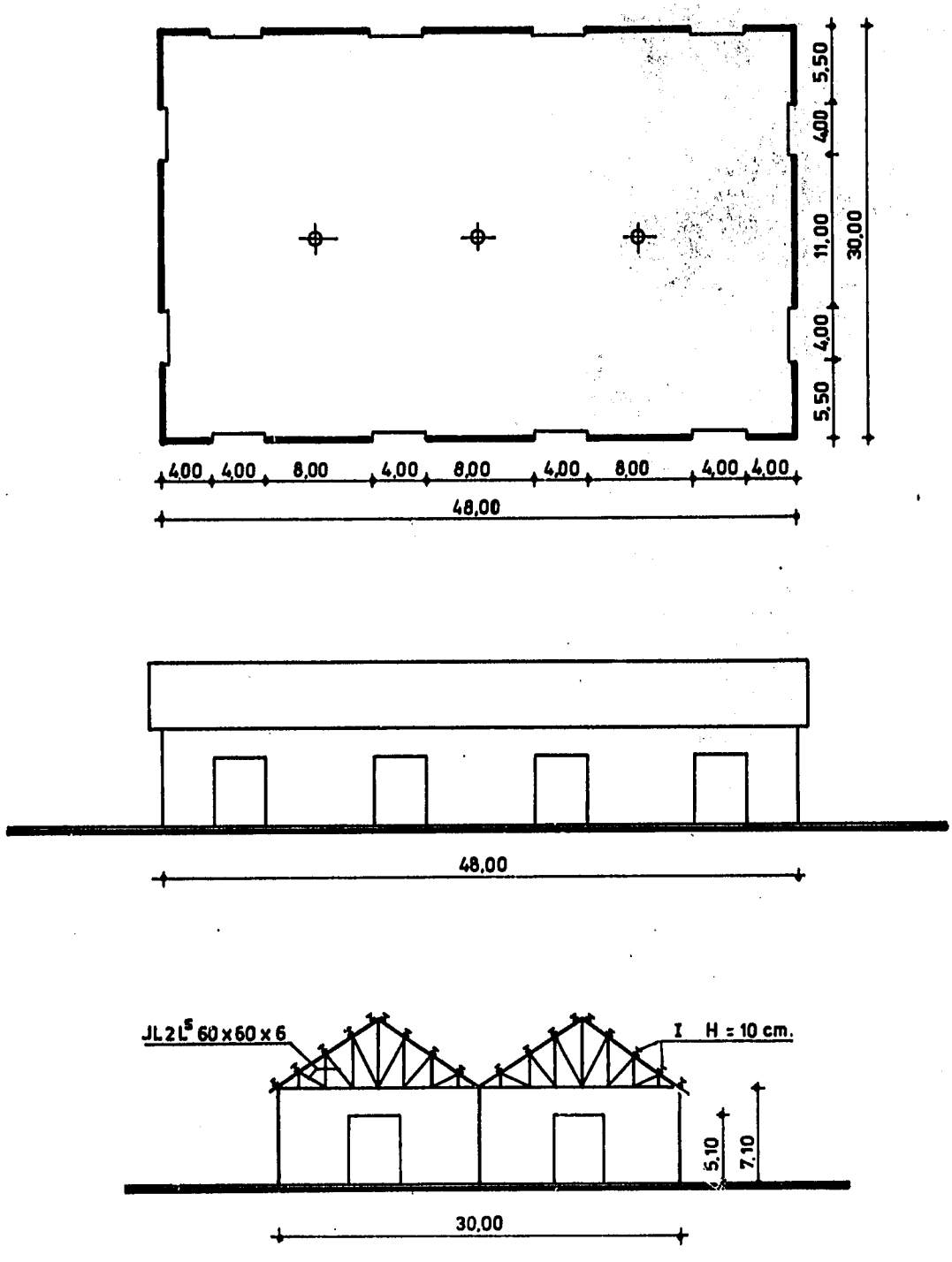


FIGURE D-4

HARRIS

TYPICAL DETAILS
BUILDING Nº 14

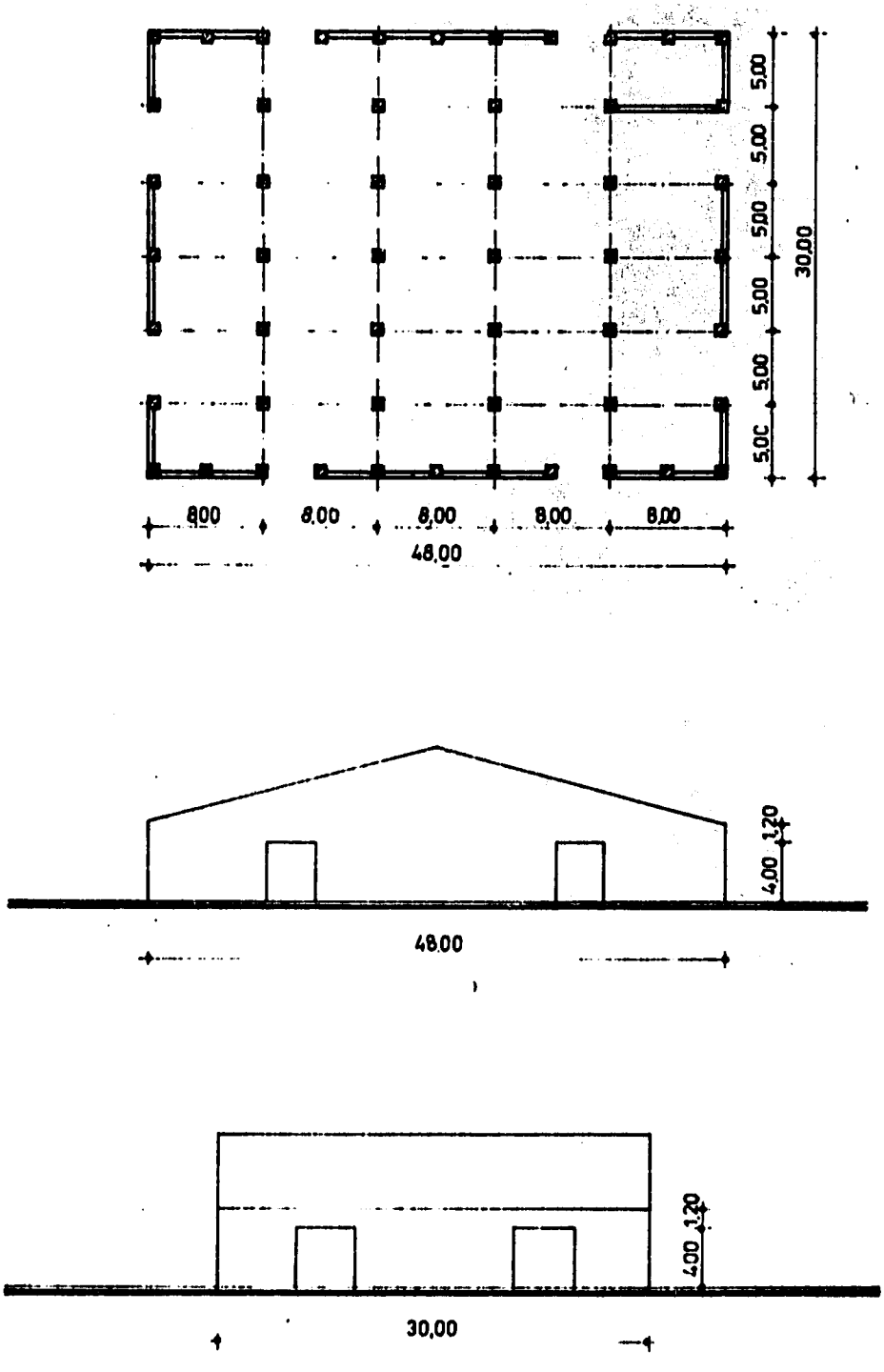


FIGURE D-5

TYPICAL DETAILS
BUILDING Nº 16

HARRIS

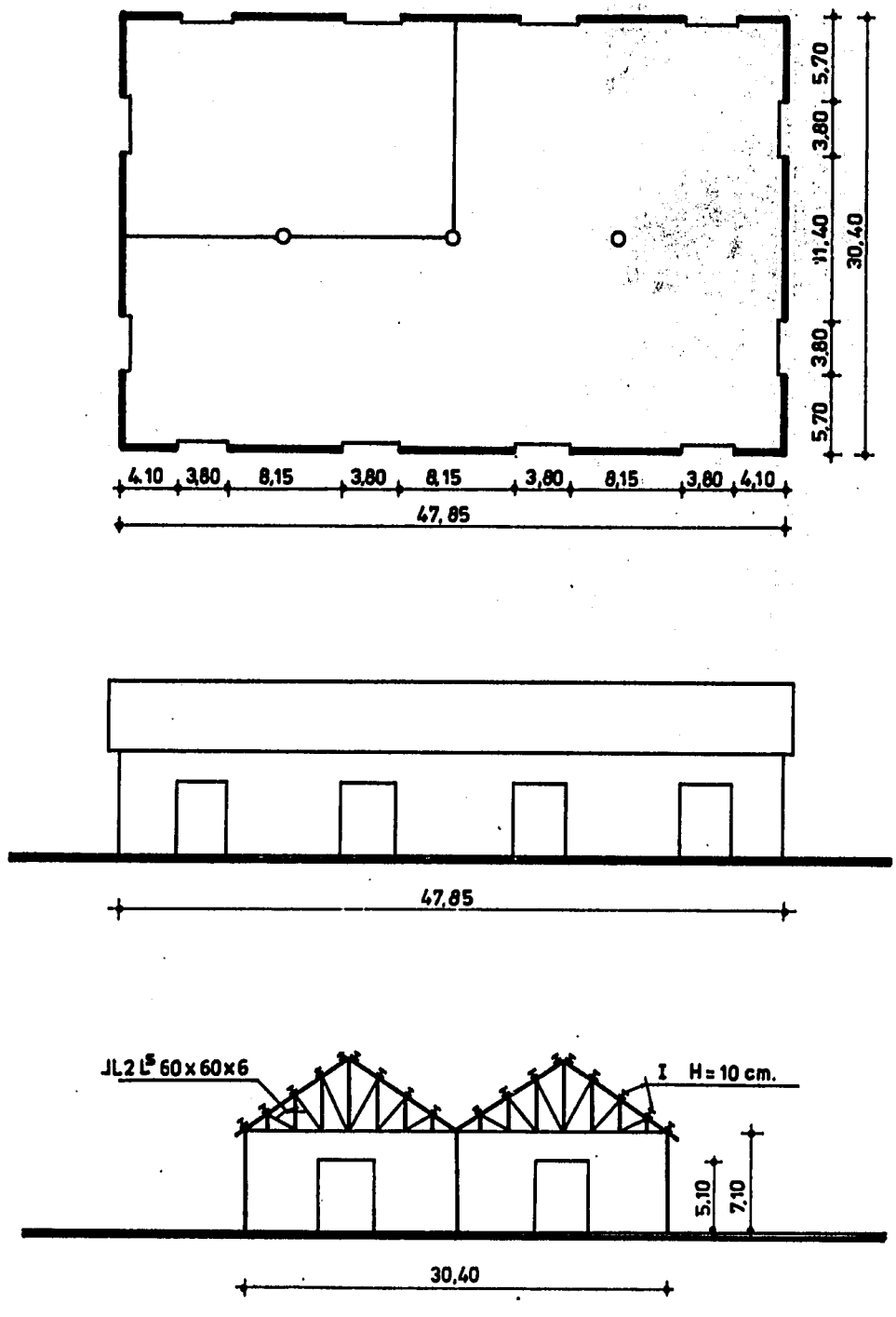


FIGURE D-6

TYPICAL DETAILS
BUILDING Nº 17

HARRIS

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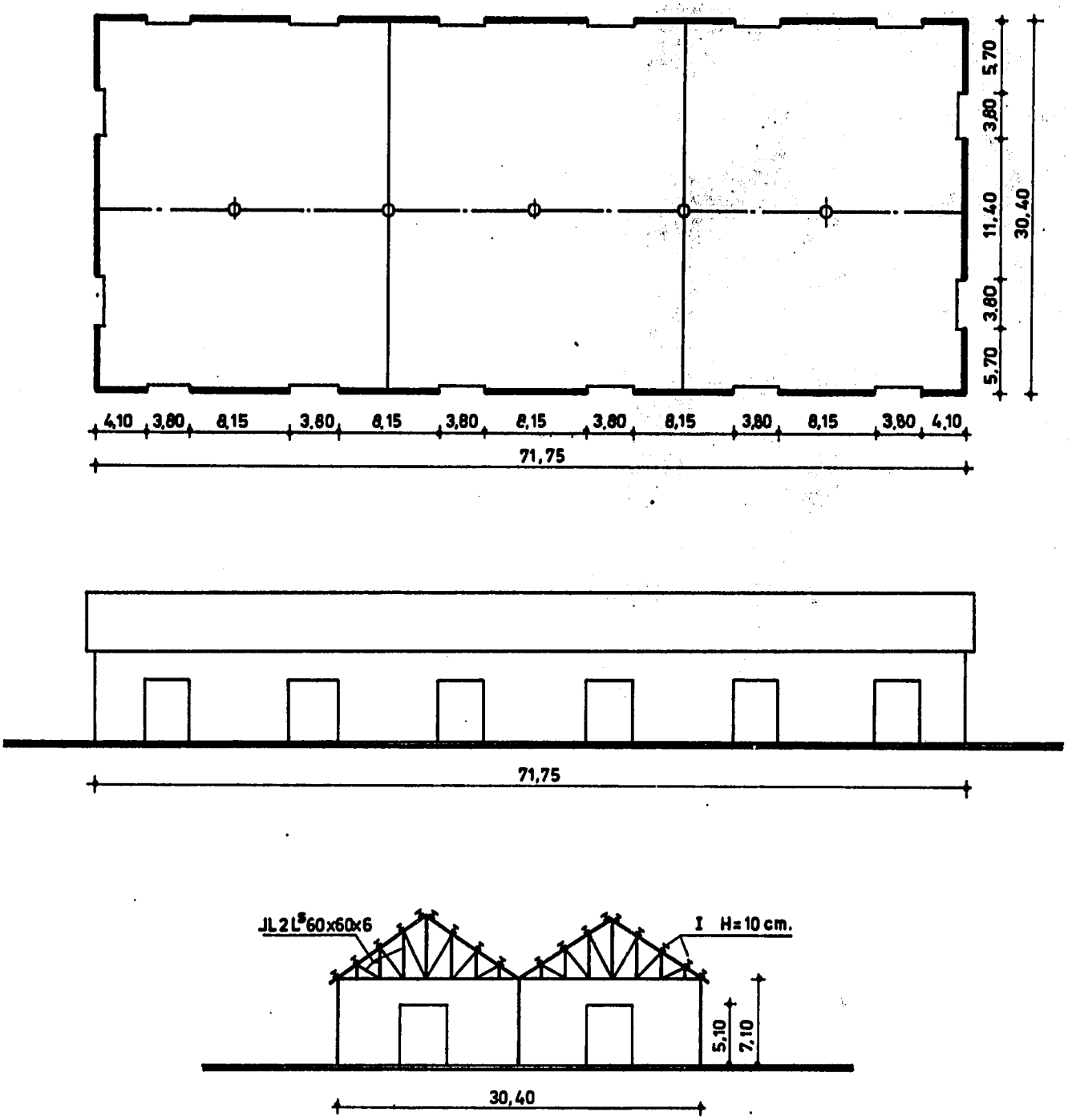

FIGURE D-7

TYPICAL DETAILS
BUILDING Nº 18

HARRIS

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APPENDIX E

'RANSIT SHED AND WAREHOUSE CAPACITY REQUIREMENTS

- Transit Shed and Warehouse Capacity Requirements

  - Accommodating the Flow of Goods

    Transit sheds, warehouses and open storage areas perform a vital function in ports. The transit sheds and transit area provide the location for receiving, dispatching and interchanging goods between the port and the vessel and for affecting customs clearances. The warehouses and associated open areas provides space for cargo which is being accumulated for export, or which its owners desire to store in the port for an extended term, in order to defer payment of duties or while awaiting sale.

    To accommodate the flow of goods which a port must handle it is essential that transit sheds and transit areas remain clear, and that cargo not be held in transit areas beyond a limited period. In order to permit the continous movement of goods through the transit sheds and areas, a system of supporting warehouses is required, together with appropriate rules governing transit shed use. The size and capacity of the transit sheds and warehouses is determined by the quantity and nature of goods flowing through the ports, and by the storage free time policies in effect.

    The efficiency of the port will be determined by the effective co-ordination of available space with appropriate policy. Because of the congestion currently occurring and expected to occur in the future at the port, receivers of bagged cargo should be required to take direct delivery from shipside. Ground storage within the confines of the port should be prohibited. Only the occasional export of bagged cargo should be allowed to move through the transit sheds. In no event should such cargo be stored in port warehouses. A layout of a typical transit shed, with required area clearances is shown in Figure E-1.

    In order to expedite vehicular traffic within the port area, it is recommended that each transit shed and warehouse be painted a different color pattern as well as given a number. In this way buildings can be identified at a distance, and unnecessary traffic around the building prevented.

- Calculating the Requirements

In order to determine the facilities required to provide adequate transit space, and further, to determine warehousing requirements as dictated by the necessity to keep the transit areas free of long term cargo storage, a computerized simulation of the flow goods was undertaken. Since storage congestion will most likely occur during peak activity periods, the assumption for the simulation are based on peak, rather than normal, activity periods, and upon varying free time periods. Tables define the activity and free time periods and tabulate the results of simulations of transit shed and warehouse maximum storage levels, as dictated by cargo size and the varying free time policies.

- Analysis of Simulation Results

The transit shed and warehouse simulation results shown in Tables E-1 and E-2 demonstrate the effect of port policy transit shed and warehouse space requirements. In the transit shed simulation undertaken, it was assumed that port policy requires all cargo received in transit sheds must be moved from shed to destination to warehouses by the end of free time. In the warehouse simulation, cargo input into warehouse was based on the same port policy; whatever portion of cargo did not move to destination or to private warehousing outside the port by the end of free time, would be moved by the port from transit shed to port warehouse. Referring to the two tables, it can be seen that under the simulated conditions, the most efficient policy is as follows :

- 15 days free time in transit shed
- All cargo not shipped by the end of free time is moved from transit shed to port warehouses.

TRANSIT SHED SIMULATION [1]

VESSEL ARRIVAL INTERVAL [2]	SERVICE TIME [3]	PARCEL SIZE [4]	DEAD TIME [5]	FREE TIME ALLOWED	MAXIMUM STORAGE CONTENTS [7]	FIRST DAY OCCURRED [8]
(Days)	(Hours)	(Tons)	(Days)	(Days)	(Tons)	
3	41	600	1	5	929	8
				10	1486	14
				15	2009	35
				30	3300	29
			2	5	1016	14
				10	1564	14
				15	2066	35
				30	3500	32
		1000	1	5	1540	8
				10	2514	14
				15	3403	35
				30	6245	35
			2	5	1726	7
				10	2658	14
				15	3678	35
				30	6397	35
5	79	2000	1	5	2166	28
				10	3258	28
				15	4467	28
				30	7562	43
			2	5	2245	8
				10	3442	28
				15	4595	28
				30	7598	43
	96		1	5	1941	14
				10	3072	14
				15	4210	49
				30	7558	49
			2	5	2254	14
				10	3386	14
				15	4565	49
				30	7708	49
6	120	3000	1	5	2685	28
				10	4050	35
				15	5358	35
				30	9555	35
			2	5	2893	35
				10	4190	35
				15	5588	35
				30	9717	35
12	161	10000	1	5	5816	7
				10	7980	42
				15	10820	43
				30	17856	91
			2	5	6565	42
				10	8596	42
				15	11388	91
				30	18060	91

1) A transit shed work week of 6 days is assumed
2) Vessels arrive at the berth at intervals indicated
3) Total time between commencement of cargo discharge and completion
4) Average number of tons of import cargo requiring covered storage per vessel
5) Time lost after cargo discharged before shipment can begin
6) Number of days cargo permitted to remain in Transit shed without charge. Simulation assumes that all cargo is shipped or moved to warehouse by the end of free time.
7) Maximum number of tons of import cargo accumulated in transit shed over the long run.
8) First date maximum storage content is reached.

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E.2

WAREHOUSE SIMULATION:[1] STORAGE REQUIREMENTS FOR IMPORTS

PARCEL SIZE[2]	TRANSIT SHED DEAD TIME	TRANSIT SHED FREE TIME[3]	WAREHOUSE DEAD TIME[4]	MAXIMUM TIME IN WAREHOUSE[5]	MAXIMUM STORAGE CONTENTS[6]	FIRST DAY MAXIMUM OCCURRED[7]
(Tons)	(Days)	(Days)	(Days)	(Months)	(Tons)	
Vessel Arrival Interval: 3 days						
Vessel Service Time :41 hours						
600	1	5	1	4	5918	125
		10			4679	125
		15			3535	125
		30			1810	139
		5		6	11536	188
		10			9469	188
		15			7421	188
		30			4842	181
Vessel Arrival Interval: 3 days						
Vessel Service Time :41 hours						
1000	1	5	1	4	9856	125
		10			7800	125
		15			5900	125
		30			3269	139
		5		6	19228	188
		10			15728	188
		15			12397	188
		30			8333	181
Vessel Arrival Interval: 5 days						
Vessel Service Time :79 hours						
2000	1	5	1	4	11593	146
		10			9146	118
		15			6996	118
		30			4117	132
		5		6	22853	181
		10			18681	181
		15			14807	181
		30			10202	202
Vessel Arrival Interval: 6 days						
Vessel Service Time :120 hours						
3000	1	5	1	4	14214	153
		10			11174	118
		15			8502	125
		30			5014	153
		5		6	28285	195
		10			23092	202
		15			18262	209
		30			12589	195
Vessel Arrival Interval: 12 days						
Vessel Service Time :161 hours						
10000	1	5	1	4	23261	174
		10			18714	125
		15			13837	167
		30			8124	160
		5		6	46711	174
		10			38561	209
		15			30012	174
		30			20788	244

1) Warehouse work week is 6 days
2) Average number of tons of import cargo requiring covered storage per vessel
3) Time lost after cargo discharged before shipment can begin. Simulation assumes that % of cargo moving from transit shed to warehouse during free time is as follows: Free time 5 days - 65%, 10 days - 55%, 15 days - 45%, 30 days - 35%
4) Time lost after cargo moved to warehouse before shipment can begin
5) Maximum time cargo remains in warehouse
6) Maximum number of tons of import cargo accumulated in warehouse over the long run
7) First date maximum storage content is reached.

