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From: Chief, Naval Technical Mission to Japan.
To : Chief of Naval Operations.

Subject: Target Report - Design of Japanese Structures.

Reference: (a)"Intelligence Targets Japan" (DNI) of 4 Sept. 1945.

1. Subject report, covering Target X-33 of Fascicle X-1 of reference (a), is submitted herewith.

2. The investigation of the target and the target report were accomplished by Lieut. W. F. Reardon, (CEC), USNR, and Lieut. D. G. Radcliffe, (CEC), USNR, assisted by Lt.(jg) J. R. Thayer, USNR, as interpreter and translator.

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DESIGN OF JAPANESE STRUCTURES

"INTELLIGENCE TARGETS JAPAN" (DNI) OF 4 SEPT. 1945

FASCICLE X-1, TARGET X-33

JANUARY 1946

U.S. NAVAL TECHNICAL MISSION TO JAPAN

SUMMARY

MISCELLANEOUS TARGETS

DESIGN OF JAPANESE STRUCTURES

The navy yards in Japan are not, on the whole, as well equipped as are similar yards in the United States. The construction of dry docks is usually good, but the utilities and dockside facilities are below the U.S. average.

At Kure Navy Yard, Dry Docks No. 3 and No. 4 are in operating condition, but the facilities ashore have been disturbed and no major overhaul of ships could be accomplished. Dry Dock No. 4 can accommodate the largest ship in the fleet, and Dock No. 3 can handle ships up to 200 meters. The shipbuilding dock is a very large dock, but has been used since the end of the war as a graveyard for midget submarines, scrap metal and other debris, and would require considerable work to put it in shape. The yard, on the whole, is ideal for the anchoring of ships, unloading of supplies, and for making limited repairs to ships. Dockside maintenance shops could be considered inoperative.

Information obtained on Dry Docks No. 1 through No. 7 at Sasebo Navy Yard showed dimensions, utilities, and dockside cranes. Information was also obtained on the general layout of the yard; additional information was obtained on the construction of ships and probably one of the largest floating cranes in Japan.

At Yokosuka Navy Yard, Dry Docks No. 4, No. 5, and No. 6 were found to be in operative condition. Dry Dock No. 6 can accommodate the largest of ships, and has six usable, large dockside cranes. Dry Dock No. 5 has suffered slight damage to the dock wall, but is in usable condition. Crane facilities are, however, limited to one 30-ton crane. Dock No. 4 is also in working condition, and can be used along with the two 20-ton hammerhead cranes. The weak links at the three docks are: (a) the poor condition of the caissons, and (b) the lack of dockside maintenance and repair shops. At Yokosuka Navy Yard there is one large hammerhead crane of 350 ton capacity in operating condition; it is being used daily in loading and unloading of ships. Maintenance at the yard has not been kept up since the war's end, and as a result, facilities are fast becoming poor. The docks themselves are typical and well constructed, and are not unusual or novel in their design.

At KOBE, the Mitsubishi Shipbuilding Company had constructed the only floating dry docks in Japan. The Navy Ministry had done little or nothing in the field of floating dry docks. The three docks at KOBE are old in design and construction, and far inferior to the floating dry docks designed by the United States during this war. In addition to these docks, there is one dry dock in the yard of very recent construction, started about 1939. It was the intention to make this dock one of the largest in Japan, but lack of materials forced the reduction in size to a fraction of its original intended length.

At Nagasaki Shipyard and Engine Works, information was obtained on Dry Docks Nos. 1, 2, and 3, which showed the sizes and shapes of these docks. In addition, answers to a questionnaire on the docks give a very complete picture of the yard.

continued

Of the two main types of hangars found in Japan, the double two-hinged arch type represents the pre-war trend in permanent hangar construction. It is a well designed and well executed structure. It uses less steel than hangars of equal size in the United States. However, it lacks refinements found in Navy hangars and is not as convenient or as completely equipped. The second type of hangar, the "Diamond Truss", is most unusual in design and the results are very good. This "Diamond Truss", or skew arch design, embodies the designer's dream of a structure of maximum strength with a minimum use of steel and erection cost. The resulting structure appears from the exterior to be an ordinary arch type structure, but the low cost of this hangar marks it as one for study by American designers.