Such a policy results in practical balance between transit shed size and warehouse size, and at the same time accomplishes the objective of preventing the transit hseds from becoming congested. It provides shippers with sufficient time to arrange for movement of their cargo. It also provides them witha choice of port storage or outside storage of their own choice. At the same time it provides the port with the right as well as a place to move the goods exceeding transit shed free time.

The simulations indicate that with less than 15 days free time, excessive cargo movement within the port is required and excessive warehouse space needed. With 30 days free time in transit sheds, the requirement for transit area exceeds the physical limits of the berth area. The calculation of warehouse requirements, when maximum warehouse residence time is 6 months, results in an intolerable port storage requirement and cannot be considered. Therefore, the transit shed and warehouse dimensions utilized in planning for the port have been based upon the 15 days free time, 4 month warehouse residence policy.

- Transit Shed Requirements, General Cargo Berths

Transit shed area per berth; in ports where quantity of import cargo per vessel may average 2,000 tons is shown in Table E.3. After allowance for usage capacity and for exports, the required area is calculated at about 7,300 m^2.

- Warehouse Requirements, General Cargo Berths

As can be seen in Table E.3 which tabulates warehouse area requirements for the port, warehouse area required per berth is computed at 6,350 m^2 per berth, which is approximately equivalent to a requirement of one warehouse for every two general cargo berths.

c) Roads

The existing port roads are constructed of both concrete and asphalt.
New port roads will be constructed of bituminous material overlying a crushed stone base. A layout of the existing port road system and typical cross section of new roadways are shown in the body of the text and on the contract drawings.

TABLE E.3

Optimum Transit Shed and Warehouse Size

Medium Ports

Tonnage Per Vessel

Average import cargo parcel per vessel	2,000 Tons
% requiring covered storage	67%
Tonnage requiring covered storage	1,350 Tons

Transit Sheds

Maximum Tonnage level reached in Transit Shed per simulation shown in Table 9.6 (15 days free time, 1,500 ton average parcel (interpolated)	4,000 Tons

Space Required

4000 tons @ 1.5 tons/M2		2,650 m2
add 100% for aisles and voids		2,650
	Total	5,300 m2
Plus surge capacity @ 25%		1,300
Plus space for exports (500 Tons) 2)		700
Total Transit Shed Area Required		7,300 m2

Warehouses

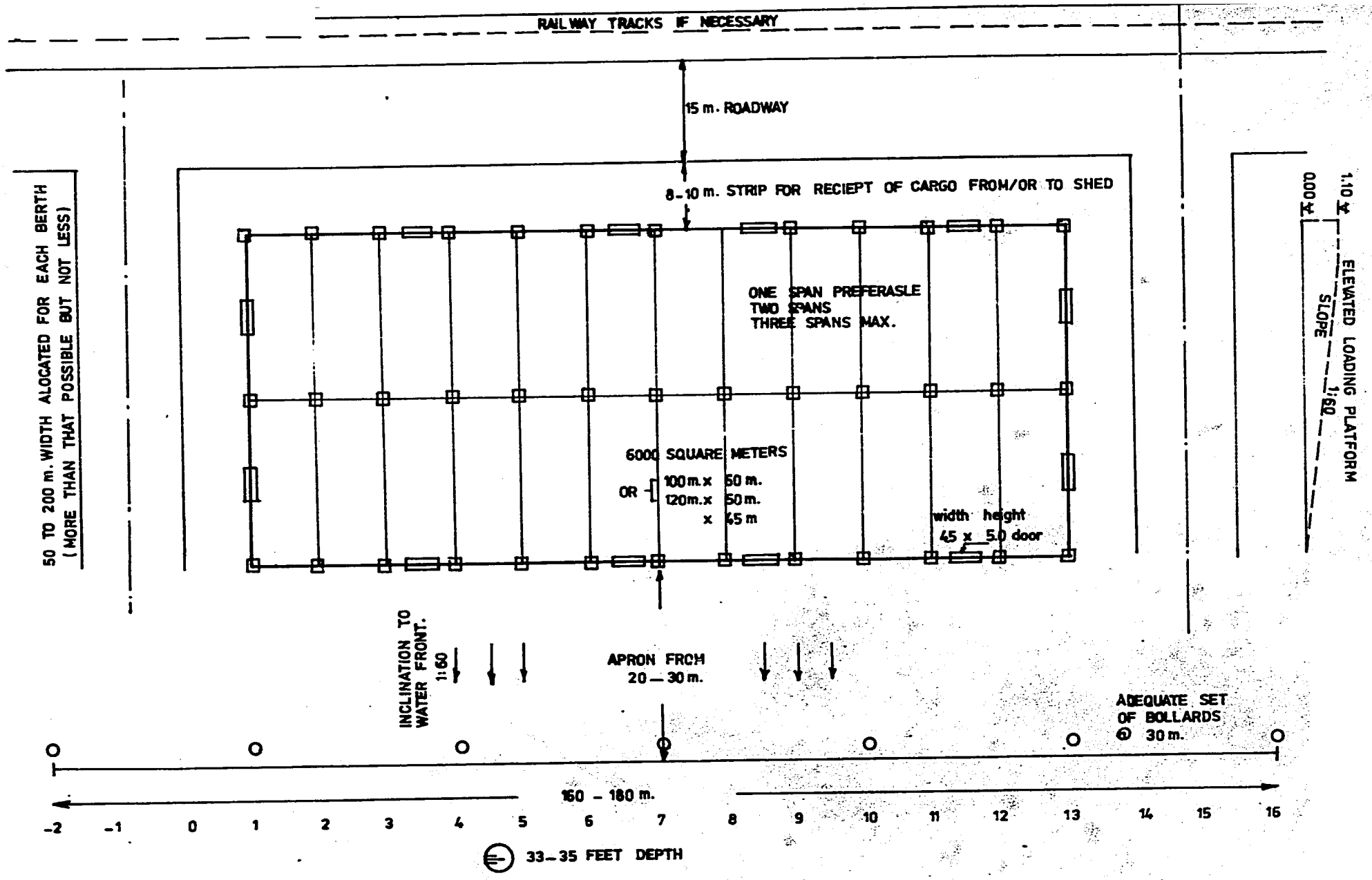
Maximum Tonnage level reached in Warehouse per simulation shown in Table 9.7 (1500 Tons (interpolated) (15 days in Transit Shed, 45 % moved to warehouse and maximum warehouse residence of 4 months)	6,500 Tons

Space Required

6,500 Tons @ 2 tons/M2		3,250 m2
Add 50% for aisles and voids		1,650
	Total	4,900 m2
Plus space for exports)		900
Total Warehouse Storage Area Required		5,800 m2

2) Space in Transit Shed for exports is calculated at 1.5 tons/M2 plus 100%. Warehouse export storage capacity represents portion to be provided within the port only. As exports increase, additional warehousing will be required within and/or outside the port.

100



- BERTH OCCUPANCY 60 % GIVES THE MIN WAITING TIME AND REASONABLE UTILIZATION OF PORT FACILITIES
- A CAPACTY OF 130 000 TO 150 000 TONS/YEAR IS ADEQUATE FOR A GENERAL CARGO BERTH.

FIGURE E-1

TYPICAL TRANSIT SHED DIMENSIONS

HARRIS

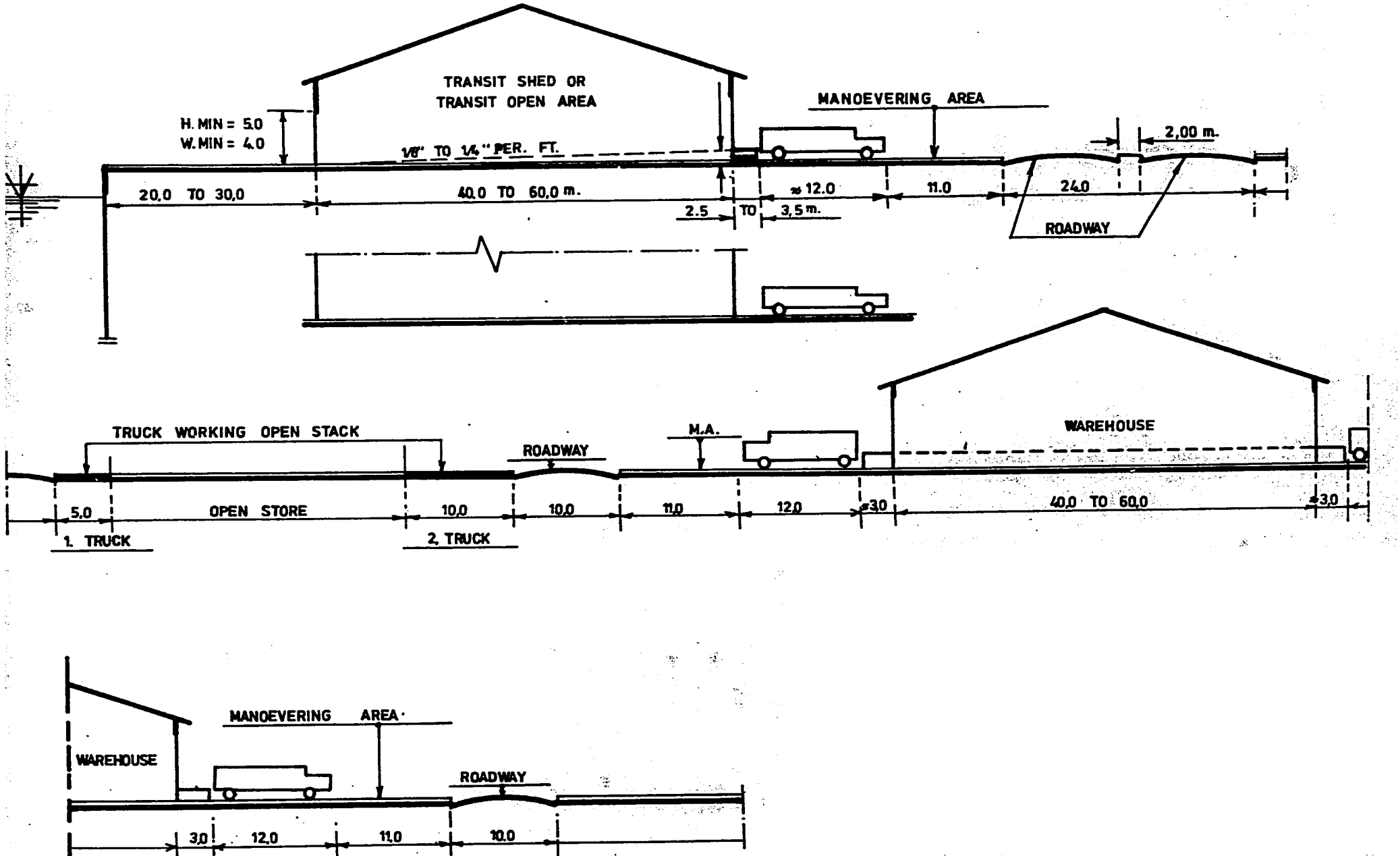


FIGURE E-2

PLANNED ROADWAY AND APRON DIMENSIONS

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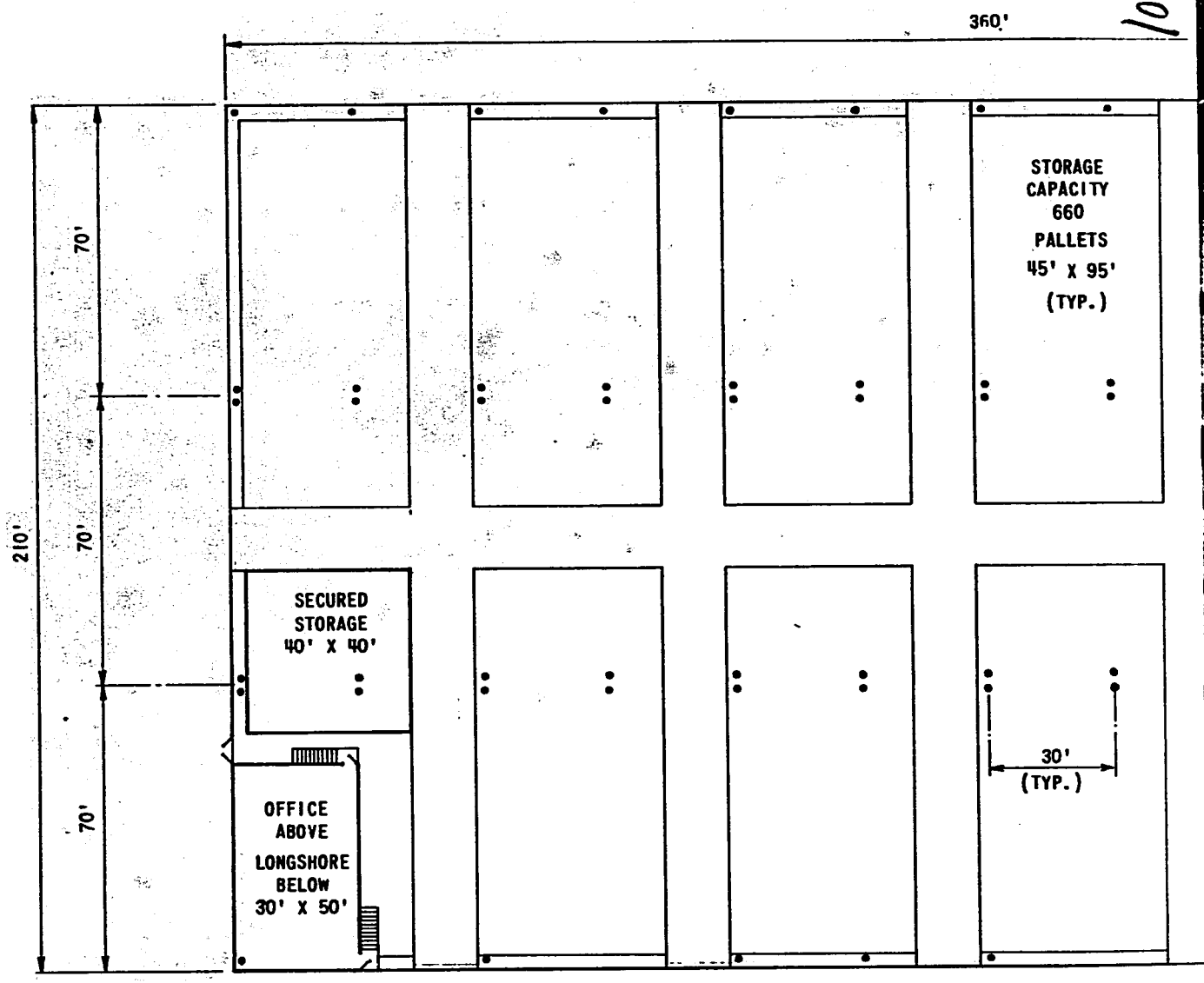
HARRIS



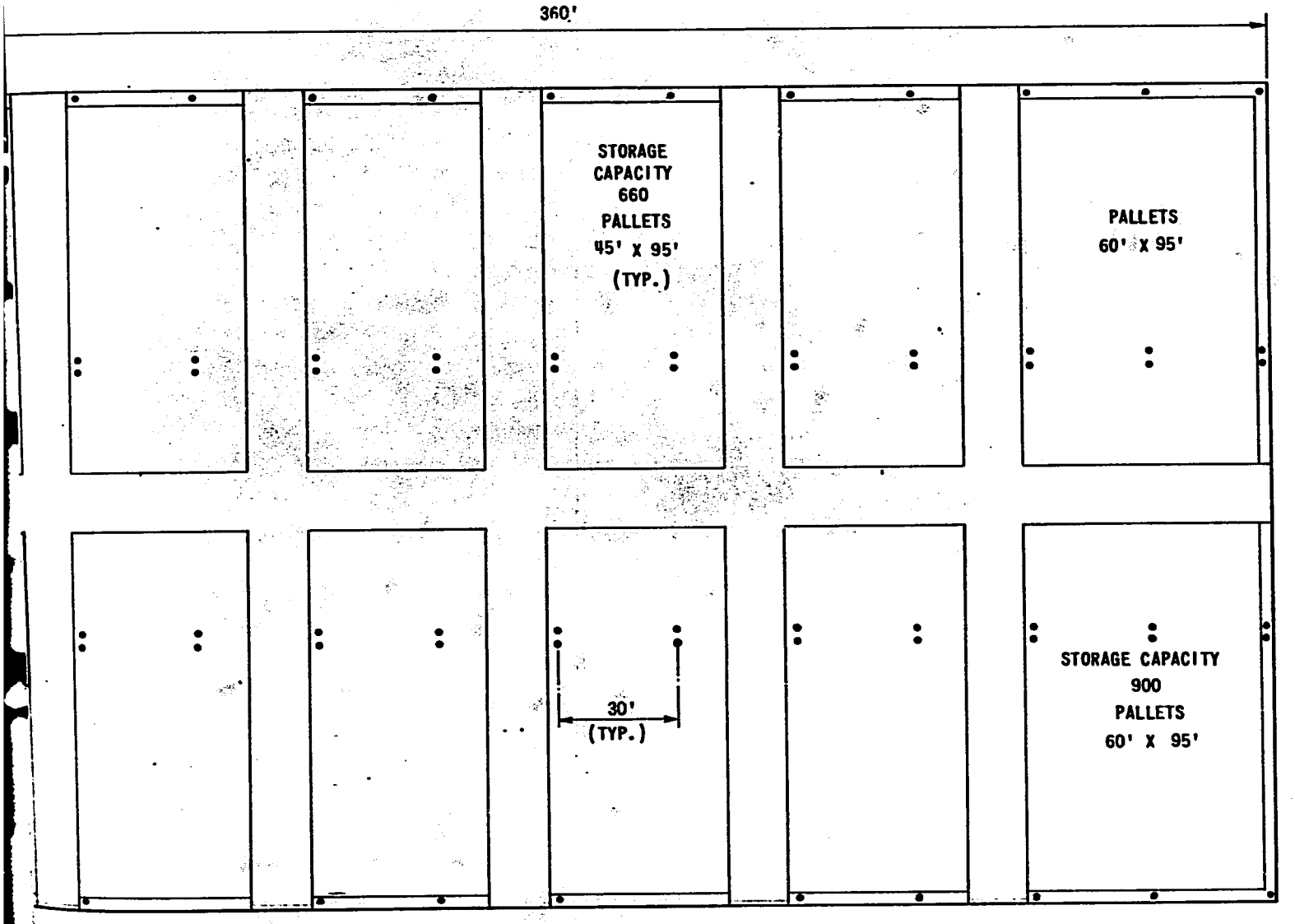
FLOOR PLAN

NOTE: MAXIMIM CAPACITY 9540 PALLETS

HARRIS

30 0 30 60

SCALE IN FEET



FLOOR PLAN

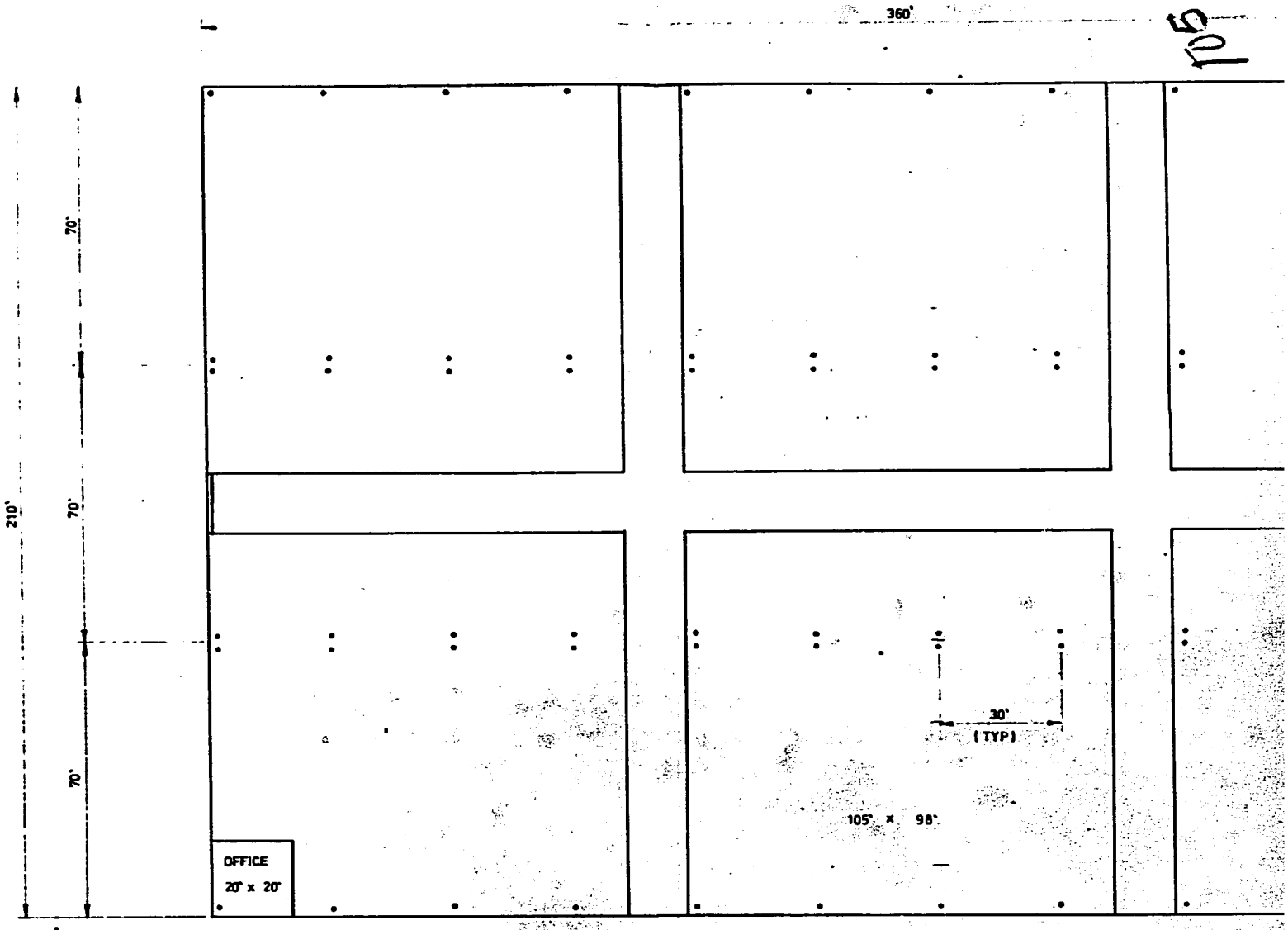
NOTE: MAXIMIM CAPACITY 9540 PALLETS

FIGURE E-3

30 0 30 60

SCALE IN FEET

TYPICAL TRANSIT BUILDING
PLAN

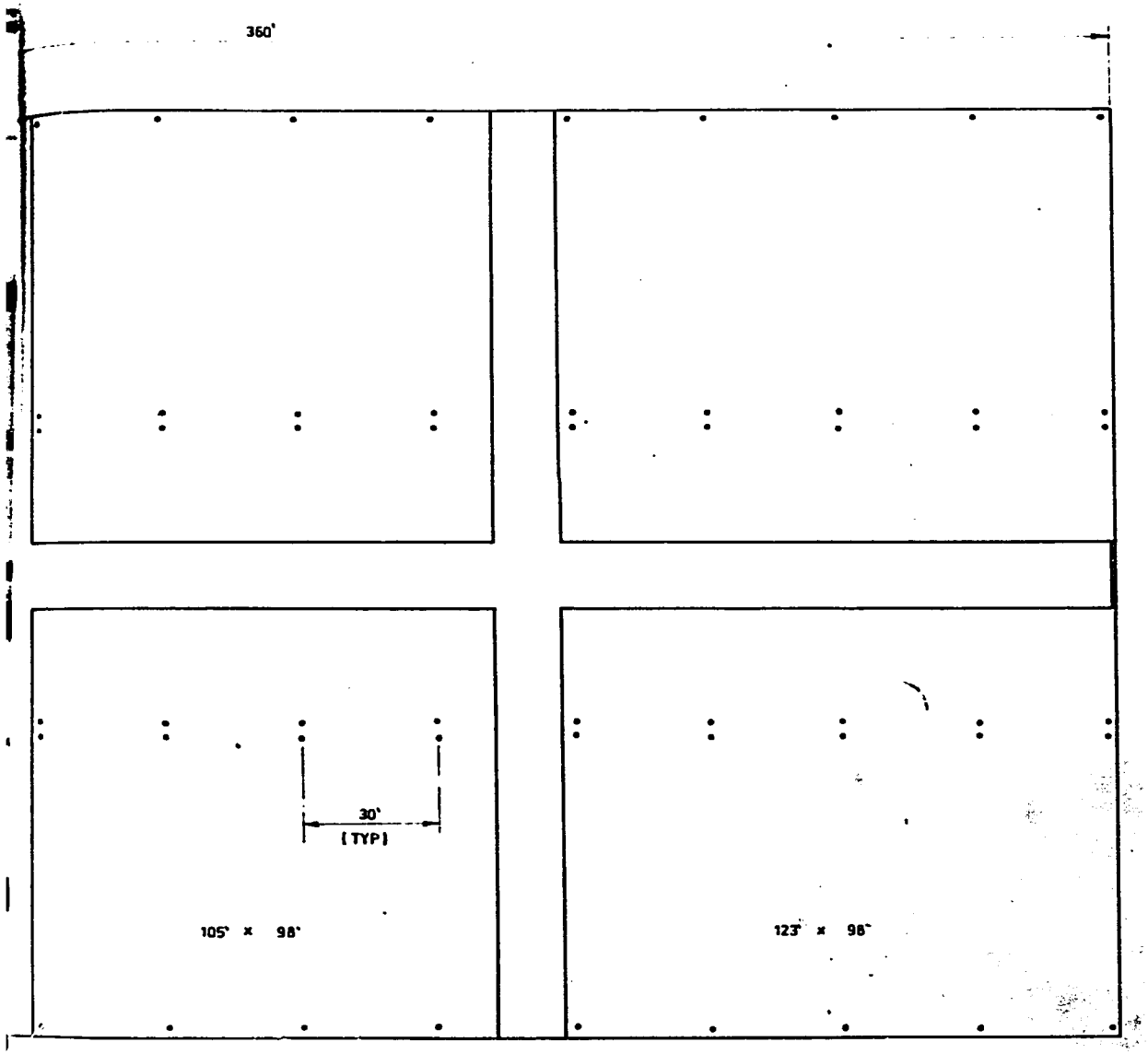


FLOOR PLAN

HARRIS

30 0 30 60

SCALE IN FEET



FLOOR PLAN

30 60

SCALE IN FEET

FIGURE E-4

TYPICAL WAREHOUSE

APPENDIX F

CONSTRUCTION MATERIALS

CONTRACTOR AVAILABILITY

Contractor and Labor Availability

Unskilled labor is available in Port Said. However, the cost of this labor is increasing. Skilled labor can be imported from Cairo, Ismailia and Suez. Local contractors have good experience in traditional construction techniques. If new methods of construction are to be used, the labor force will require training. There are several Egyptian Contractors in the field of port construction. The following firms are examples of large local Construction Contractors actively engaged in construction in Egypt.

- The Arab Contractors "Osman Ahmed Osman"
- The General Canal Company for Port Works
- The General Nile Company for Roads and Bridges
- The General Arab Company for Contracting
- EGYCO
- SPECO (Specializing in Steel Construction)
- METALCO (Specializing in Steel Construction

Dredging can be accomplished by either the Suez Canal Authority or by foreign dredging Contractors. The unit prices used in this report for dredging are based on prices received from the Suez Canal Authority.

Construction Materials and Sources

The following list shows some major sources, nearest to Port Said, of most commonly used construction materials. All of these materials are available at the present time at these sources.

Material	Source
Cement	Cairo
Reinforcing Steel	Cairo
Sand	Ismailia
Gravel	Abu-Swair
Limestone	Ataqua
Granite	Aswan
Basalt	Abu-Zabaal
Bricks	Ismailia/Cairo
Concrete Blocks	Manufactured locally
Structure Steel	Cairo
Timber	Imported

Materials	Source
Glass	Cairo
Asbestos Pipes	Cairo
Clay Pipes	Cairo
Galvanized Steel Pipes	Cairo
Copper Wire	Cairo or imported
Floor Tiles	Ismailia/Cairo
Sanitary Fixtures	Cairo
Lamps and Bulbs	Cairo or imported
Asphalt and Bitumen	Cairo
Lime	Fayed
Oil Paints	Cairo
Sheetpiles	Imported

a) Construction Materials

- Cement and Aggregate for Concrete

The following types of cement and aggregate are normally used for construction in Egypt :

- Cement for plain reinforced concrete, mortar and plaster, supplied in 50 kg bags :
- Ordinary Portland Cement to ES 373-1963, DS 12-1958, ASTM C150-56 type 1.
- Rapid Hardening Cement to ES 373-1963, BS 12-1958, ASTM C150-56 type III.
- Sulphate Resisting Cement (Sea-Water Cement) to ES 583-1965, BS 1370-1958, ASTM C150-56 type II.
- Blast Furnace Slag Cement to ES 974-1969, BS 146-58, ASTM 205-33T/1959.
- Sand for fine aggregate in concrete :

  Silicious sand, ES 1108-1971. Unit weight from 1.6 to 1.8 t/m^3.
- Coarse aggregate for concrete :

  Gravel or crushed stone to applicable standards.

- Reinforcing Steel for Concrete

The following types of steel bars are available for use in reinforced concrete, and are produced in a normal range of diameters :

- Ordinary Mild Steel (ST 37)

- Deformed Bars
- High Tensile Steel (ST 52)

- **Bricks and Blocks**

The following kinds of bricks are manufactured in Cairo.

SER. NO	DESCRIPTION	STANDARD DIMENSIONS in cm	STRENGTH in kg/ sq. cm	VOLUME WEIGHT t/mg	APPLICATION
1	Sand pink brick	25x12x6	150	2	
2	Wire cut brick	25x12x6	100	1.8	
3	Hard pressed brick	25x11x5.5	250	2	
4	Ordinary red burnt brick	25x12x6	35	1.7	
5	Light sand brick	25x13x12			

In addition, the following special grades of brick are produced :

- Refractory and insulation bricks of required sizes and shapes are manufactured on site : volume-weight - 2.0 t/cu.m., fire resistance - up to 1700°0, crushing strength - 100 kg/sq.cm.
- Blue brick (acid-proof) with glazed and non-glazed surface, with smooth or rough rear side. Standard size is 23 x 11 x 6, volume-weight 3.32 t/cu.m.

- **Window Glass**

The following kinds of window glass are made in Cairo.

Ordinary glass 3.4 and 6 mm thick with sheet size 180 x 90, 230 x 160 and 220 x 200 cm glass is mainly used of 4 mm thickness.

Hardened glass, 6 to 8 mm thick;

Armoured glass, 5 to 8 mm thick with sheet size 240 x 110 cm;

Dull glass, 3 to 8 mm thick with sheet size 250 x 110 cm; as a rule, sheets 4 mm thick are used.

- Corrugated and Plain Asbestos-Cement Sheets

Corrugated and plain asbestos-cement sheets used for roofing or on exterior walls of transit sheds and warehouses. They are manufactured in Egypt according to British standard BS 690/1958 by :

"Siegwart and Cifer Co." for manufacturing of pipes and cement products :

Dimensions of corrugated sheets :

Length - 1220, 1525, 1830, 2135 and 2440 mm;
Width - 750, 950 and 1050 mm;
Corrugation Pitch - 146, 73 mm;
Sheet Thickness - 6 mm;
Corrugation Height - 25.4, 54;

The sheets are provided 4 & 8 mm thick on request.

Dimensions of plain sheets :

Length - 1200 mm;
Widhh - 1200 mm;
Thickness - 6 mm;

on request the slats can be produced 4-25 mm thick,

- Asbestos-Cement Pipes

Asbestos-Cement Pipes are made by "Siegwart and Cifer Co." according to British Standard :

BS - 486-1956 - Pressure Pipes 75-600 mm dia
BS - 486-1953 - Pressure Pipes 72-450 mm dia
BS - 582-1948 - Sewer Pipes 50, 75, 100 and 150 mm dia

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- **Timber**

All timber used in Egypt is imported mainly from Finland. Timber is used fpr bearing structures.

- **Heat Insulating Materials**

Foam concrete "Selton" with volume weight 160 kg/cu.m, slag wool with volume-weight 160 kg/cu.m. and boards and cork dust with volume-weight 170 and 130 kg/m^2 are used as heat insulating materials for building structures.

- **Dampproofing Materials**

(produced locally)

- Roll Dampproofing Materials :

  Rival 2 - bituminous felt without coating;
  Duretex 1, 2, 3 - bituminous felt with sand coating from both sides;
  Glassphalt - bituminous glass wool with sand covering from both sides with 1.0 m wide and 10 long;
  Asphaltoid 0 - bituminous jute cloth without covering;
  Asphaltoid 1, 11, 111 proof layer bituminous jute cloth with sand coating;

- Bitumastics :

  Overol B.O. - for pasting of bitumen sheets in cold state.
  Bitumen paste - for glueing of bitumen sheets in hot states.
  Fibrous paste for fastening of bituminous felt in cold state;
  Mastic "K" - for fastening of gravel on flat roofs manufactured on request;
  Bitumastic "0" - is used in hot state for joints sealing
  Bitumastic "Paltox" - is used in cold state for joints filling
  Mastic 0 ebe - elastic and durable is used for filling of joints of floors
  Nerol "0", "F", "B" - bitumen solutions, for metal coating and for coating for dampproofing and acid-proof surfaces;

The above materials are available on request.

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- **Tile Materials for Floors and Walls**

Standard tiles are used for floors and facing of walls :

- 200 x 200 x 15 mm and 200 x 200 x 20 or 30 cement tiles, two-ply;
- 200 x 200 x 20 mm colour mosaic tiles, two-ply 300 x 300 x 30
- asphalt tiles of any colour, 2 mm thick, pasted on normal tiles;
- 150 x 150 mm ceramic tiles, 6-10 mm thick, glazed;
  6-13 mm available
  15-20 mm on request
- 220 x 110 x 28 mm clinker tiles;
- 200 x 200 x 30 mm concrete slabs with steel chips;
- 220 x 110 x 120 mm basalt blocks.

- **Varnish, Paint Materials and Chemicals**

These materials are manufactured in Egypt according to prospectus of "Paint and Chemicals Industry Corp." Cairo.

- Paints for building and general use
  a) dyes for priming
  b) glassy enamel
  c) dull enamel and varnish
  d) varnish for floors
- dyes of oil industry
- siccatings and thinners

VESSEL DIMENSIONS

GENERAL CARGO VESSELS

DWT	LOA m	LBP m	BEAM m	LOADED DRAFT m
1,000	57	53	8.7	4.2
2,000	75	72	10.8	4.9
4,000	101	97	13.7	6.1
6,000	119	114	15.6	7.0
8,000	132	127	17.0	7.7
10,000	142	136	18.1	8.2
12,000	150	144	19.0	8.6
14,000	156	150	19.6	8.9
16,000	162	155	20.3	9.2
18,000	166	160	20.7	9.5
20,000	170	163	21.0	9.8

VESSEL DIMENSIONS

CONTAINER VESSELS

DWT	LOA m	LBP m	BEAM m	LOADED DRAFT m	20 FOOT CONTAINER CAPACITY
5,000	105	101	14.5	6.5	165
10,000	142	135	18.9	8.2	500
15,000	188	175	25.7	9.1	800
20,000	233	224	31.0	9.6	1,200
25,000	254	244	31.6	10.4	1,600
30,000	275	264	32.2	11.3	2,000
35,000	285	269	32.5	11.8	2,300
40,000	285	274	32.7	12.4	2,600
45,000	290	278	33.0	13.0	2,850

1. These figures are average figures to be used as a guide only.

2. Ro/Ro (rollon/rolloff) vessels have similar characteristics to container vessels. See also Table 4.10 for car ferries.

VESSEL DIMENSIONS

ORE AND BULK CARRIERS[1]

DWT	LOA m	LBP m	BEAM m	LOADED DRAFT m
10,000	140	135	18.5	7.9
20,000	180	173	22.8	9.7
30,000	205	197	26.5	10.7
40,000	223	214	29.7	11.1
50,000	225	216	30.5	11.6
60,000	245	236	35.0	12.0
80,000	259	249	39.2	12.6
100,000	265	255	40.0	13.8

1 Grain carrying vessels not likely to exceed 100,000 DWT at Port Said.

VESSEL DIMENSIONS
TANKERS[1]

DWT	LOA m	LBP m	BEAM m	LOADED DRAFT m
10,000	140	134	17.2	7.9
20,000	178	171	22.4	9.5
30,000	200	192	25.8	10.3
40,000	215	206	29.0	11.4
50,000	230	221	32.0	12.6
60,000	243	233	33.2	12.6
80,000	251	247	37.0	13.8
100,000	280	252	41.2	14.6
150,000[2]	295	280	44.1	17.0
200,000[2]	324	310	48.1	19.2
250,000[2]	341	329	50.8	21.0
300,000[2]	347	332	52.5	23.4

[1]Tankers in excess of 100,000 tons may pass through the canal, but are not expected to utilize the existing port.

[2]Included for information only.

VESSEL DIMENSIONS

BARGE CARRIERS

DWT	LOA m	LBP m	BEAM m	LOADED DRAFT m	CARRIER SYSTEM
32,000	272	247	30.4	11.3	LASH
38,400	268	226	32.0	11.9	SEABEE
43,000	261	234	32.2	11.3	LASH

VESSEL DIMENSIONS

BARGES

CARRIER SYSTEM	DWT	LOA m	WIDTH m	DEPTH m	LOADED DRAFT m	CAPACITY m^3
LASH	375	18.8	9.5	4.4	2.5	570
SEABEE	850	29.8	10.7	4.9	-	1,133

VESSEL DIMENSIONS

LPG AND LNG TANKERS[1)]

CARGO CAPACITY m^3	LOA m	LBP m	BEAM m	LOADED DRAFT m
4,600	105	96	15.5	7.2
9,000	124	117	19.7	7.8
14,800	154	144	23.0	7.6
23,300	173	164	25.8	10.2
29,195	178	165	26.0	9.7
36,000	187	178	27.5	10.5
52,000	200	188	31.3	11.6
75,000	210	200	32.5	12.4
98,500	246	234	39.9	12.7
125,000	285	273	43.7	10.9

1) Unlikely to be utilizing Port Said port facilities.

VESSEL DIMENSIONS

COASTAL VESSELS

DWT	LOA m	LBP m	BEAM m	LOADED DRAFT m
250[1]	38	-	7.5	4.0
550	54	49	8.4	3.2
750	54	49	8.5	3.6
1,000	66	59	10.0	3.8
1,300	80	-	12.4	4.0
1,500	87	62.8	10.6	4.5

1 Ionian Sea, Lebanese, Turkish coastal type wooden hull motorized sailers.

VESSEL DIMENSIONS

SMALLER VESSELS

DWT	LOA m	BEAM m	LOADED DRAFT m
1,810	90	11.0	3.5
1,968	93	11.5	3.5 - 4.0
2,140	96	12.0	3.5
2,935	114	14.0	3.5
4,016	120	15.0	4.2

VESSEL DIMENSIONS

PASSENGER AND CAR FERRIES

CAPACITY	LOA m	BEAM m	LOADED DRAFT m
40 cars - 274 passengers	49	11.0	2.4
70 cars - 250 passengers	68	16.1	4.2

VESSEL DIMENSIONS

TUGS

CLASS (H.S.)[1]	LOA m	BEAM m	LOADED DRAFT m
300	18	5.6	2.5
600	18	6.0	3.5
1200	28	8.0	4.0
2000	35	9.5	4.5
2500	38	9.7	5.0
3200	42	10.8	5.8

1 Shaft Horse Power

VESSEL DIMENSIONS

FISHING VESSELS

GROSS REGISTERED TON	LOA m	LBP m	BEAM m	LOADED DRAFT m
60[1]	21	-	6.0	2.6
200	40	35	7.0	3.5
350[2]	34	-	7.0	3.8
400	55	45	8.5	4.0
600	65	55	10.0	4.5
800	70	60	10.5	4.8
1,000	75	65	11.0	5.0
1,500	80	70	12.0	5.3
2,000	85	75	13.0	5.6
2,500	80	90	14.0	5.9

1 wood hull

2 trawler

APPENDIX H

ANALYSIS OF ALTERNATIVES

ANALYSIS OF THE ALTERNATIVES

Engineering

A comparison of the feasible alternatives has been made as is shown on Table H.1. A study of this table indicates that an evaluation of the alternatives can be summarized as follows :

- Alternative 5b (the expanded scope to include the propoerty south of the existing port area) is the only alternative capable of meeting the projected berth and port capacity requirements in 1985 without lightering.

- Alternative 5a has the capacity of meeting projected berth requirements for 1980 and with some continued lightering this scheme meets 1985 cargo requirements.

- Alternatives 1, 2, 3 and 4 which are limited to the existing port area have insufficient capacity in 1980.

- Alternatives 5a and 5b will permit phasing of the construction rehabilitation so that there will be no interference with existing operations. The capacity of the port with these alternatives would not be impaired or reduced. The rehabilitation schemes provided by the other alternatives interfere, to a lesser or greater extent, with existing operations, thus reducing port capacity during the construction periods.

- Alternative 1 is the least cost.

- Alternative 5b is the most costly in terms of capital expenditure and requires considerable relocation of the bunker oil storage and loading facilities alongside the Canal.

- Alternative 4 is the most costly per unit of thruput capacity.

- Alternative 4 would interfere most with existing port operations during construction, effectively reducing port capacity during these periods.

- Alternative 3 provides the greatest increase in port efficiency as related to cost.

- Alternative 5a provides the greatest increase in port capacity as related to cost.

Port Capacity

Port capacity under each of the alternatives is shown in Table H.1. Comparison of Alternatives.