The shortage of critical materials during the war forced the Japanese to depart radically from pre-war design standards. Refinements in weights of materials and bearing powers of soils allowed the designer to keep within the code and still save material. Wind and snow loads were reduced and factors were introduced to protect areas experiencing unusual conditions. Very few large and modern earthquake-proof structures were built because of material shortages. Earthquake protection was based on a seismic coefficient of from 0.15 to 0.12 gravity. In the field of timber construction, basic design stresses were raised and additional increases were allowed for material specifically selected. Allowable stresses in steel were raised to an unbelievable new high, approximately 34,000 pounds per square inch.

For specific structures, such as houses and housing units, limits were placed on size, shape, types of materials, design loads, and utilities to be used. All this was done with a view toward keeping the material used to a minimum and to prohibit the use of critical materials.

NavTechJap Report, "Bombproof Construction in Japan", Index No. X-31, contains a description of the underground headquarters of the Japanese Navy Ministry. In addition to being a bombproof structure, it is also an unusual one and is therefore referenced to this report. Similarly, NavTechJap Report, "Earthquake Resistant Construction in Japan", Index No. X-12, is referenced to this report.

TABLE OF CONTENTS

LIST OF ENCLOSURES

LIST OF ILLUSTRATIONS

continued

REFERENCES

Location of Target:

Kure Navy Yard
Sasebo Navy Yard
Yokosuka Navy Yard
Mitsubishi Shipbuilding Yard at KOBE
Nagasaki Shipyard and Engine Works
Kisarazu Airfield
Yokosuka Airfield
Architectural Institute of Japan, TOKYO
Hitachi Aircraft Company of Chiba, Dispersal Plant at OAMI

Japanese Personnel Who Assisted in Gathering Documents:

Prof. H. FUTAMI, Professor at Tokyo Imperial University
Prof. K. MINAMI, Professor at Waseda University, TOKYO
Mr. K. NAKAMURA, Imperial Japanese Second Demobilization Ministry
Mr. Shigeru MORI, former Lt. Comdr. in the Civil Engineering Headquarters of the Japanese Navy Ministry
Mr. Keiichi TSUDA, Kisarazu Branch Office of the Tokyo Construction Department of the Transportation Ministry
Mr. Yasutaro AKABOSHI, former Technician in the Yokosuka Civil Engineering Department
Mr. Zenkichi UMAGAYA, Tomoe Iron Works, TOKYO

Japanese Personnel Interviewed:

Prof. R. S. SANO, Honorary Professor of Tokyo Imperial University
Prof. A. IMAMURA, former Professor of Seismology at Tokyo Imperial University
Dr. K. MUTO, Professor at Tokyo Imperial University
Prof. T. TANIGUCHI, Professor at Tokyo Imperial University
Prof. KOBAYASHI, Professor at Tokyo Imperial University
Prof. H. FUTAMI, Professor at Tokyo Imperial University
Prof. T. NAITO, Dean of Engineering, Waseda University, TOKYO
Mr. Shigeru MORI, former Lt. Comdr. in the Civil Engineering Headquarters of the Japanese Navy Ministry. A graduate of the class of 1936 of the Imperial University, TOKYO
Mr. Keiichi TSUDA, Kisarazu Branch Office of the Tokyo Construction Department of the Transportation Ministry. Former Lieut. in the Civil Engineering Headquarters of the Japanese Navy Ministry.
Mr. Tashiro SHIRAISHI, President of the Shiraishi Foundation Company, TOKYO
Mr. Makoto SATO, Asst. Chief Engineer of the Shiraishi Foundation Company. A graduate of the University of Washington in the class of 1930.
Mr. Yasutaro AKABOSHI, former civilian technician in the Yokosuka Civil Engineering Department.
Mr. Fumio IITSUKA, former Commanding Officer of the 3015 Construction Battalion at OAMI.
Mr. Zenkichi UMAGAYA, Engineer, Tomoe Iron Works, TOKYO