Table H.1
Comparison of Alternatives
Rehabilitation Schemes

ITEM	EXISTING PORT LAYOUT		ALT.NO.1 MINIMUM REHAB.		ALT.NO.2 EXPANDED WRHOUSNG		ALT.NO.3 MEDIUM REHAB.		ALT.NO.4 MAJOR REHAB.		ALT.NO.5a EXPANDED SCOPE		ALT.NO.5b EXPANDED SCOPE	
CAPACITIES														
General Cargo														
Ship &/or Lighter	260		418		418		418		420		420		2,440	
Neo Bulk														
Ship &/or Lighter	1,000		861		861		918		925		1,230		1,100	
Special Cargo														
Ship &/or Lighter	0		900		900		950		1,200		1,500		1,500	
Dry Bulk														
Mech.,Non Mech. &Lighter	1,385		600		680		680		760		825		1,632	
TOTALS	2,645		2,779		2,859		2,966		3,305		3,975		6,672	
BERTHS														
Type	Ship	Lgtr	Ship	Lgtr	Ship	Lgtr	Ship	Lgtr	Ship	Lgtr	Ship	Lgtr	Ship	Lgtr
Length (Meters)	180		180		180		180		180		180		180	
Water Depth (Meters)	8.5	4.0	8.5	4.0	8.5	4.0	8.5	4.0	8.5	3.5 4.0	8.5	4.0	8.5	3.5 4.0
NUMBER OF BERTHS														
General Cargo	0	3	1		1		1		1		1		5	
Neo Bulk	4	0	3	4	3	4	3	4	3	14	3.4	18	3	18
Special	0	0	2		2		2		2		2.6		4	
Dry Bulk - Mechanical	1		1		1		1		1		1		2	
- Non Mechanical	2	1	0		0		0		0		0		0	
TOTALS	7	4	7	4	7	4	7	4	7	14	8	18	14	18
STORAGE CAPACITY														
Covered Storage														
Rehabilitated Bldgs. M^2	11,500		13,600		12,500		7,000		1,500		7,000		7,000	
New Bldgs. M^2					9,160		27,500		70,000		27,500		55,000	
Open Storage M^2	10,500		60,000		75,000		65,000		71,000		96,000		120,000	

1) Lighterage should be discontinued as soon as possible because of extraordinary high cost per ton for double handling cargo.
2) Cargo thruputs expressed in 1,000 tons.

ESTIMATED QUANTITIES

MINIMUM REHABILITATION

ALTERNATIVE NO. 1

Item	Quantity
Site Clearing, Removal of Debris and Disposal	L.S.
Demolition - of parts of Cap beam	100 M^3
Casting Cap Beam(partially)	100 M^3
Demolition - Basalt Blocks	65,000 M^2
Cast in Place Concrete Apron	16,250 M^3
Concrete Apron - Unpaved Areas	
Cut	8,500 M^3
Subgrade	4,250 M^3
Concrete	4,250 M^3
Fenders (Rubber)	100
Building Demolition	L.S.
Building Rehabilitation	L.S.
New Offices, Admin & Medical Services	400 M^2
Fencing & Gates (repairs)	L.S.
Painting (Incl Fencing)	L.S.
Open Storage Areas	
Cut	27,000 M^3
Fill	10,000 M^3
Paving	55,000 M^2
Fire Protection, Potable Water & Sanitary	L.S.

ESTIMATED QUANTITIES

MINIMUM REHABILITATION

ALTERNATIVE NO. 1

Item	Quantity
Electrical - Labor & Material	L.S.

ESTIMATED QUANTITIES

EXPANDED WAREHOUSING

ALTERNATIVE No. 2

Item	Quantity
Dredging	
Demolition of Cap Beam	200 M^3
Casting Cap Beam	200 M^3
Fenders (Rubber)	100 Ea
Bldg. Demolition (Incl. Salvage)	10,000 M^2
Building Rehabilitation	L.S.
Demolition of Basalt Blocks	65,000 M^2
Cast-in-Place Concrete Apron	16,250 M^3
Concrete Apron in Unpaved Areas	
Cut	8,500 M^3
Subgrade	4,250 M^3
Concrete	4,250 M^3
Site Clearing, Removal of Debris & Disposal	L.S.
Open Storage Areas	
Cut	27,000 M^3
Fill	10,000 M^3
Asphalt Paving	55,000 M^2
Fire Protection, Potable Water & Sanitary	L.S.
Electrical Labor & Material	L.S.

ESTIMATED QUANTITIES

EXPANDED WAREHOUSING

ALTERNATIVE NO. 2

(cont'd)

Item	Quantity
Fencing & Gates (repairs)	L.S.
Painting (Incl. fencing)	L.S.
New Warehousing/Transit Sheds (incl. slab & utilities & painting) 3x32x100 = 9,600 M	9,600 M^2
New Offices, Admin & Medical Services	400 M^2

ESTIMATED QUANTITIES

MEDIUM REHABILITATION

ALTERNATIVE No. 3

Item	Quantity
Dredging	
Demolition of Cap Beam	500 M^3
Casting Cap Beam	500 M^3
Fenders (Rubber)	100 Ea
Bldg. Demolition	120,000 M^2
Bldg. Rehabilitation	L.S.
Demolition of Basalt Blocks	65,000 M^2
Cast-in-Place Concrete Apron	16,250 M^3
Concrete Apron in the Unpaved Areas	
Fill	8,500 M^3
Subgrade	4,250 M^3
Concrete	4,250 M^3
Site Clearing, Removal of Debris & Disposal	L.S.
Open Storage Areas	
Cut	27,000 M
Fill	10,000 M
Asphalt Paving Paving	55,000 M
Fire Protection Potable water & Sanitary	L.S.
Electrical, Labor & Material	L.S.
Fencing & Gates Repair & Relocation	L.S.

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ESTIMATED QUANTITIES

MEDIUM REHABILITATION

ALTERNATIVE NO. 3

(CONT'D)

Item	Quantity
Painting (Incl. fencing)	L.S.
New Transit Sheds (Incl Slab & Utilities)	21,120 M^2
New Warehouses	6,400 M^2
New Offices Admin. Fire & First Aid	600 M^2
New Mosque & Repair Shop	L.S.

ESTIMATED QUANTITIES

MAXIMUM REHABILITATION

ALTERNATIVE NO. 4

Item	Quantity
Dredging	30,000
Demolition of Cap Beam	500 M^3
Casting Cap Beam	500 M^3
Fenders (Rubber)	100 Ea
Bldg Demolition	L.S.
Bldg Rehabilitation	L.S.
Demolition of Basalt Blocks	65,000 M^2
Cast-in-place Cement apron	16,250 M^3
Concrete Apron in Unpaved Areas	
Cut	8,500 M^3
Subgrade	4,250 M^3
Concrete	4,250 M^3
Site Clearing, Removal of Debris & Disposal	L.S.
Open Storage Areas	
Cut	30,000 M^3
Fill	15,000 M^3
Asphalt Paving	100,000 M^3
Fire Protection, Potable Water & Sanitary	L.S.

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ESTIMATED QUANTITIES

MAXIMUM REHABILITATION

ALTERNATIVE NO. 4

(CONT'D)

Item	Quantity
Electrical Labor & Material	L.S.
Fencing & Gates	L.S.
Painting (Incl. fencing)	L.S.
New Transit Sheds (Incl Slab & Utilities)	45,400 M^2
New Warehouses	25,300 M^2
New Office Admin. & Fire & First Aid	600 M^2
New Mosque & Repairs Shop	L.S.
New Quay Wall	500 LM
Relocate Grain	L.S.

ESTIMATED QUANTITIES

(Alternatives Nos. 5a & 5b)

EXPANDED SCOPE

Alternatives 5a and 5b have not been investigated in detail as they are beyond the scope of the Consultant's work. However, any of the four schemes shown above can be combined with work in the southern part of the site to obtain the cost of the overall development shown in schemes 5a and 5b.

For example, shown below are order of magnitude cost estimates for Alternatives 5a and 5b which combines the work under Alternative 3, Medium Rehabilitation, with relocation of the grain facility to south Abbas Basin (5a) and for 5b, with tank relocation and subsequent utilization of the southern area of the site (west of Hasim Basin) for general and special cargo and a relocated grain facility. These developments would provide the following.

	Capacity Tonnage	Berth Occupancy	Meets Cargo Projections to
Scheme 5a	3,975,000	60%	1985
Scheme 5b	6,672,000	60%	1985

ESTIMATED QUANTITIES

EXPANDED SCOPE

(Alternative Nos.5a&5b)

Item

Alt #3 - plus Additional Work Shown Below

Demolition, Removals & Relocations

Dredging
Sheet Pile Quay (or Dolphins)
Pavement Aprons
Relocated Road
Asphalt Paving
Relocated Grain Silos
Fencing
Electrical
Mechanical
Transit Sheds
Warehouses

TOTAL

CONTINGENCY 15%

SUBTOTAL

OVERHEAD AND PROFIT 10%

TOTAL ESTIMATED CAPITAL COST - CONSTRUCTION

APPENDIX I

CARGO HANDLING AND EQUIPMEMT REQUIREMENTS

CARGO HANDLING AND PORT OPERATIONS

There is a direct relationship between the method of cargo handling in a port and the operation of the port. The speed and method of cargo handling affects the requirements for operation of the port and the movement of goods in and out of the port just as the procedures of storage, customs and labor regulations affect the cargo handling. This report describes the relationship of these activities and presents recommended methods and procedures for achieving efficient port operation and productive utilization of port facilities and port labor.

CARGO HANDLING METHODS

Types of Cargo

Methods of handling cargo in ports are determined by the types of cargo to be handled. In general, cargo handling methods will vary in accordance with the classification used in this study as follows:

- General cargo: packaged and parcels
- Neo/bulk cargo: large lots, primarily bagged cargo
- Special cargo: large lots, primarily such items as steel and lumber
- Bulk cargo: grain, ores, liquids

Division of Work

Cargo handling in ports consists of two parts. Stevedoring work is performed on board vessel and at the quay; terminal work is performed onshore and in the transit sheds and warehouses.

Stevedoring Methods

Ports today are planned for the handling of general and neo/bulk cargo to or from vessel by ships gear or when required, by high capacity quay cranes, mobile cranes or floating cranes, in the case of heavy lifts. The methods to be utilized in conjunction with this system are as follows:

- General Cargo

This cargo is presently handled to or from vessel in many ports by nets and slings, with delivery to storage by trailer or other means. It can also be handled on pallets by fork-lift truck to nearby transit sheds and areas. This latter method is commonly used today in modern ports of the world because of its increased speed of handling and lower unit cost and is recommended.

The forklift and pallet method of cargo handling involves the use of wooden platforms, known as pallets, on which cargo is placed and then moved as a unit during its transport between ships hold and storage or inland shipment. Stevedoring pallets are constructed with slots, known as wings, into which the cables or bars of lifting bridles are placed during movement between ships hold and quay side. Slots in the pallets permit the insertion of the forks of forklift trucks, which pick up and transport the pallet, as well as stacking the pallet in storage or in rail car or truck. Hydraulic lifting masts on the forklift trucks provide the means by which the cargo is lifted vertically and propulsion is provided by diesel, gasoline or electric power. Cargo being handled by forklift truck is shown in Figure 1 .

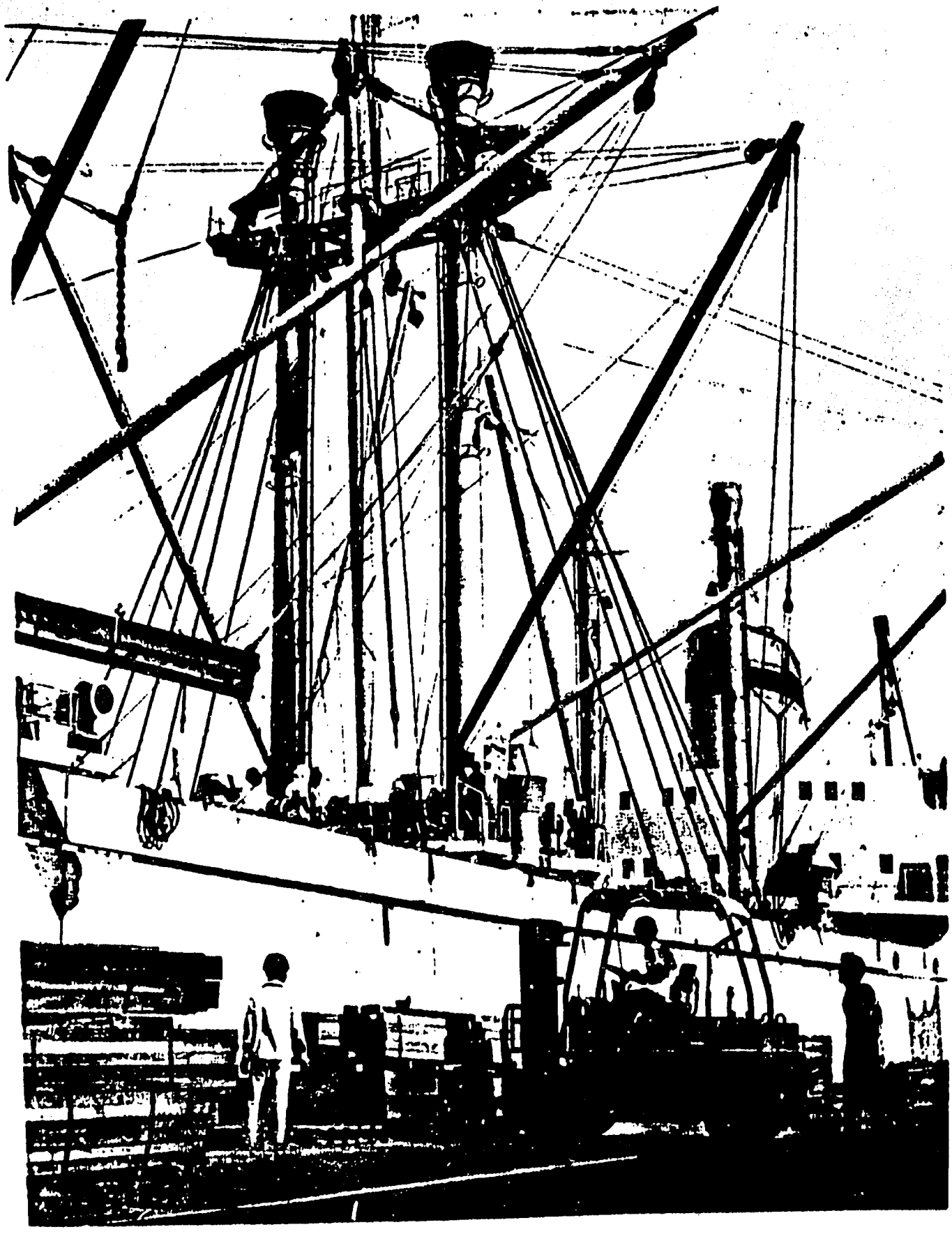


FIGURE 1
FORKLIFT TRUCK
AT SHIPSIDE

- Neo/bulk Cargo

This cargo can be handled in the same manner as general cargo, but because of the large lots of similar cargo, benefits particularly from mechanization. A typical example of neo/bulk cargo is a bagged cargo moving in full shipload quantity, such as bagged cement, fertilizer, oil cake meal or fish meal. Preferably stored under cover, in order to protect against rain, wind, sun damage or possible spontaneous combustion in the case of meals, the commodity can be handled at discharge or loading rates of 1,000 to 2,000 tons per day. In shipload lots, neo/bulk cargo handling can occupy a berth for a week or longer continuously and requires full use of transit shed space, plus the necessity for planning and scheduling of prompt movement of the cargo to long-term storage inside or outside the port.

- Special Cargo

This cargo requires open storage areas and high capacity mobile or portal cranes. Thus, special cargoes in large lots and requiring crane service should be handled at special berths.

- Bulk Cargo

Small lots of bulk cargo imports can also be handled at the special cargo berths. However, when large volumes of particular bulk cargoes are to be handled, facilities specially designed for the commodity are required. Examples are grain elevators and ore loaders or unloaders. Such specially designed facilities are capable of handling the particular commodities for which they are designed at very high loading or unloading rates. Properly designed and equipped grain

handling berths can attain average unloading rates of 1,000 tons per hour with a minimum of shrinkage or dust contamination. Similarly, ore facilities can be designed and equipped to attain even higher discharge or loading rates, with minimal loss of product. Such facilities, however, are normally inflexible and can be utilized only for the products for which they are designed.

- Container Cargo

This cargo can also be handled at special cargo berths and to a limited degree at general cargo berths, when an occasional container may be encountered on board a general cargo vessel. Standard container vessels, however, require their own specialized container facilities which include container cranes, as shown on Figure 2 . Ashore, containers are usually handled in the port by one of two principal methods:

- Wheeled operation - The containers remain at all times on their own set of bogie wheels or chassis and are hauled within the container area by specially equipped fifth wheel type tractors, usually known as "Yard Hustlers". Standard road tractors may also be used. When a full wheeled operation is utilized, no stacking of containers is undertaken.

- Stacking operation - The containers are delivered to stacking areas by specialized transport vehicles, straddle carriers or side loader or by trailer or the abovementioned tractor and chassis. Containers are then stacked by straddle carriers, side loader, container forklift or by specialized bridge cranes which are often indicated by a manufacturers trade name such as "Transtainers".

FIGURE 2
CONTAINERS UNLOADED BY CONTAINER CRANE
TRANSPORT BY STRADDLE CRANE

In addition to the handling of containers in the port, certain containers will require loading or unloading. This operation is accomplished at a container freight station or "stuffing shed".

- Rollon/Rolloff Cargo

Here, little handling is involved in the port. The cargo merely rolls on wheels to or from vessels through the port, unless loading or unloading of the trailers is required in the port.

- LASH

"Lighter Aboard Ship" cargo involves, as far as port facilities are concerned, similar handling as described for general, breakbulk, special and bulk cargo, except that the barges are loaded or unloaded at the berth. It is necessary therefore, for the port to provide crane service for lifting the cargo to and from the barges. This is normally done with mobile cranes. Since heavy lifts are sometimes involved, cranes capable of lifting 20 to 50 tons are also required. Figure 3 shows a LASH vessel unloading a barge.

- SEABEE

Similar to LASH, but utilizing larger barges. Port requirements are the same as for LASH.

Terminal and Warehouse Methods of Cargo Handling

Within the port, cargo may be handled between the point of rest in the port and the inland transport carrier in a number of ways, varying from manually carrying the cargo by

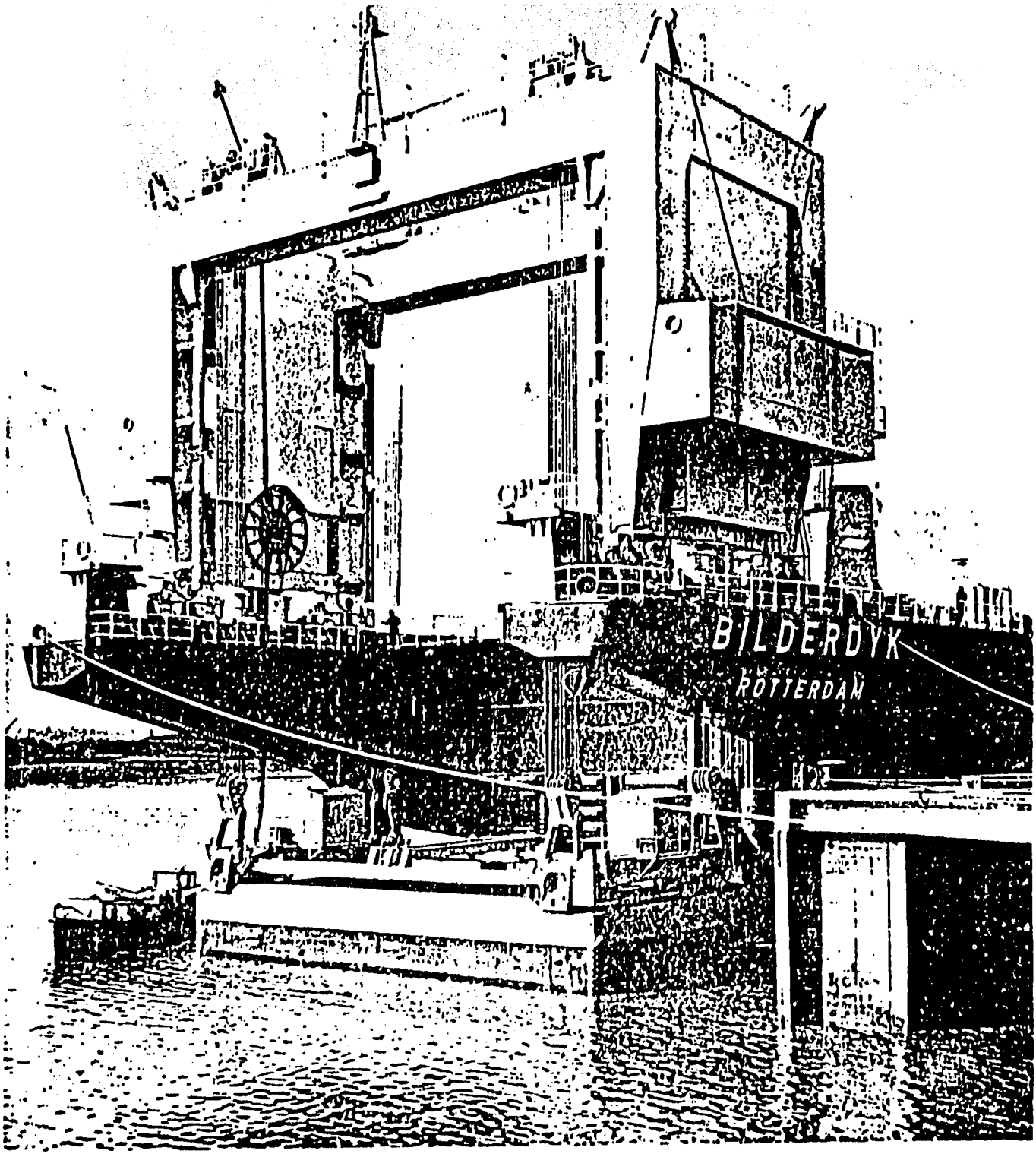


FIGURE 3
UNLOADING LASH BARGE

hand, to hand trucking, to handling by pallet and forklift truck. Fast, efficient handling in ports of the world today is accomplished with the forklift and pallet method. This method is generally recommended. Figure 4 shows an example of warehousing using the forklift and pallet method. Heavy and unwieldy items, normally stacked in open storage, will be lifted by mobile cranes to and from rail car or truck.

Conclusions

- General and Neo/bulk Cargo

General and neo/bulk cargo should be handled by forklift and pallet method both on vessel and in transit sheds, due to the increased speed of handling and the lower unit cost.

- Special Cargo

Special cargo should be handled at open berths equipped with cranes or can be handled by floating cranes.

- Bulk Cargo

Bulk cargo in large quantities should have its own specialized facilities. Small lots can be handled at the special cargo berths.

- Container Cargo

Container cargo should be concentrated at major ports, which should have container terminal facilities developed. Wheeled operation is preferred initially. Empty containers can be handled by forklift trucks equipped with lifting frames, but full containers will require handling

FIGURE 4
INSIDE A TRANSIT SHED UTILIZING
PALLETIZED HANDLING METHOD

by straddle carrier or by heavy lift forklift. Later as cargo volume increases, if limited space requires, container storage can be switched to modular stacking, utilizing rail or tire-mounted bridge cranes, with inland delivery by rail as well as by road.

Transport of Cargo Within The Ports

The port serves as an interface between two modes of transport, namely, a waterborne carrier and a land carrier. Onshore most cargo requires at least one rehandling within the port. Movement of cargo within the port is often accomplished by the use of agricultural tractor and trailer. Transfers of packaged cargo between shipside and adjacent transit sheds can be accomplished by forklift, except at berths where transit sheds are not located close to the berths. In such cases, in order to maintain speed of ship loading and unloading, heavy duty 20 ton tractor trailers can be utilized to maintain an undelayed flow of goods.

Transfers of packaged cargo between transit sheds and warehouses and storage areas can be accomplished by forklifts or by tractor trailers depending upon the distance. The equipment list shown herein is intended to provide sufficient equipment to cope with normal transfer requirements. Transport of other cargoes within the port should be with the use of specialized equipment as described for containers and by specialized handling systems designed for transfer of individual bulk commodities.

TRANSIT AND STORAGE POLICY

Extended residence time of goods in transit increases the quantity of goods stored in transit areas. Lack of transit storage space affects the efficiency of cargo handling to

or from vessel. The effective establishment and enforcement of free and allowed time for cargo in transit areas has a direct effect upon the port capability as a whole. While economies should accrue to the shipper who minimizes his port storage cost and time, governmental policy affecting import regulations or storage charges may create conditions under which it is more advantageous for the shipper to leave his goods in the port. In such cases, it is essential that the port be able to move the goods from the transit areas at its own expense or at the expense of the goods to long-term storage.

PORT EQUIPMENT

Equipping ports for the handling of its projected flow of goods is based upon the recommended cargo handling methods discussed earlier.

A list of equipment required for a standard general and neo/bulk cargo berth is given in Table 1 . Based on this table, the total requirements for a port would be established. The equipment requirements for the port, however, would be established considering compatibility with existing port equipment and ability to make multiple berth use of certain equipment.

Cranes

Quay cranes would be specified in accordance with anticipated types and volumes of cargo. Use of rail-mounted heavy duty portal cranes versus the use of tire-mounted mobile cranes requires individual study. Mobile cranes for use in ground storage areas are specified.

Table 1

CARGO HANDLING EQUIPMENT
FOR GENERAL AND NEO/BULK CARGO BERTHS[1]

1	Mobile Crane - 20 Ton
2	Forklift Trucks - 5 Ton
10	Forklift Trucks - 3 Ton
6	Forklift Trucks - 2.5 Ton
1,500	Stevedore Pallets
500	Warehouse Pallets
1	Unit Miscellaneous Stevedoring Equipment[2]
1	Unit Miscellaneous Warehouse Equipment[2]
1	Fifth Wheel Type Tractor
1	Fifth Wheel Type Trailer - 20 Ton
2	Yard Tractors
4	Yard Tractors
1	Truck - 5 to 10 Ton (stake body)
1	Utility Vehicle - 1 to 2 Ton (Pickup Truck)
6	Motor Scooters or other personnel carriers

Plus

1	Forklift - 10 Ton (as may be specifically required)

1 Requirements per berth.
2 Miscellaneous cargo handling equipment as required for particular types of cargo.

Forklift Trucks

Due to the advantages of standardization, specifications for forklift trucks are generally limited to four years.

- 5-6 Ton Diesel Powered Pneumatic-Tired Forklift

This equipment will principally be used in servicing the cargo handling requirements of the open storage areas. It can also be used on the quay in stevedoring operations where lifts beyond the capability of the standard three ton stevedoring forklifts are required.

- 3 Ton Diesel Powered Pneumatic-Tired Forklift

This unit offers a capability to lift a standard two ton pallet load and carry it at reasonable speed over paved or unpaved surfaces. Its principal use will be in stevedoring operations on the quay and in the sheds and it is also very useful in open stacking areas.

- 2.5 Ton Diesel Powered Pneumatic-Tired Forklift

This unit is specified because of its smaller dimensions which makes it particularly suitable for transit shed and warehouse work and for loading and unloading van-type trailers and containers as well as rail cars. It can also be used to fill in on stevedoring operations, although its capacity will be stretched. A low mast version will be used for working in stevedoring operations on board vessel and for handling cargo to and from inside the containers.

- 10-12 Ton Diesel Powered Pneumatic-Tired Forklift

This unit, with heavy lift capability, is for use in open storage areas for handling steel and for stacking empty containers.

Pallets and Cargo Handling Accessories

Pallets are required for two different uses, namely, for stevedoring and warehousing. Two sizes have, therefore, been specified.

- Stevedore Pallets

1,200 x 1,800, 50 mm hardwood wing-type pallets are specified for use in stevedoring operation. The size is specifically designated to provide a two ton lift to or from vessel. These pallets can also be used in open stacking areas and to a limited degree in the transit sheds when sufficient pallets are available. When such is the case, the cargo can be permitted to remain on the stevedoring pallets during the free time, thus eliminating the necessity to rehandle the cargo from pallet to floor to warehouse pallet. Permitting the use of stevedoring pallets for storage of imported goods must be carefully controlled by the port in order to maintain an adequate supply of available pallets. Customary use of stevedore pallets will be as work pallets carrying cargo between ships holds and sheds, with the pallet being emptied and the cargo hand stacked at sheds or on vessels to free up the pallet for reuse. The cost of these pallets is too great to permit them to be shipped out of the port. It is generally advisable when receiving export cargo in the transit areas to stow the goods on stevedoring pallets at time of receipt, thus making the cargo immediately

ready for loading on to the vessel when it arrives, without the necessity of palletizing the cargo after the vessel's arrival.

- Warehouse Pallets

Varying sizes of warehouse pallets are used for storage of breakbulk cargo in transit sheds and warehouses. With the development of unitization and increased use of shippable pallets, a size compatible with standard shipping containers and vans has resulted in the establishment of International Standards Organization (ISO) standards for pallet sizes. A recent study of pallet size compatability[1] concluded that the most compatible size for use in over-the-road transport and containers was 1,000 by 1,200. While this is a one ton pallet, it is also compatible with the 1,200 by 1,800 wing type pallet and can be handled two at a time on such a pallet, when pallet hooks are not available. In the interest of handling efficiency, however, a two ton pallet of the 1,200 by 1,800 size is preferable for use in port warehousing.

Cargo Handling Accessories

A standard allowance should be made for stevedoring accessories required for efficient handling. Examples are as follows:

- Pallet hooks
- Drum hooks
- Paper handling gear
- Skid rollers, spreaders, pallet slings, savealls
- Other specialized handling equipment

1 ICHCA Committee T.O.G., Netherlands, 1973.

Transport Equipment

General requirements for transport of cargo within the port area were discussed earlier. The equipment with which transport of cargo and personnel can be accomplished in addition to short-distance transport of cargo by forklift truck, consists of the following equipment:

- Heavy Duty Tractor Trailers (Flat Bed)

Twenty ton capacity comparable to over-the-road equipment. This equipment can be utilized for transporting cargo on pallets between transit shed and warehouse, where a large quantity needs to be moved at once. It can also be used for handling goods between shipside, warehouses and storage areas and will be particularly useful for rapid movement of cargo being handled to and from free zone areas. The trailers will also be useful should trips outside the port be required for handling mobile equipment or cargo, when pulled by a licensed over-the-road tractor.

- Yard Tractors and Trailers

Because of the cost of the heavy duty tractor trailers, routine transport in the port should be accomplished by lower speed yard equipment which can shuttle cargo within the port in the same fashion as above, but at a slower pace and in smaller quantities.

- Trucks and Utility Vehicles

A limited number of light weight trucks should be available in the port for utility use and for transfering cargo. Utility vehicles should be provided for messenger service and for supervisory and personnel transport.

- Pickup Trucks, Motor Scooters and Other Forms of Personnel Transport

These vehicles are particularly useful in large ports where walking time of supervisory and clerical personnel would be wasteful.

Special Equipment

In addition to the above equipment required for fast and efficient cargo handling in ports, special equipment may be needed to serve particular requirements of the individual cargoes.

- Container Handling Equipment

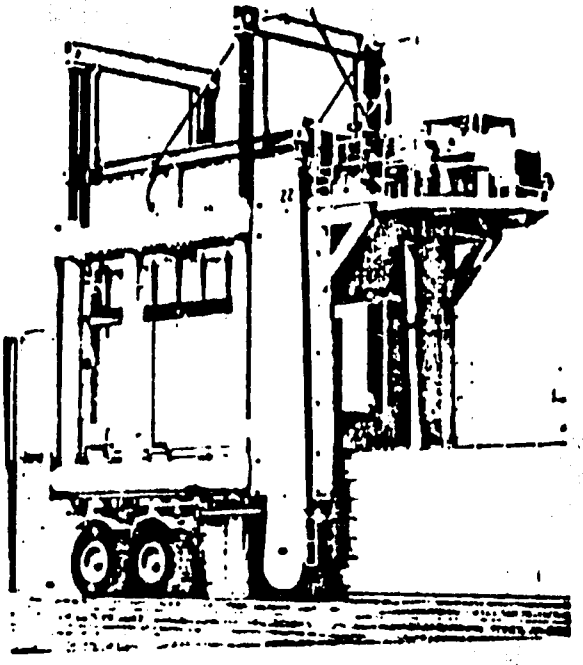
Types of mobile equipment especially designed for the handling of containers are shown in Figures 5 and 6 . They are as follows:

- Straddle Carriers

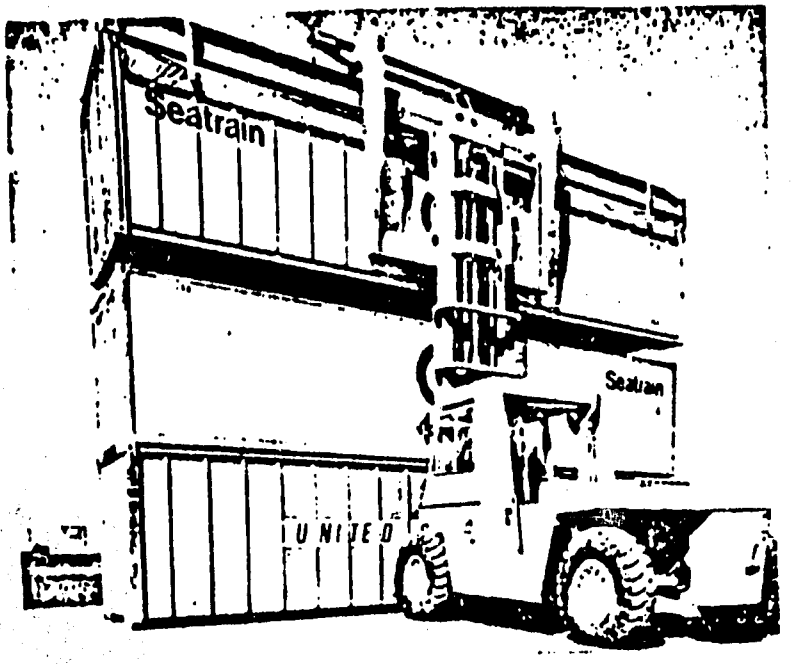
Tire-mounted diesel powered machines which straddle the container and lift and carry between the wheels. Capable of stacking two or three high, the units provide a fast and safe container handling capability. The primary disadvantages of these units is their costly and difficult maintenance and periodic breakdowns.

- Side Loaders

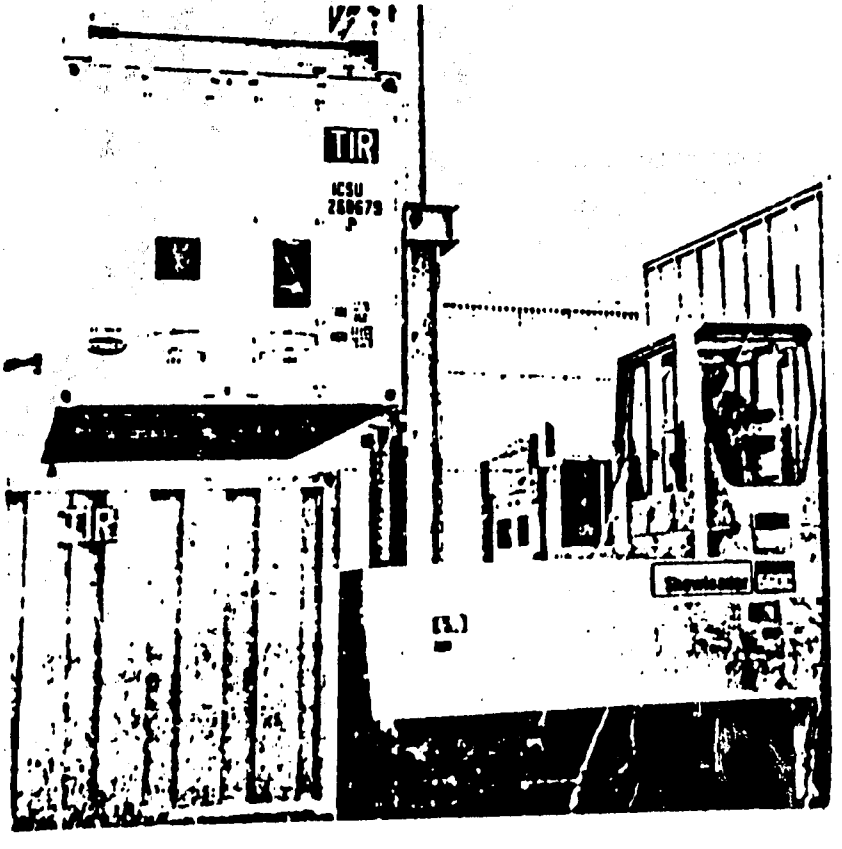
Tire-mounted diesel powered machines which lift the container from the side and carry over the body, with a two high stacking capability. These machines are also subject to high maintenance and breakdowns.



STRADDLE CARRIER

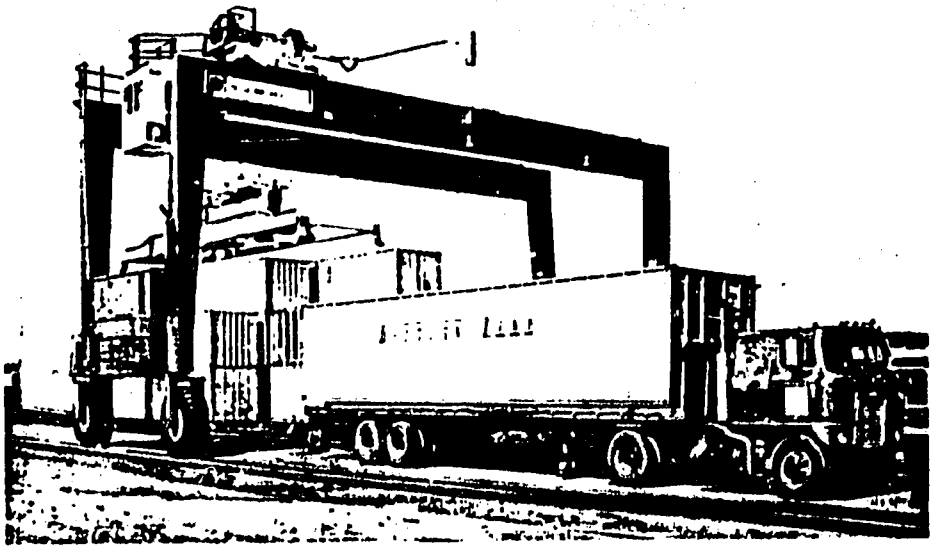


CONTAINER FORKLIFT

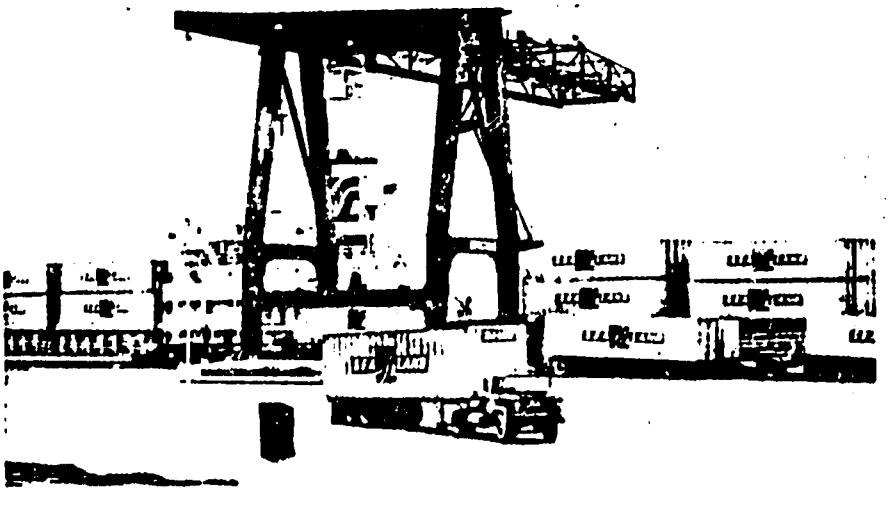


SIDELOADER

FIGURE 5



BRIDGE CRANE LOADING CONTIANERS TO TRACTOR TRAILER



CONTAINERS MOVED BY TRACTOR AND CHASSIS

FIGURE 6

- Bridge Cranes

Also known by the Paceco trade name of "Transtainers", although manufactured by a number of companies, these units provide for modular stacking of containers three high and offer concentrated container storage where space is at a premium. Rail or tire mounted, the units offer reliable, low maintenance container stacking capability. However, these units are merely container stacking devices and cannot be utilized for transport. Movement of containers to or from these stacking areas must be accomplished by straddle carrier, side loader or on wheels by tractor and chassis or trailer.

- Forklift Trucks

Large 30 to 40 ton forklift trucks have been fitted with container lifting frames and offer reliable low maintenance lifting and transport container capability. These units can stack up to three high, but lack of maneuverability due to necessity to carry the container sideways and in reverse.

- Container Chassis and Fifth Wheel Tractors

Used in "wheeled operation" of container handling, this method has been increasingly adopted in major ports of the world whenever adequate land area is available. Consisting of a large number of tandem trailer frames and a limited number of pulling tractors, "Yard Hustlers", the containers are loaded on their wheels at arrival and normally remain on wheels thereafter. The yard hustlers pull the containers to storage areas where they are parked. A modified wheel operation utilizes a limited number of chassis, together with

one of the above stacking machines, thus limiting the wheeled operation to transport only (Figure 7 shows a "Yard Hustler").

Bulk Handling Equipment

Bulk handling systems such as ship loaders and unloaders benefit from the presence of mobile equipment.

- Bulldozers

These machines are used for leveling and dressing the storage piles, for assisting in reclaiming and for leveling and loosening cargo on board vessel during loading and unloading.

- Front End Loaders

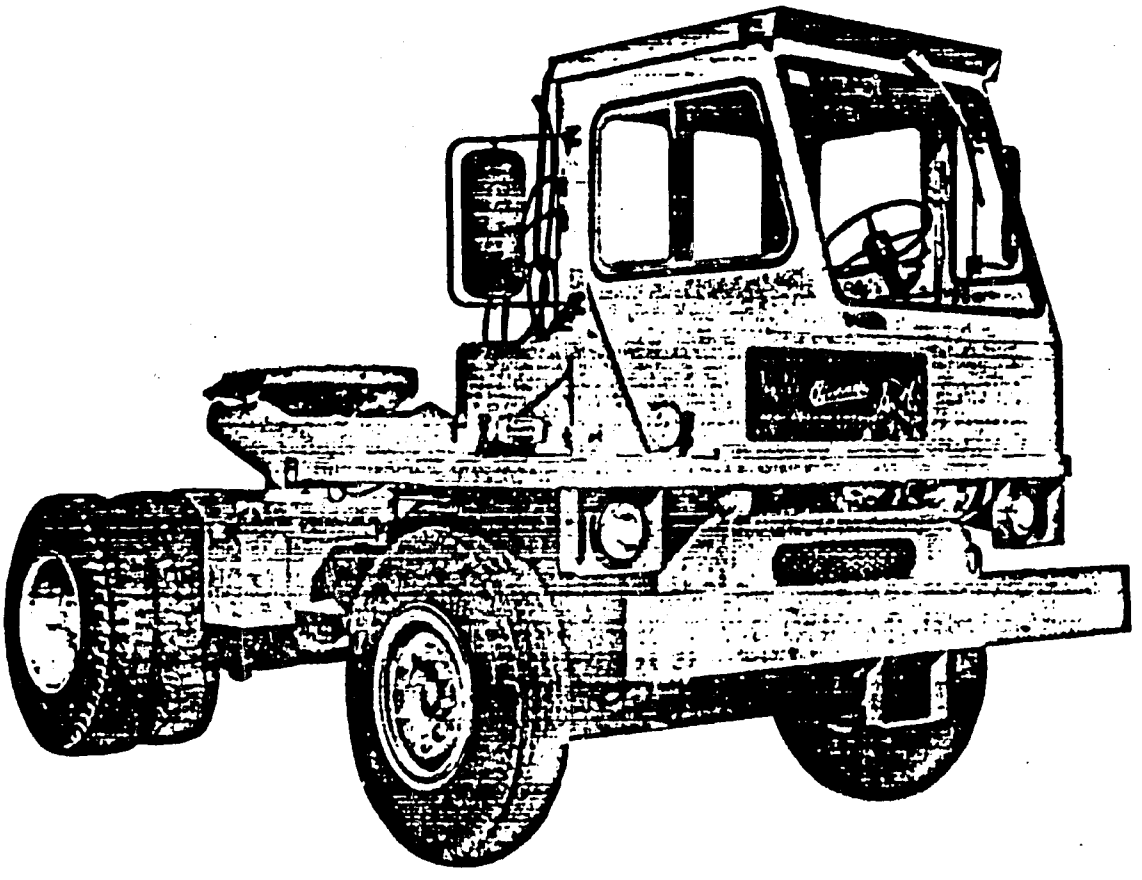
These rubber-tired diesel powered articulated machines, with hydraulic buckets, are used for reclaiming bulk cargo from stockpile, for loading trucks and are also useful for miscellaneous port maintenance work. Small front end loaders are used in ship-hold operation.