Related Reports:

NavTechJap Report, "Earthquake Resistant Construction in Japan", Index No. X-12
NavTechJap Report, "Bombproof Construction in Japan", Index No. X-31

INTRODUCTION

The subject of structures presented such a broad field of study that it was considered of primary importance to select particular subjects within that field which, when developed in detail, would give a representative view of the field in general. Accordingly, it was decided to direct the investigation of the target toward three principal divisions, namely: Waterfront Structures, Aircraft Hangars, and Wartime Construction Measures.

The selection of the subject of Waterfront Structures as a principal division of the target was based upon the belief that a study of this class of structures would give a representative picture of the field of heavy construction and would be of particular interest to the Bureau of Yards and Docks. The degree of detail to which this part of the investigation was carried resulted from a request from the British Admiralty for information on the larger dry docks and floating docks in Japan.

The subject of Aircraft Hangars was selected as another principal division of the investigation not only from the standpoint of their importance as a class of military structures, but because it was also believed that a study of hangars would reflect the ability of the Japanese to handle light-weight structures of considerable span.

Under the heading of Wartime Construction Measures, the principal aim was to determine what, in general, the Japanese had accomplished toward the conservation of critical construction materials. This section of the investigation was concerned with emergency building standards, wartime housing regulations, and examples of representative wartime construction.

THE REPORT

Part I
WATERFRONT STRUCTURES

A. GENERAL DISCUSSION

It was felt that any investigation in the field of structures should include information on navy yard facilities. Such an investigation would be of interest to the U.S. Navy Bureau of Yards and Docks, and would also cover a request by the British Admiralty for information on certain docks in Japan. Of particular interest were the Navy Yards at KURE, SASEBO, and KOBE, the Mitsubishi Shipbuilding Yard at KOBE, and the Nagasaki Shipyard.

At Kure Navy Yard it was possible to secure a rather complete set of drawings covering Dry Dock No. 4 and the shipbuilding dock. In addition, the answers to certain pertinent questions furnished a complete picture of these two docks. Also, a dockmaster's data book was procured which furnished information on Dry Docks Nos. 1, 2, and 3.

At Sasebo Navy Yard a comprehensive general drawing was secured. In addition, answers to a general questionnaire on Dry Dock No. 7 and the dockmaster's data book were procured. This data book contained information on all the docks at SASEBO, making it both interesting and useful. Plans of the building slips, showing their principal dimensions, were also obtained. Pictures were taken of Dry Dock No. 7 and of one of the largest floating cranes in Japan.

A general layout of the Nagasaki Shipyard, together with answers to a questionnaire on Dry Docks Nos. 1, 2, and 3 were procured.

At the Mitsubishi Shipbuilding Yard at KOBE, plans and answers to the questionnaire on Graving Dock No. 4 were obtained. It was also determined that the only floating dry docks in Japan were designed and fabricated by the Mitsubishi Shipbuilding Company. Plans of floating Dry Docks Nos. 1, 2, and 3 were obtained.

At Yokosuka Navy Yard all plans and specifications had been destroyed in the bombing raids. It was therefore necessary to seek information through a questionnaire presented to the Japanese Navy Ministry, and through field trips to the Navy Yard. Since the British Admiralty was interested in Dry Docks Nos. 5 and 6, the investigation centered on those two docks. Pictures were taken to supplement the data received from the Japanese.