When high volume reclaim is required, screw, chain or belt conveyors reclaiming is utilized, rather than front end loaders, due to their higher capacity. Reclaiming by screw is common at grain facilities. Bucket wheel reclaim is more common at ore facilities.

Other Port Equipment

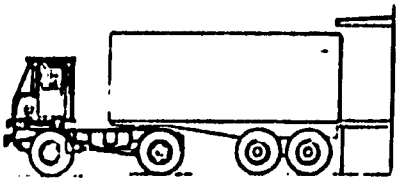
- Fire Trucks and Fire Engines

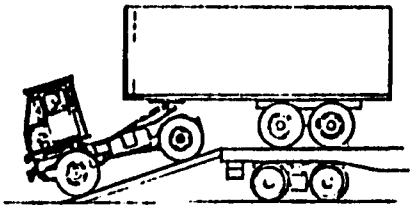
The port requires the presence of emergency firefighting crews and equipment. This should include fire trucks as well as fire engines.



DESIGNED TO MOVE TRAILERS IN

UCK TERMINALS – PIGGYBACK – INDUSTRIAL – MARINE OPERATIONS





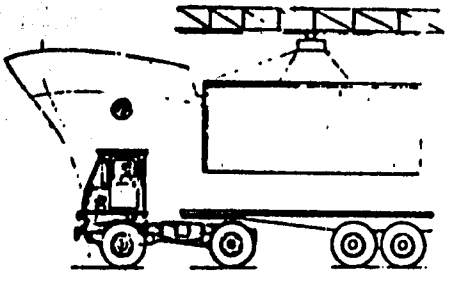


FIGURE 7
YARD HUSTLER

MAINTENANCE

The single most important factor in successful port operation, maintenance of plant and equipment, represents one of the most difficult problems confronting port management.

Equipment Maintenance

An ample and regularly replenished, properly controlled spare parts inventory, together with a highly motivated, skilled, well trained and well supervised mechanical force is essential. Modern ports and modern methods are totally dependent upon reliable equipment performance. The ability of ports to meet their required capacities very largely depends on the performance of the port maintenance force. Therefore, it is vital that the development and training of a skilled maintenance force be established, supported by large and fully equipped workshops with spare parts inventories supported by a system of central parts control.

TRAINING

Training is an important and continuing function of port operation. For proper training of port personnel, it is essential that the training effort cover the following areas of port operation:

- Stevedoring methods
- Equipment operation
- Maintenance
- Warehousing, storage and handling techniques and inventory control
- Tallying procedures
- Supervision

SUPERVISION

Present-day supervision of both stevedoring and port operations often suffers from a heavy workload, an excessive area responsibility and an insufficient number of supervisors. Supervisory training programs must concentrate in the area of both stevedoring supervision and port operation supervision. Effective supervision requires a sufficient number of dedicated, highly motivated, knowledgeable, responsible and well compensated individuals. Experience and ability to motivate the workers under his responsibility can count for more effective supervision than education alone. At the same time, the supervisor must be backed up by a complete understanding of his immediate objectives and the confidence that he holds the full support of management behind his activities. Good supervision is another key factor in the success of port operation. Neither on board ship, on the quays, nor in the sheds and warehouses should workers be left without supervision. Development and expansion of a strong supervisory force is an essential for port operations.

APPENDIX J

BERTH CAPACITY METHODOLOGY

BERTH CAPACITY METHODOLOGY

INTRODUCTION

An important factor in determining the berth requirements of a port is the establishment of realistic berth capacities for the port being developed. The actual capacity of a berth in tons per year is not fixed, but rather is dependent upon a number of variables.

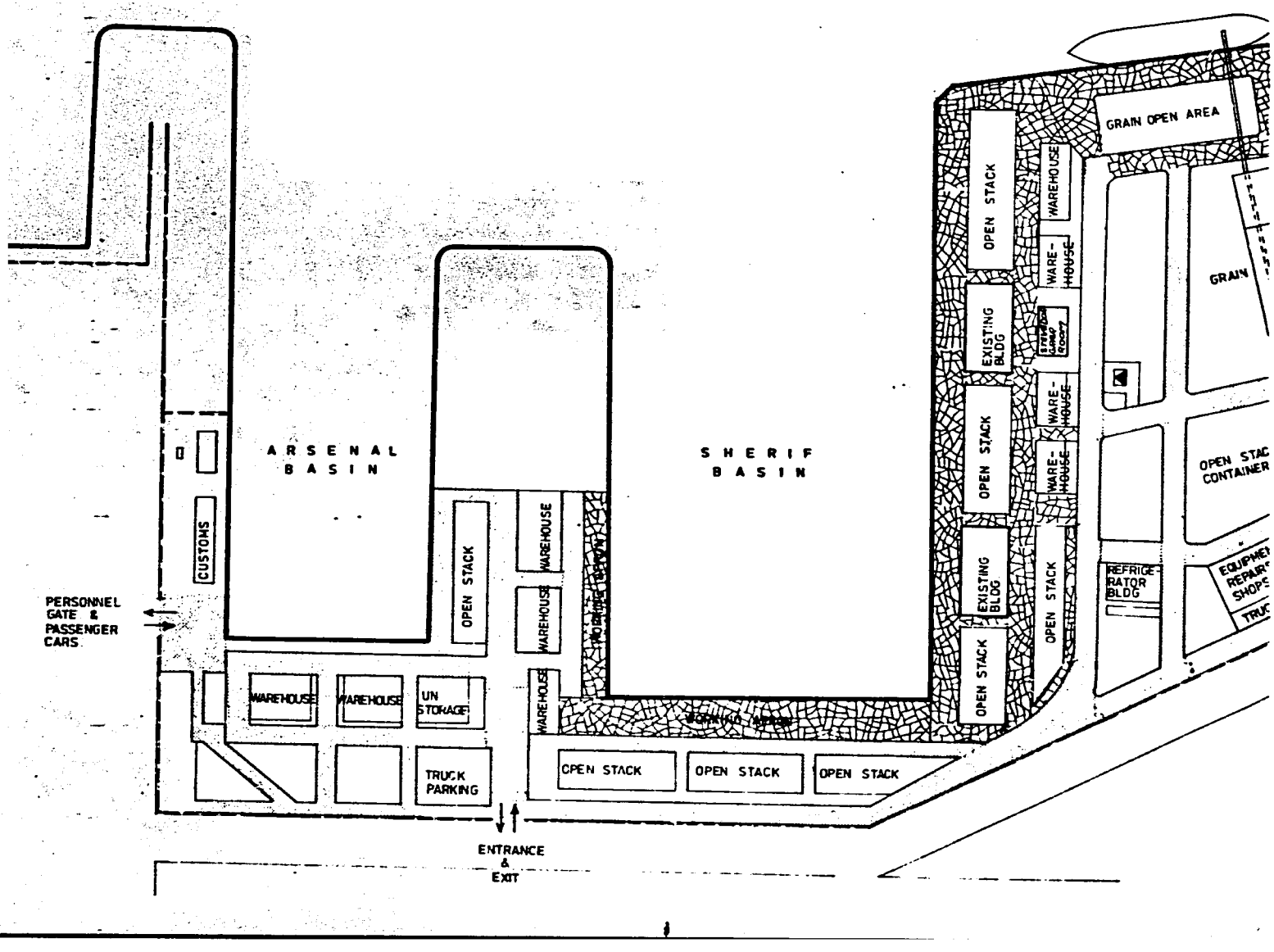
In order to provide a means of taking these variables into consideration and at the same time to provide an understandable and useful method for determining berth capacities and hence, port requirements, a computer program was developed.

The computer program calculates average vessel waiting times, total waiting time per year, yearly tonnages over berths and through the ports, number of vessels and other useful data. The results are presented in tabular form.

Methodology

The Consultant's in-house methodology utilized for determining cargo berth capacities considers the following variables:

- Type of cargo to be handled
- Cargo handling methods and equipment
- Working hours per day
- Number of days per year during which berth can be operated
- Quantity of cargo per vessel
- Vessel arrival pattern


ARSENAL BASIN
SHERIF BASIN
CUSTOMS
PERSONNEL GATE & PASSENGER CARS
WAREHOUSE
WAREHOUSE
UN STORAGE
TRUCK PARKING
OPEN STACK
WAREHOUSE
WAREHOUSE
WAREHOUSE
OPEN STACK
OPEN STACK
OPEN STACK
ENTRANCE & EXIT
OPEN STACK
EXISTING BLDG
OPEN STACK
EXISTING BLDG
OPEN STACK
WAREHOUSE
WARE-HOUSE
WARE-HOUSE
WARE-HOUSE
OPEN STACK
GRAIN OPEN AREA
GRAIN
OPEN STAC CONTAINER
REFRIGE-RATOR BLDG
EQUIPMEN REPAIR SHOPS
TRUC

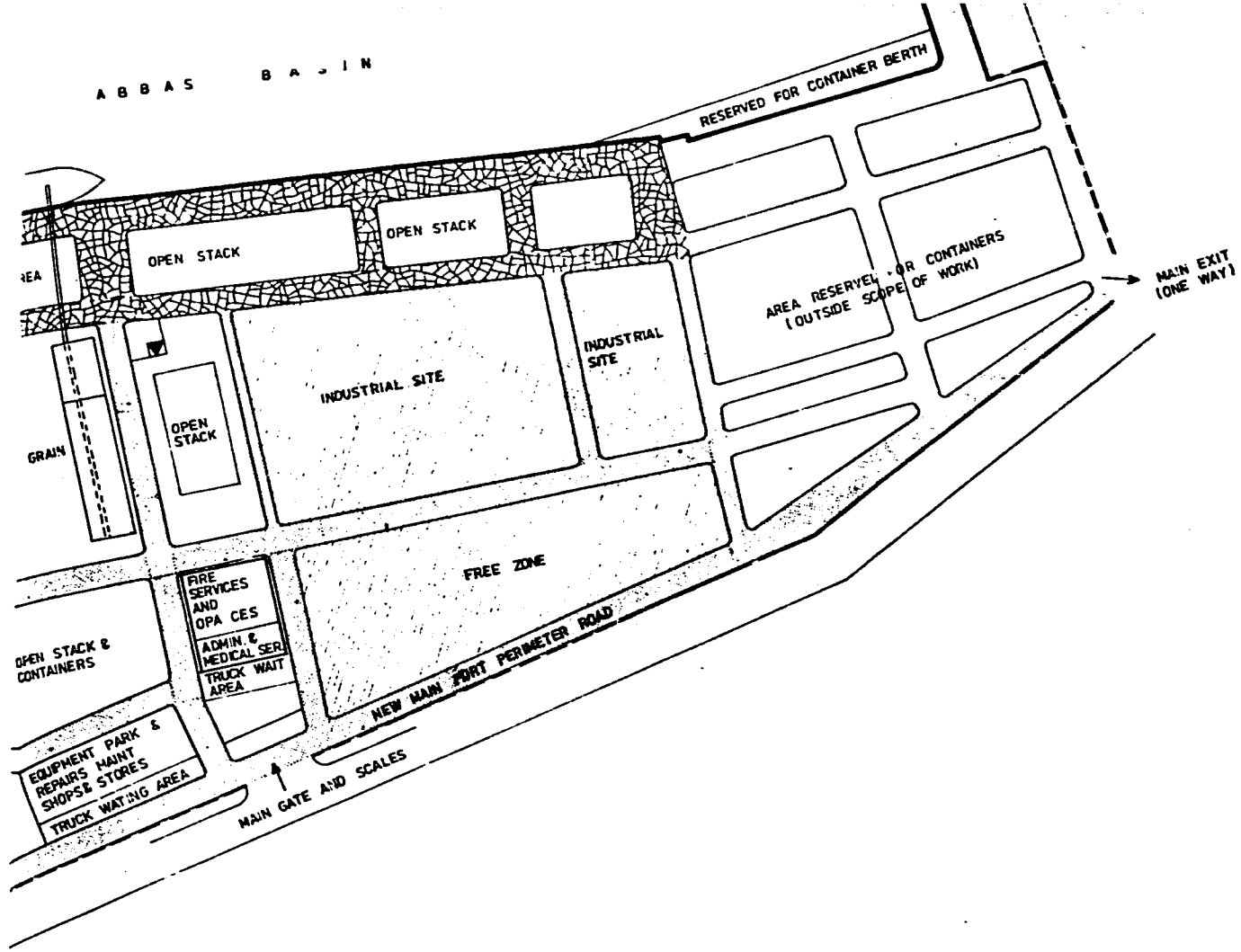
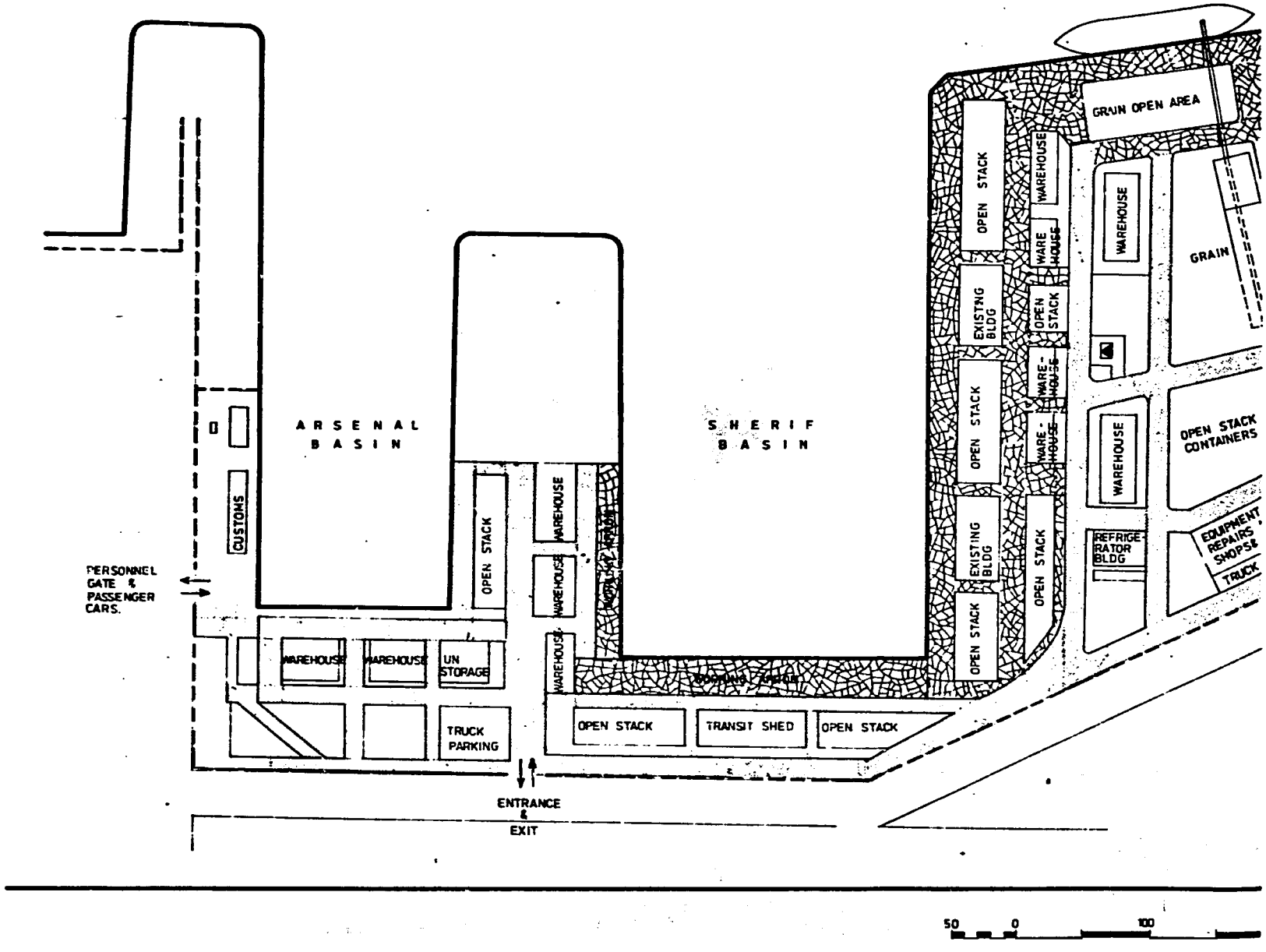


FIGURE H-1

MINIMUM REHABILITATION
ALTERNATIVE 1


ARSENAL BASIN
SHERIF BASIN
CUSTOMS
PERSONNEL GATE & PASSENGER CARS.
WAREHOUSE
WAREHOUSE
UN STORAGE
TRUCK PARKING
OPEN STACK
WAREHOUSE
WAREHOUSE
WAREHOUSE
OPEN STACK
TRANSIT SHED
OPEN STACK
ENTRANCE & EXIT
OPEN STACK
WAREHOUSE
WARE HOUSE
OPEN STACK
EXISTING BLDG
WARE-HOUSE
OPEN STACK
WARE-HOUSE
EXISTING BLDG
OPEN STACK
OPEN STACK
GRAIN OPEN AREA
WAREHOUSE
GRAIN
WAREHOUSE
OPEN STACK CONTAINERS
REFRIGE-RATOR BLDG
EQUIPMENT REPAIRS SHOPS &
TRUCK
50
0
100

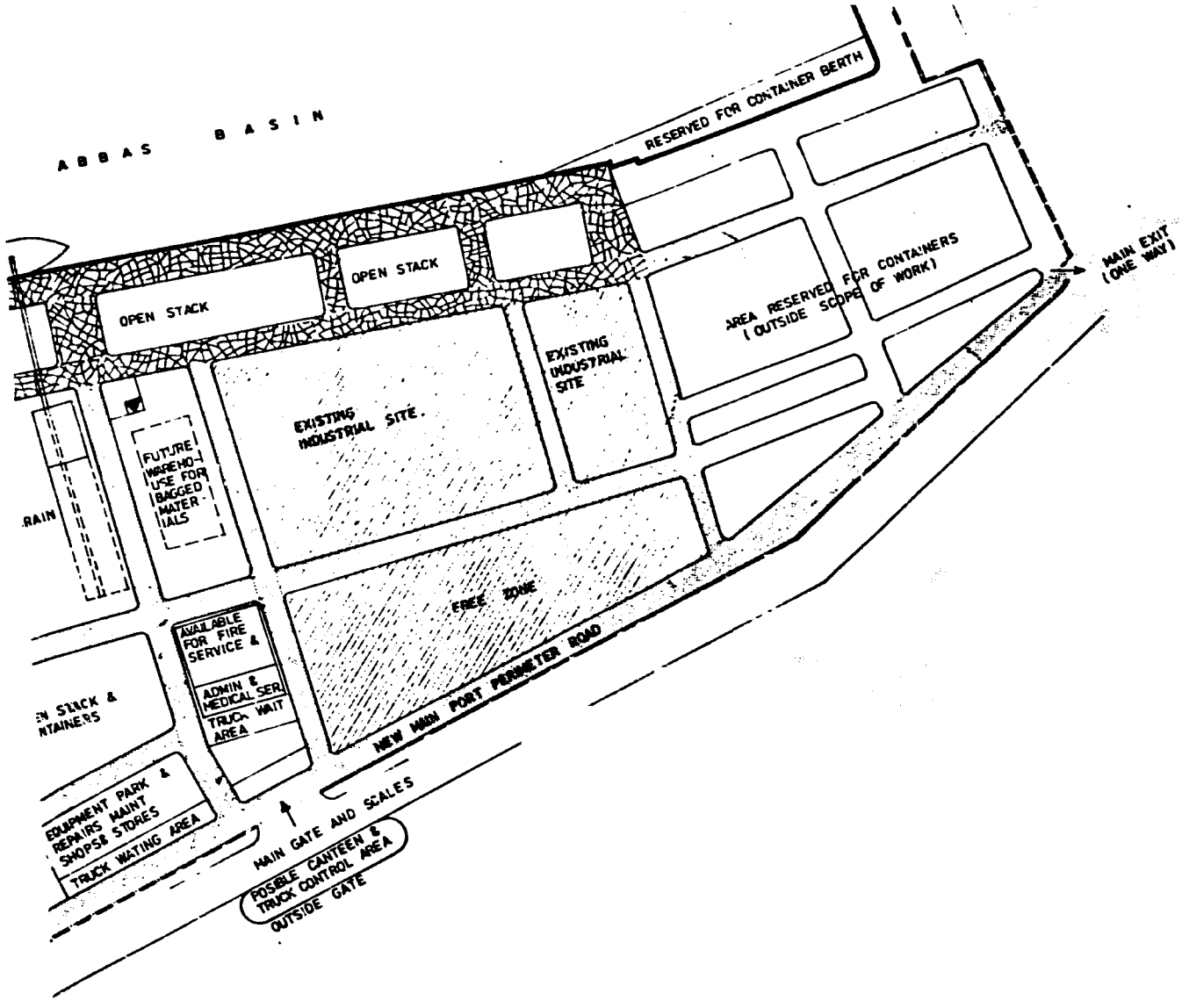
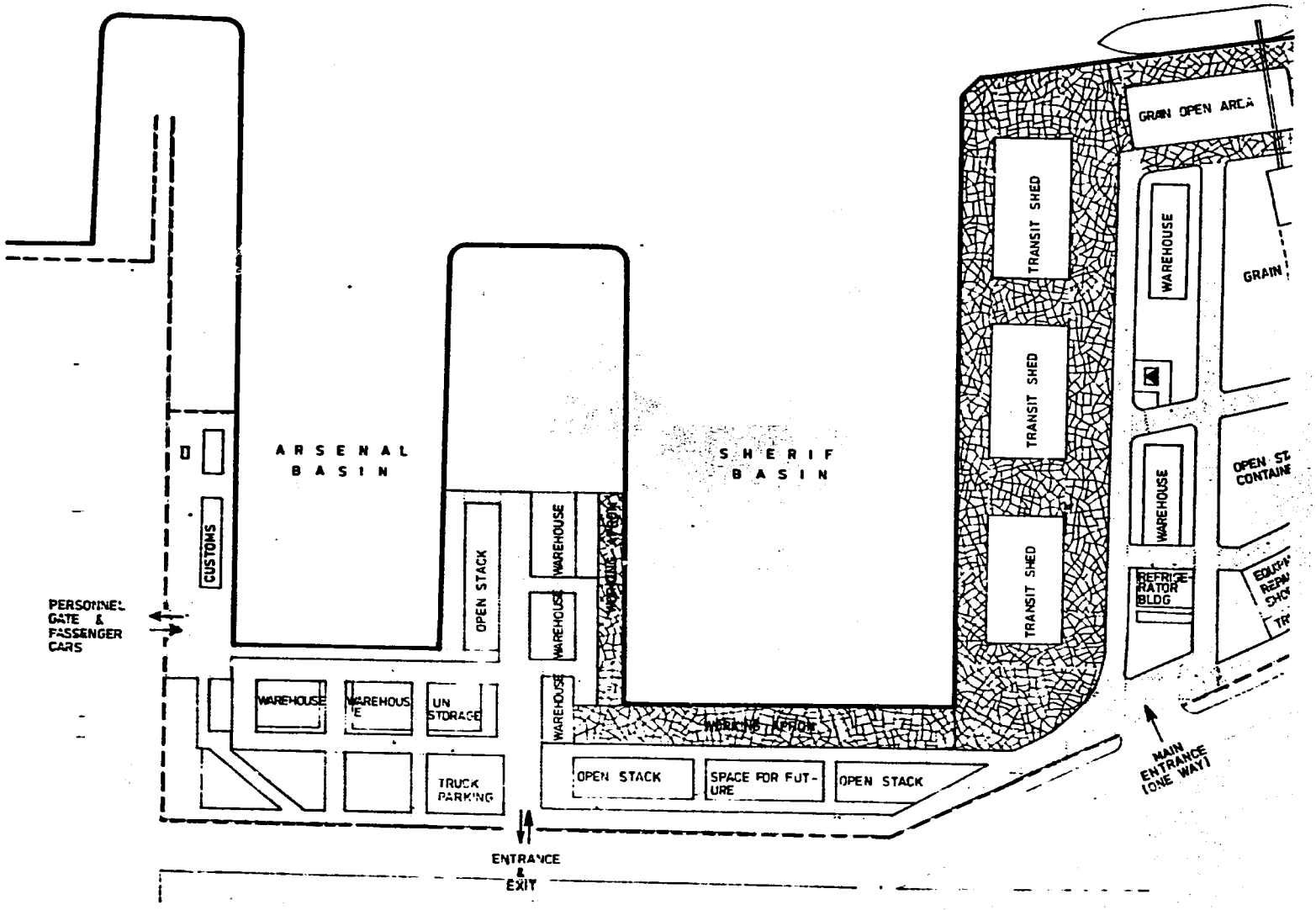


FIGURE H-2

EXPANDED WAREHOUSING
ALTERNATIVE 2


ARSENAL BASIN
SHERIF BASIN
CUSTOMS
PERSONNEL GATE & PASSENGER CARS
WAREHOUSE
WAREHOUSE
UN STORAGE
TRUCK PARKING
OPEN STACK
WAREHOUSE
WAREHOUSE
WAREHOUSE
OPEN STACK
SPACE FOR FUT-URE
OPEN STACK
ENTRANCE & EXIT
TRANSIT SHED
TRANSIT SHED
TRANSIT SHED
GRAIN OPEN AREA
WAREHOUSE
WAREHOUSE
REFRIGE-RATOR BLDG
GRAIN
MAIN ENTRANCE (ONE WAY)

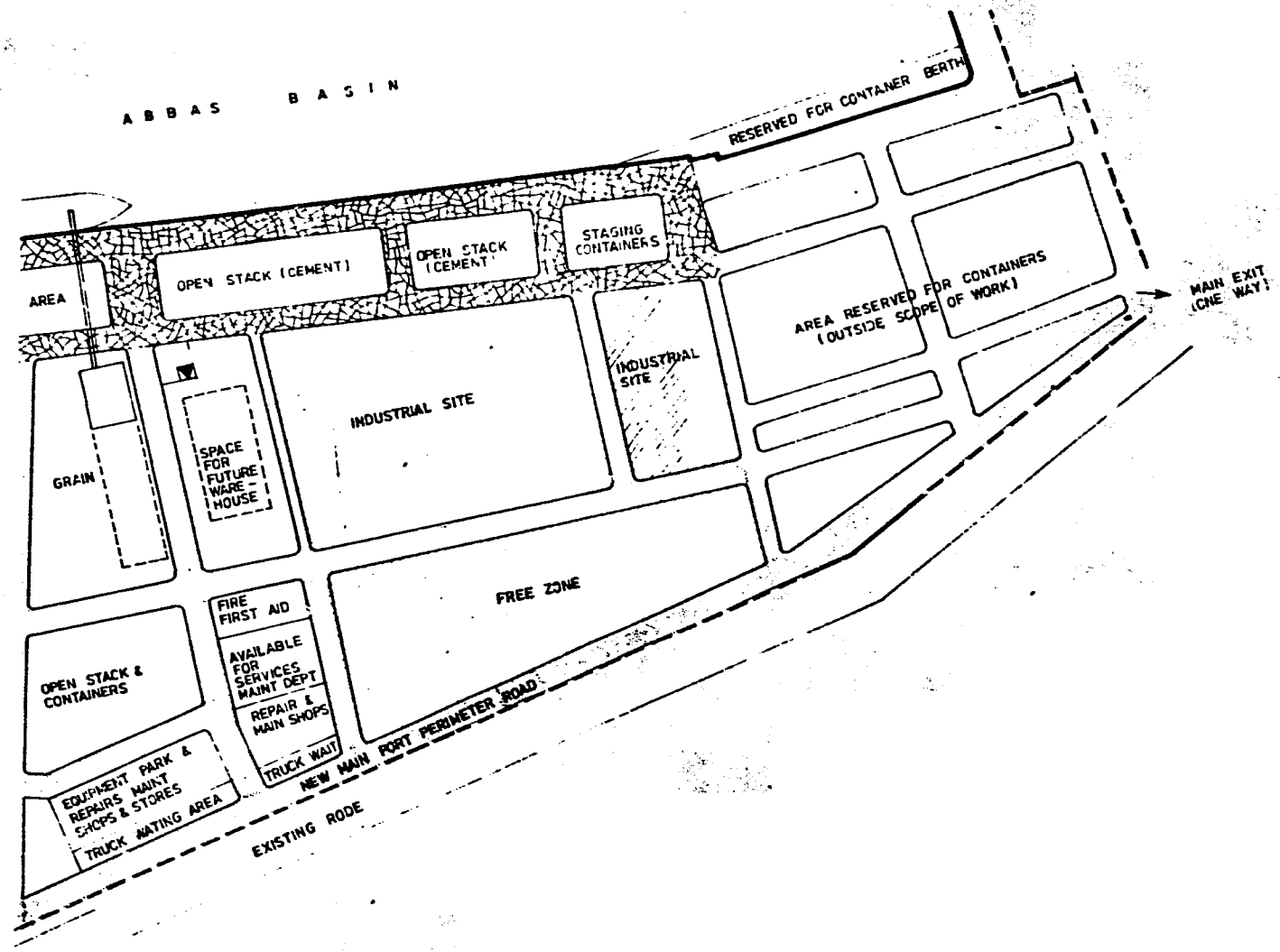
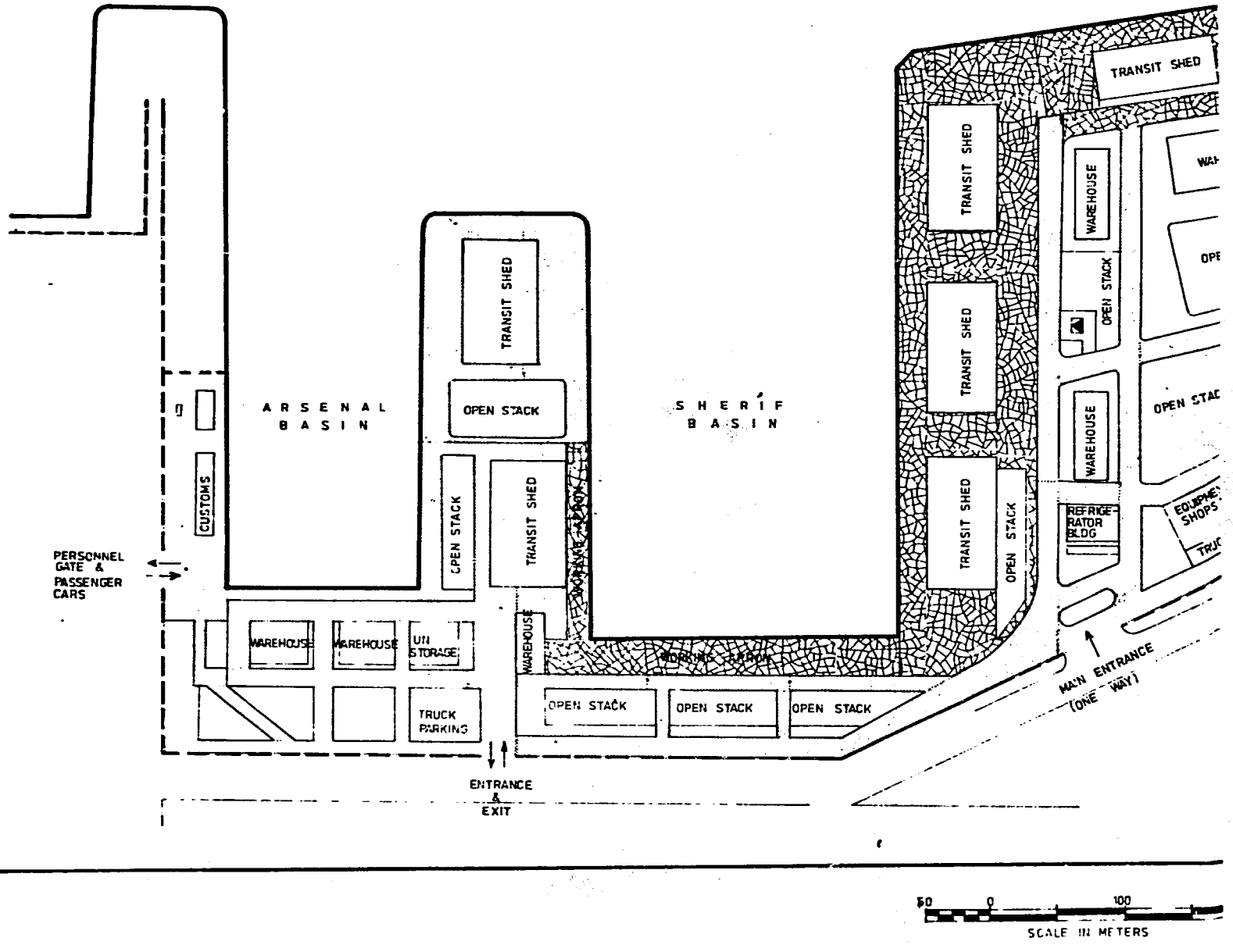


FIGURE H-3

200

MEDIUM REHABILITATION ALTERNATIVE - 3


ARSENAL BASIN
SHERIF BASIN
TRANSIT SHED
OPEN STACK
CUSTOMS
PERSONNEL GATE & PASSENGER CARS
WAREHOUSE
UN STORAGE
TRUCK PARKING
ENTRANCE & EXIT
MAIN ENTRANCE (ONE WAY)
REFRIGERATOR BLDG
EQUIPMENT SHOPS
50
0
100
SCALE IN METERS

12

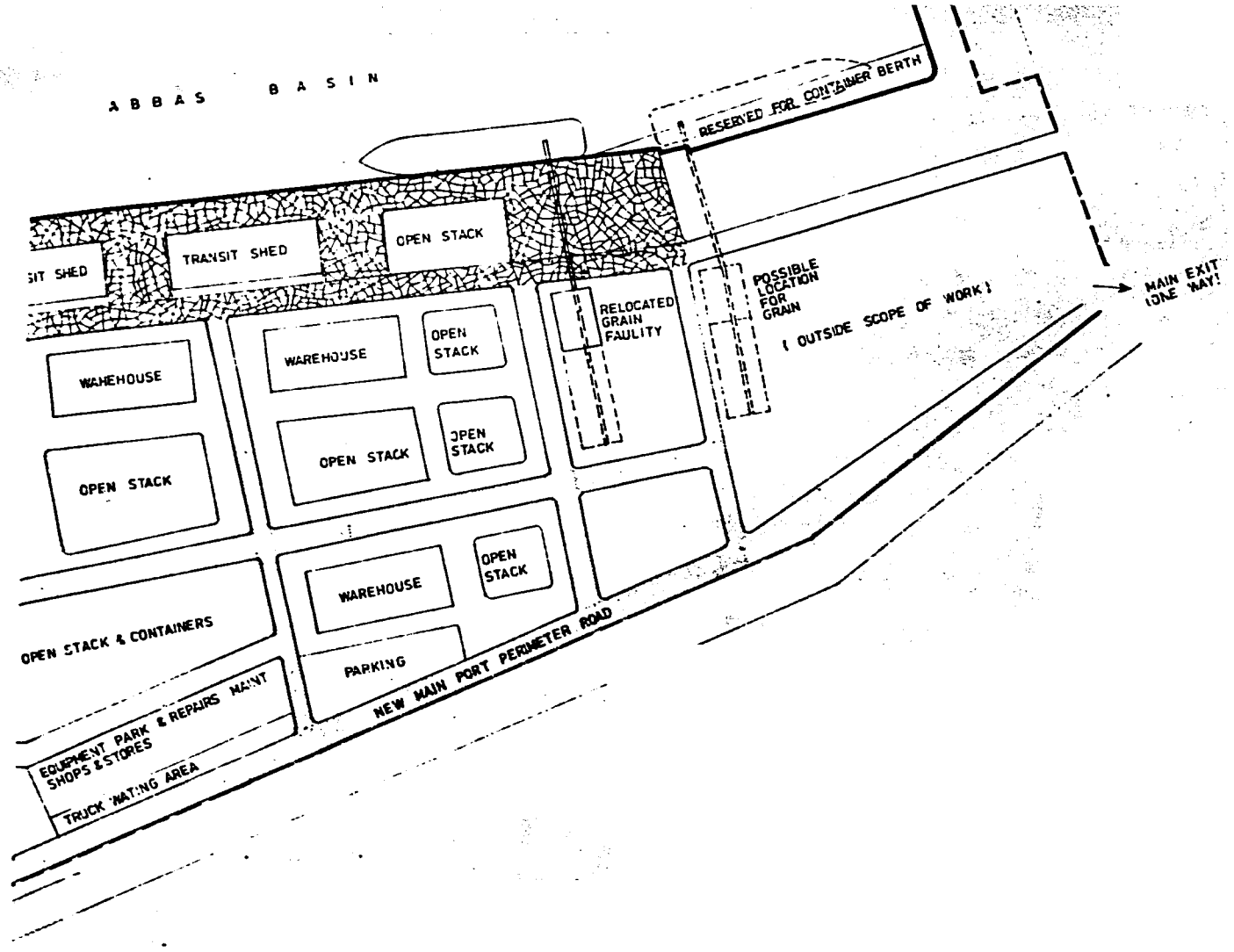
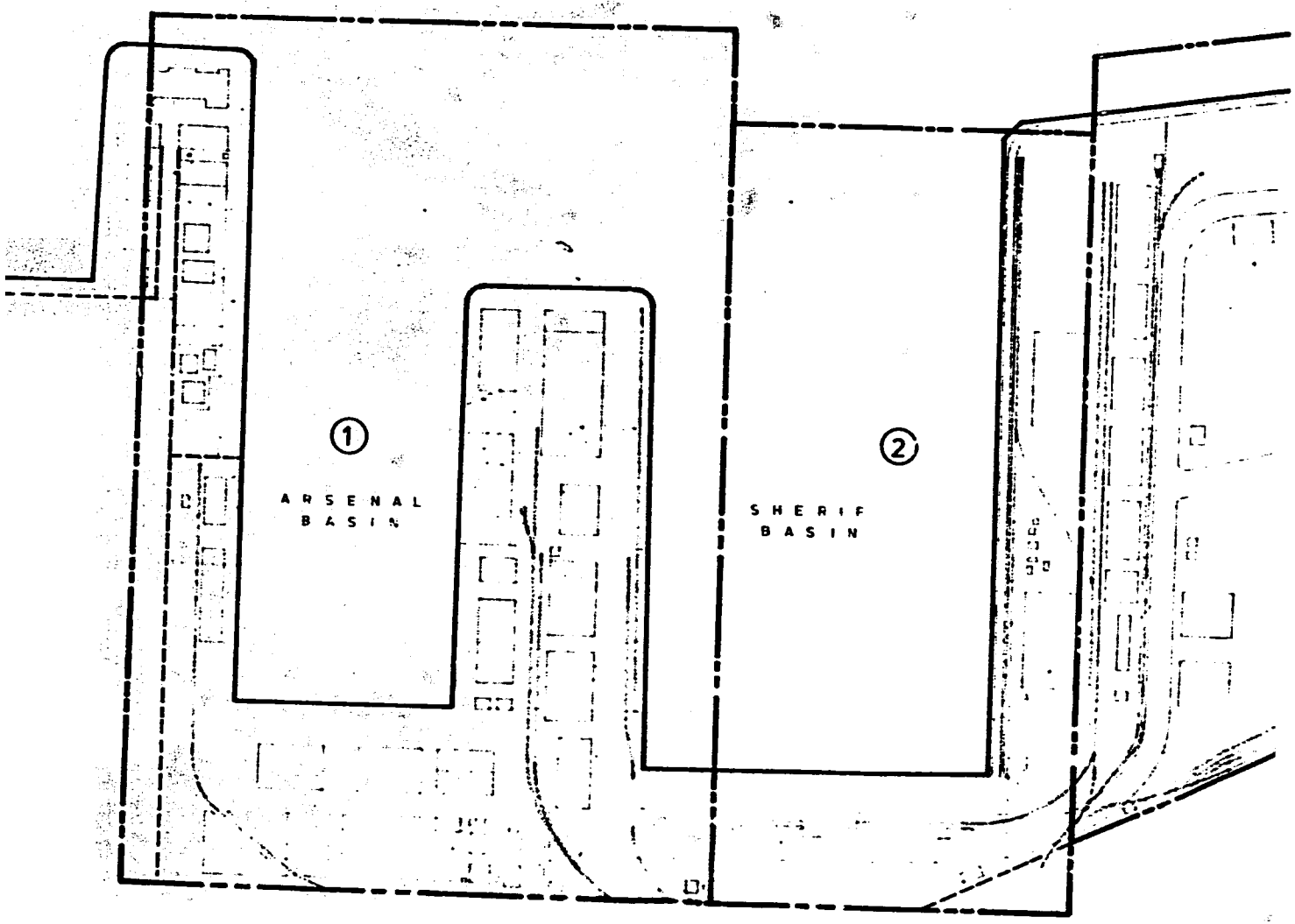
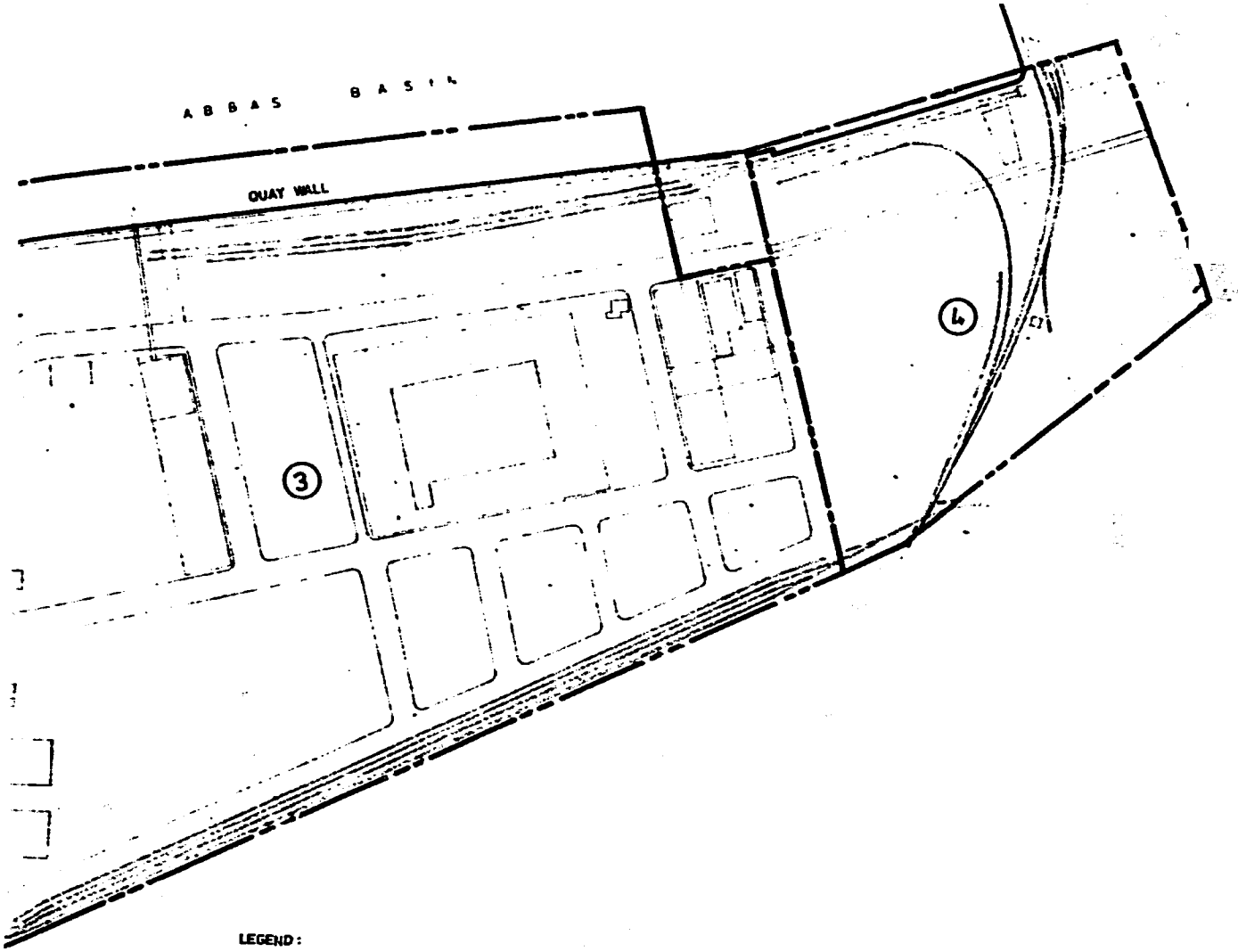