B. KURE NAVY YARD

Kure Navy Yard, located on the Inland Sea, provides an excellent base for the building, alteration, repair, and maintenance of the ships of the fleet. The Yard furnishes the following main facilities: (a) four dry docks for ship overhaul, (b) one large shipbuilding dock, (c) three building slips, (d) three main ship anchorages, (e) one ship mooring canal, (f) several pontoon piers, and (g) miscellaneous docking spaces. These main facilities are supplemented by the various shops, equipment, and utilities necessary to make a yard operational. The yard covers an area roughly 1200 meters long by 500 meters wide and is one of the leading Navy yards in Japan. NavTechJap Document No. ND50-5300 (see enclosure (A)), is a general drawing of the yard showing the layout of the facilities available.

Of the dry docks at Kure Navy Yard, No. 4 is the most important and most recent. It was completed in 1930 at a cost of over 4,200,000 yen. A summary specification sheet contains general information on the dock size and shape. It has been forwarded as NavTechJap Document No. ND50-5301. A general drawing indicating the plan and sections was forwarded as NavTechJap Document No. ND50-5302.

The dock is provided with only one caisson, a turtle type. Details are shown on Page 32 of NavTechJap Document No. ND50-5303. Piping arrangements for flooding the caisson are indicated in NavTechJap Document No. ND50-5304. No provisions were made for protection of the dock or caisson against either bomb or underwater attack. A detail of the dock mouth is shown in NavTechJap Document No. ND50-5302, and also on page 29 of NavTechJap Document No. ND50-5303. These show that the sides of the dock at the entrance were on a 1 in 20 slope. Details of grooves and stops for the caisson, together with details of the blocks and dock altars, are shown in NavTechJap Document No. ND50-5302, and also on pages 29 and 35 of NavTechJap Document No. ND50-5303. No lifts were provided with this dock.

NavTechJap Document No. ND50-5305, entitled "General Charts of Water Mains", gives the details of fresh and salt water supply for ships in dock. Details for flooding magazines are shown in NavTechJap Document No. ND50-5306.

Electric power supply was available for the following purposes: for light, 1000 amperes of 100-220 volt direct current; for power, 1000 amperes of 100-220 volt DC; for electric welding, 450 KVA at 220 volts AC; and for the pumping station, 2000 KVA at 2200 volts AC. The electrical distribution is indicated in NavTechJap Document No. ND50-5307.

Details of compressed air and oil distribution systems are shown in NavTechJap Document No. ND50-5308. No steam distribution system was provided at this dock, nor is there any method of disposing of waste washing water and sewage. No equipment was provided for the recovery of sludge oil from the water surface.

At Dock No. 4, one pump house was provided with an average pumping capacity of 10,000 tons of water per hour. A list of equipment in this pump house is shown on pages 22 and 23 in NavTechJap Document No. ND50-5303. For protection against air attack, sand-filled concrete blast walls were placed around the entire structure (see NavTechJap Document No. ND50-5309). A schematic drawing of the pumping arrangement is shown in NavTechJap Document No. ND50-5304.

Dry Dock No. 4 was provided with six capstans, each with a capacity of 15 tons, a velocity of 10.67 m/min., and driven by a 60 hp motor at 220 volts DC.

There are two travelling hammerhead cranes; one is on each side of Dock No. 4, and rated at 20 tons each at operating radii of 20 meters. These cranes are shown in general in NavTechJap Document No. ND50-5310, and in detail on page 37 of NavTechJap Document No. ND50-5303.

Details of fendering arrangements for the passage of large ships through the dock entrances into the dock are shown in NavTechJap Document No. ND50-5313.

At the present time Dock No. 4 is being used as a harbor for small craft, but the dock could be used and appeared to be in good condition.

The shipbuilding dock is the second largest dry dock at the Kure Navy Yard. It was completed in 1926, and the cost was approximately 690,000 yen. A Summary Specification Sheet giving information on the size and shape of the dock is forwarded as NavTechJap Document No. ND50-5311. Plan and sections

are indicated in NavTechJap Document No. ND50-5312.