FIGURE H-4

MAXIMUM REHABILITATION
ALTERNATIVE 4


1
ARSENAL
BASIN
2
SHERIF
BASIN



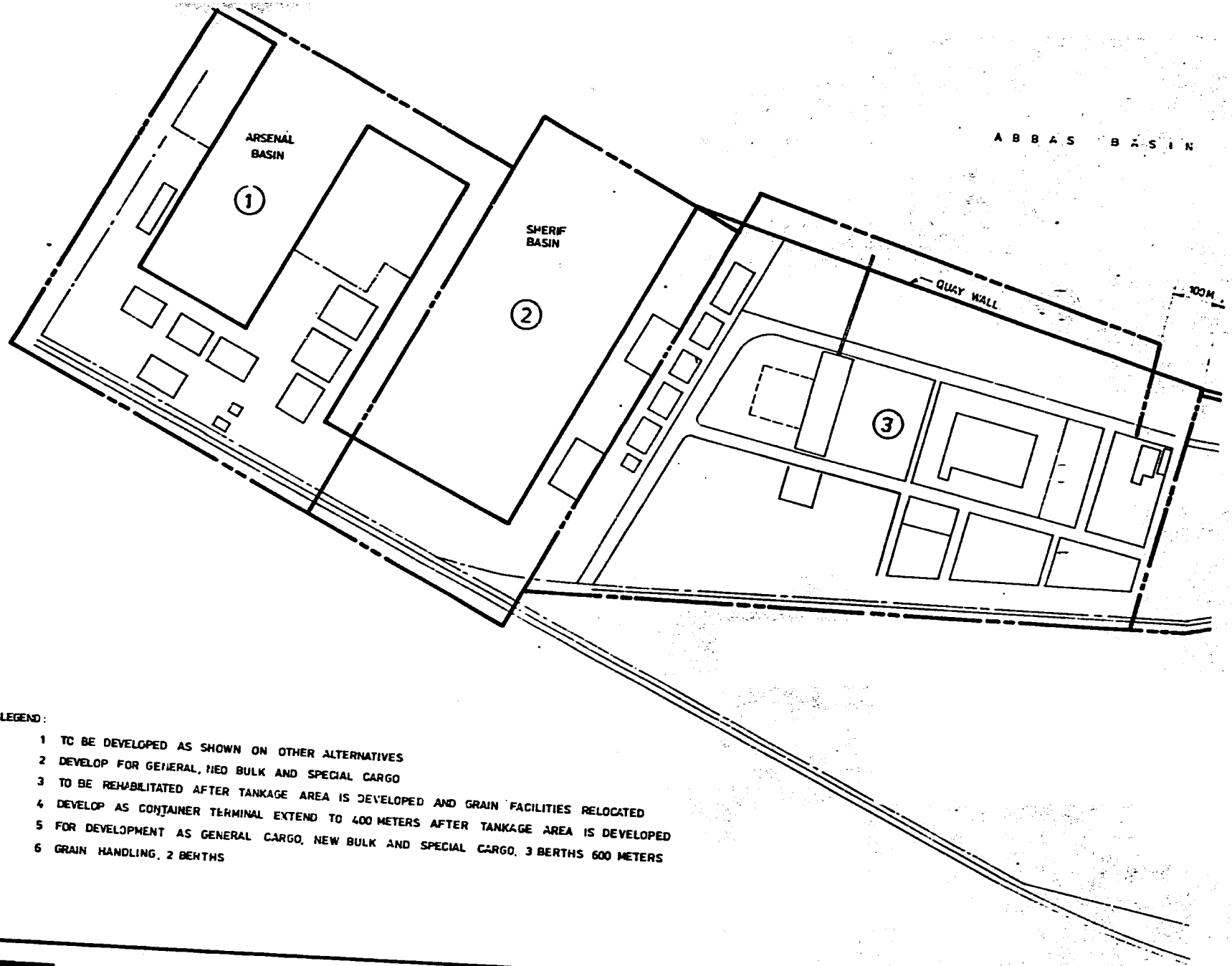
LEGEND:

1 TO BE DEVELOPED AS SHOWN ON OTHER ALTERNATIVES
2 DEVELOP FOR GENERAL, NEO BULK AND SPECIAL CARGO
3 TO BE REHABILITATED AFTER GRAIN FOR FACILITIES RELOCATED
4 DEVELOP FOR GRAIN FACILITIES

0 200
N METERS

FIGURE H-5

EXPANDED SCOPE
ALTERNATIVE 5a



LEGEND:

1 TO BE DEVELOPED AS SHOWN ON OTHER ALTERNATIVES
2 DEVELOP FOR GENERAL, NEO BULK AND SPECIAL CARGO
3 TO BE REHABILITATED AFTER TANKAGE AREA IS DEVELOPED AND GRAIN FACILITIES RELOCATED
4 DEVELOP AS CONTAINER TERMINAL EXTEND TO 400 METERS AFTER TANKAGE AREA IS DEVELOPED
5 FOR DEVELOPMENT AS GENERAL CARGO, NEW BULK AND SPECIAL CARGO, 3 BERTHS 600 METERS
6 GRAIN HANDLING, 2 BERTHS

HARRIS

0 100 200 300
SCALE IN METERS

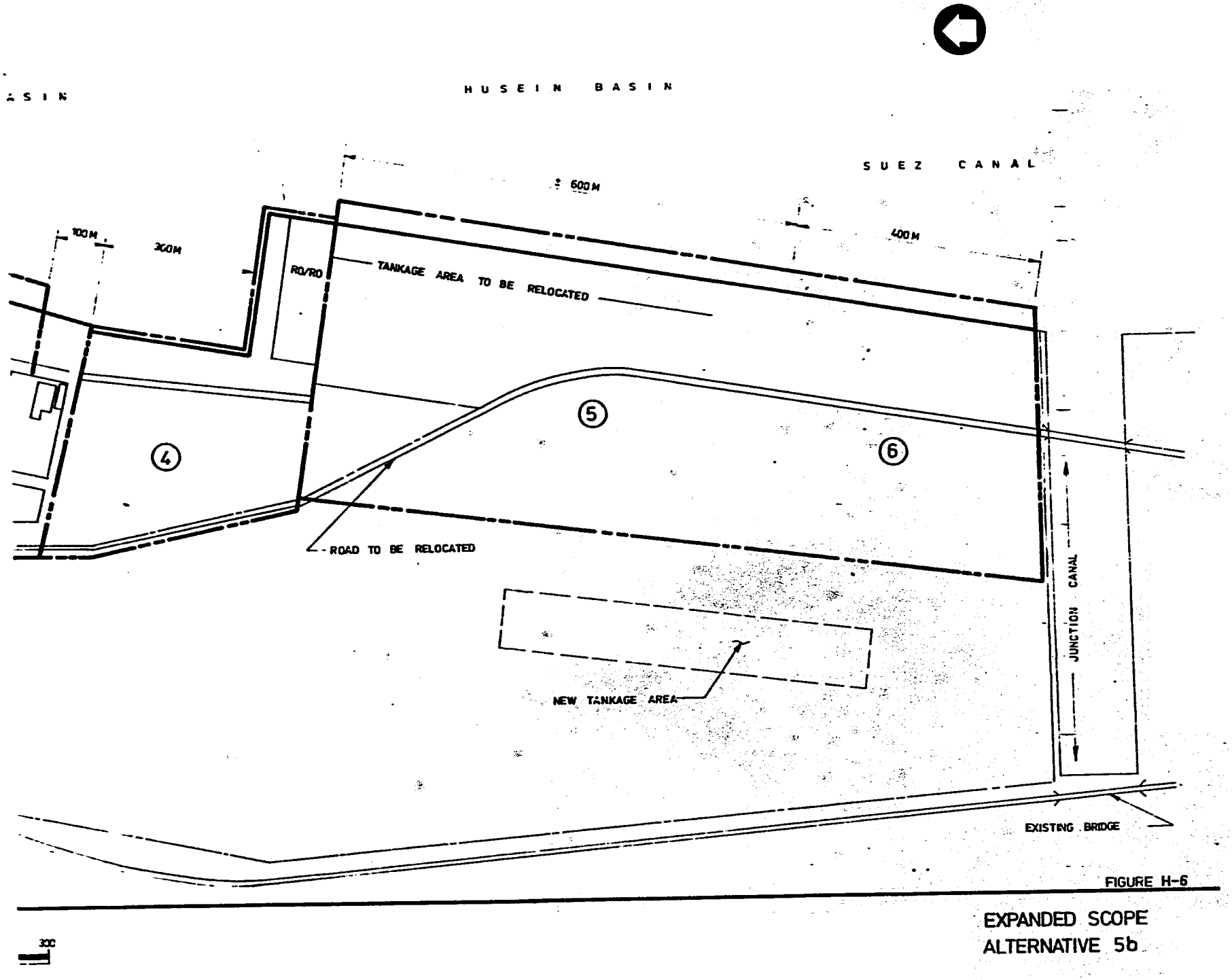


FIGURE H-6

EXPANDED SCOPE
ALTERNATIVE 5b

TABLE 1.0

PORT CAPACITIES FOR GENERAL CARGO - DEEP SEA VESSELS

DAYS WORKED PER YEAR: 340 — TONS PER BERTH PER DAY: 600.

NO. BERTHS	BERTH OCCUPANCY FACTOR (%)	AVERAGE TONNAGE PER VESSEL	AVERAGE VESSEL SERVICE TIME (HRS)	WAITING TIME / SERVICE TIME RATIO	AVERAGE VESSEL WAITING TIME (HRS)	AVERAGE WAITING TIME PER 1000 TONS (HRS)	TONS WORKED PER YEAR ALL BERTHS	AVERAGE TONS WORKED PER YEAR PER BERTH	AVERAGE TONS WORKED PER MONTH PER BERTH	NUMBER OF VESSELS CALLING PER YEAR	AVERAGE NUMBER OF VESSELS CALLING PER MONTH	TOTAL VESSEL HOURS WAITING TIME
1	20.	3000.	120.00	0.25	32.21	10.74	40800.	40800.	3400.	13	1	419.
1	40.	3000.	120.00	0.67	85.68	28.63	81600.	81600.	6800.	27	2	2319.
1	60.	3000.	120.00	1.50	193.24	64.41	122400.	122400.	10200.	40	3	7729.
1	80.	3000.	120.00	4.00	515.29	171.76	163200.	163200.	13600.	54	4	27826.
2	20.	3000.	120.00	0.04	5.37	1.79	81600.	40800.	3400.	27	2	145.
2	40.	3000.	120.00	0.19	24.54	8.18	163200.	81600.	6800.	54	4	1325.
2	60.	3000.	120.00	0.56	72.40	24.13	244800.	122400.	10200.	81	6	5870.
2	80.	3000.	120.00	1.76	229.02	76.34	326400.	163200.	13600.	108	9	24734.
3	20.	3000.	120.00	0.01	1.32	0.44	122400.	40800.	3400.	40	3	53.
3	40.	3000.	120.00	0.06	10.10	3.37	244800.	81600.	6800.	81	6	818.
3	60.	3000.	120.00	0.30	36.08	12.69	367200.	122400.	10200.	122	10	4440.
3	80.	3000.	120.00	1.06	138.96	46.32	489600.	163200.	13600.	163	13	22650.
4	20.	3000.	120.00	0.00	0.34	0.13	163200.	40800.	3400.	54	4	21.
4	40.	3000.	120.00	0.04	4.87	1.62	326400.	81600.	6800.	108	9	526.
4	60.	3000.	120.00	0.16	23.11	7.70	489600.	122400.	10200.	163	13	3767.
4	80.	3000.	120.00	0.72	96.04	32.01	652800.	163200.	13600.	217	18	20841.
7	20.	3000.	120.00	0.00	0.01	0.00	285600.	40800.	3400.	95	7	1.
7	40.	3000.	120.00	0.01	0.03	0.20	571200.	81600.	6800.	190	15	150.
7	60.	3000.	120.00	0.06	7.34	2.53	856800.	122400.	10200.	285	23	2104.
7	80.	3000.	120.00	0.35	44.71	14.90	1142400.	163200.	13600.	380	31	16991.
10	20.	3000.	120.00	0.00	0.00	0.00	408000.	40800.	3400.	136	11	0.
10	40.	3000.	120.00	0.00	0.19	0.06	816000.	81600.	6800.	272	22	51.
10	60.	3000.	120.00	0.03	3.26	1.09	1224000.	122400.	10200.	408	34	1331.
10	80.	3000.	120.00	0.20	26.46	8.79	1632000.	163200.	13600.	544	45	14336.
15	20.	3000.	120.00	0.00	0.00	0.00	612000.	40800.	3400.	204	17	0.
15	40.	3000.	120.00	0.00	0.02	0.01	1224000.	81600.	6800.	408	34	9.
15	60.	3000.	120.00	0.01	1.44	0.48	1836000.	122400.	10200.	612	51	634.
15	80.	3000.	120.00	0.11	13.71	4.57	2448000.	163200.	13600.	816	68	11184.
20	20.	3000.	120.00	0.00	0.00	0.00	816000.	40800.	3400.	272	22	0.
20	40.	3000.	120.00	0.00	0.00	0.00	1632000.	81600.	6800.	544	45	2.
20	60.	3000.	120.00	0.00	0.07	0.02	2448000.	122400.	10200.	816	68	317.
20	80.	3000.	120.00	0.08	8.23	2.75	3264000.	163200.	13600.	1088	90	8973.
25	20.	3000.	120.00	0.00	0.00	0.00	1020000.	40800.	3400.	340	28	0.
25	40.	3000.	120.00	0.00	0.00	0.00	2040000.	81600.	6800.	680	56	0.
25	60.	3000.	120.00	0.00	0.00	0.05	3059440.	122400.	10200.	1020	85	148.
25	80.	3000.	120.00	0.04	5.00	1.80	4080000.	163200.	13600.	1360	113	7327.

[illegible]

178

- Vessel waiting time
- Number of berths in a port handling essentially the same cargo type
- Labor productivity
- Effects of scale

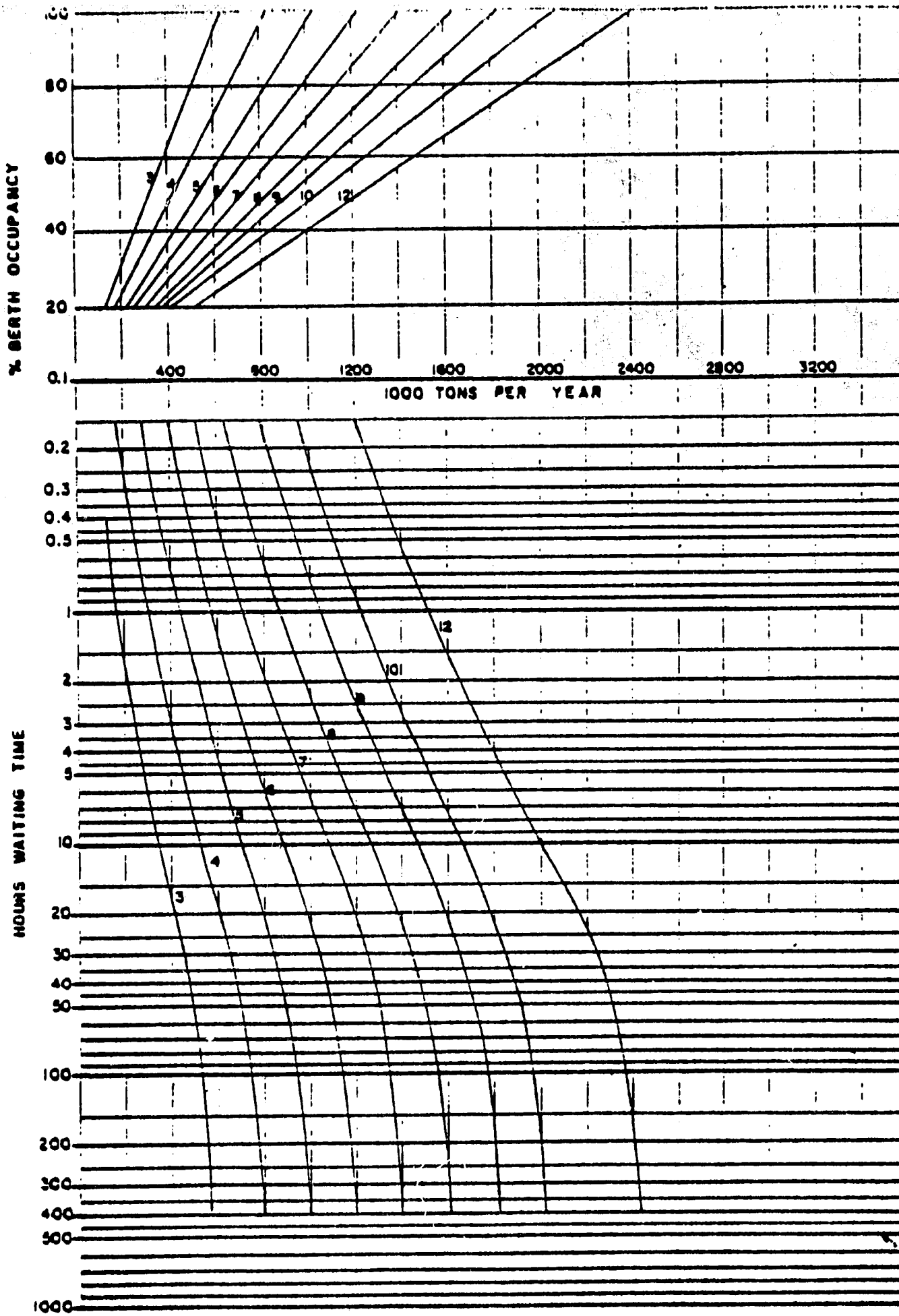
The method was programmed for computer calculations and the results given graphical presentation. These graphs were used in determing the berth requirements. Berth capacities by type of cargo were determined separately.

a. Use of Berth Capacity Tables

Table J-1 is a typical berth capacity table for general cargo berths. Referring to the table, it can be seen by looking under the Number of Berths column in the "4 berths" section, that a port of four berths with 60 percent berth occupancy and an average of 1,000 tons of cargo per vessel, at a rate of 600 tons per day loading or discharge, can be expected to handle approximately 490,000 tons of cargo per year, with an average waiting time per vessel of eight hours. The table also shows that the average annual tonnage per berth will be 122,000 tons. Other information such as number of vessels per year (489) and total waiting time per year for the port as a whole (3,767 hours) is also shown.

b. Use of Berth Capacity Graphs

Figure J-2 is a typical berth capacity graph for general cargo berths. This graph can be utilized to determine the number of berths required for a port to handle a given volume of general cargo with a desired waiting time. For example, to determine how many berths are required to handle



BERTH CRITERIA DEEP SEA VESSELS

TYPE OF CARGO : GENERAL CARGO

DAYS WORKED PER YEAR : 340

AVERAGE TONS PER VESSEL : 1000

FIGURE 1.1

180

1.0 million tons with average waiting time per vessel of three hours, follow the 1,000 line (1,000,000 tons) downward to the "Number of Berths" line closest to three hours. In this case, the answer is eight berths. To determine the berth occupancy level, follow the 1,000 line upward to the eight berth line, which intersects at 60 percent. The graph can also be used to determine the capacity of a port with a given number of berths under varying waiting time conditions.