The dock is provided with only one caisson, that being a turtle type caisson as shown on page 31 of NavTechJap Document No. ND50-5303. Piping arrangements for flooding the caisson are indicated in NavTechJap Document No. ND50-5304. No provisions are made for the protection of either the dock or the caisson against bomb or underwater attack. Details of the dock mouth, the grooves and stops for the caissons, together with details of the keel blocks, are shown on page 30 of NavTechJap Document No. ND50-5303 and in NavTechJap Document No. ND50-5312. No lifts are provided on this dock.

NavTechJap Document No. ND50-5305 gives the details of fresh and salt water supply available at the dockside. In the event that this dock was used for the repair of ships, arrangements similar to those used on No. 4 Dock could be used for flooding ship's magazines. These details are shown in NavTechJap Document No. ND50-5306.

Electric power distribution is indicated in NavTechJap Document No. ND50-5307. Power available is 330 kw of direct current at 220 volts. No figures were available on the amount of power available for lighting and welding.

Details of compressed air and oil distribution are shown in NavTechJap Document No. ND50-5308. No steam distribution system was provided, nor was there any method of disposing of waste water or sewage. No equipment was furnished for the recovery of sludge oil from the water surface.

The building dock was provided with a pump house with an average pumping capacity of 14,300 tons of water per hour as shown in NavTechJap Document No. ND50-5311. This pump house serves both the building dock and No. 3 Dock. A layout of the pump house, together with the list of equipment and pump capacities, is shown on pages 19 and 20 of NavTechJap Document No. ND50-5303. The pump house was protected against air attack by means of concrete blast walls around the entire structure; a detail of these blast walls is shown in NavTechJap Document No. ND50-5309. A schematic drawing of pumping arrangement is shown in NavTechJap Document No. ND50-5304.

Two capstans were provided at the building dry dock. Each was equipped with a 60 hp motor (220 volts DC) and had a hauling capacity of 10 tons.

The building dock was equipped with six bridge cranes which spanned the dock. Four of these cranes were 15 ton capacity, one 60 ton capacity and one 100 ton capacity. In addition, there were two smaller 20 ton bridge cranes on the dockside for bringing material from the nearby shops. (See NavTechJap Document No. ND50-5310).

Details of the fendering arrangements for passage of ships into the dock are shown in NavTechJap Document No. ND50-5313.

The building dock is now dewatered and is being filled with scrap metal and debris. It had been in use for the construction of midget submarines, many of which were in the dock when the war ended. The docksides were littered with steel plate and scrap which have since been dumped into the dock. It would, therefore, take a great deal of work to clean out this dock. The pump house which serves this dock and No. 3 Dock is in working condition. The shore facilities, however, have been damaged, and it is doubtful whether they would be of much value for use in any major overhaul.

In addition to information on No. 4 Dock and the shipbuilding dock, NavTechJap Document No. ND50-5303 also furnishes information on Dry Docks Nos. 1, 2, and 3. Dock measurements and sections are shown on pages 26, 27, and 28. Caisson details are furnished on pages 31 and 32. Keel block measurements are shown on pages 33 and 34.

NavTechJap Document No. ND50-5305 gives the details for fresh and salt water supply available at the dockside. Arrangements similar to those shown in NavTechJap Document No. ND50-5306 could be used for flooding magazines of ships in dock.

Details of compressed air and oil distribution are shown in NavTechJap Document No. ND50-5308 for Dock No. 3, and in NavTechJap Document No. ND50-5314 for Docks Nos. 1 and 2.

Pump House No. 2 serves both No. 3 Dock and the shipbuilding dock. A lay-out of the pump house, together with the equipment and capacities, is shown on pages 19 and 20 of NavTechJap Document No. ND50-5303. Pump House No. 1 serves both No. 1 and No. 2 Docks. The arrangement of the machinery along with details on the pumping equipment is indicated on pages 17 and 18 of this document.

NavTechJap Document No. ND50-5310 shows the arrangement of cranes serving No. 3 Dock. Details of these cranes are shown on page 36 of NavTechJap Document No. ND50-5303.

The dockmaster's data book contains much valuable information on all the docks at KURE, and is being forwarded to the Washington Document Center as NavTechJap Document No. ND50-5315.

No. 3 Dock is in usuable condition and is now dewatered. The pump house which serves both this dock and the shipbuilding dock is in working condition.

C. SASEBO NAVY YARD

1. General Description of Facilities. The Navy Yard at SASEBO employed a total of approximately 37,290 workers at peak operation. The division of employees between the various departments at this activity was as follows:

a.	General Department	2540
b.	Construction Department	10020
c.	Engine Department	9700
d.	Ordnance Department	11658
e.	Submarine Department	50
f.	Accounting Department	3152
g.	Medical Department	170
	TOTAL	37290

(Note: NavTechJap Document No. ND50-5316 shows a detailed breakdown of the various major departments listed above.)

The importance of this Navy Yard is indicated by the amount of work credited to the Yard by the Japanese naval authorities for a period of one year immediately preceding the close of the war. NavTechJap Document No. ND50-5317 is a summary of the work accomplished during this period of time.

In addition to the industrial shops, the facilities of the Yard included six dry docks and three shipbuilding slips. NavTechJap Document No. ND50-5318 shows the building arrangement and general layout of the Yard as it existed at the end of the war. This plan, to the scale of 1000 to 1, shows the approximate size of the various shop buildings, dry docks, building slips, piers, and the location and capacity of dockside and pier cranes.

2. Information on Dry Docks. Detailed information on the dry docks at the Sasebo Navy Yard was obtained from a dock manual, originally prepared in December 1937 and revised in June 1944. A copy of the manual is forwarded as NavTechJap Document No. ND50-5319.

Table I (a translation of page 4 of NavTechJap Document No. ND50-5319) shows the dates of the start and completion of construction of the different docks, as well as the cost of construction of the dock proper, the cost of pump houses, pumping equipment, caissons, and keel blocks.

Table II (translated from page 5 of the same Document) gives detailed information on the volume of the docks, time required to pump out and flood the docks, number of pumps, their capacity and horsepower. The time required to flood and lift caisson is also given in Table II.

Principal dimensions of the docks with cross-sections at the mouth and and through the body of each dock are given on pages 12 through 17 of NavTechJap Document No. ND50-5319. Detailed cross-sections, which give the dimension of the dock altars and the capacity at high tide when the caisson is located at the outermost stop, are to be found on pages 18 through 23 of the same Document.

The table on page 8 of the Document gives the draft measurements of the main caissons for the different docks. On pages 24 through 29 principal measurements and typical sections of each main caisson are given on diagrammatic sketches. Location of ports and draft measurements are also shown on these sketches.

NavTechJap Document No. ND50-5299 contains answers to the questionnaire on dry docks (which was prepared by the British Admiralty) as they apply to No. 7 Dry Dock at the Sasebo Navy Yard.

3. Information on Shipbuilding Slips. The location of the three shipbuilding slips is shown in NavTechJap Document No. ND50-5318. More detailed information on the individual slips is contained in NavTechJap Document No. ND50-5320. Slip No. 2, the largest of the three, has a total length of 115.1 meters above the maximum high tide line, and extends 87.07 meters under water from this line making a total length of 202.17 meters. The maximum width of the top of the slip is 28.0 meters. A gantry crane of 35 tons capacity, operating on an elevated track 177 meters long, furnishes the principal lifting power for the slip. Auxiliary lifting power is provided by four small gantries of five ton capacity each. All cranes are powered by electricity.

4. Information on Dockside Cranes. NavTechJap Document No. ND50-5318 shows the location and capacity of all dockside cranes and pier and wharf cranes which were in operation at the close of the war. It is interesting to note that the No. 7 Dock was provided with three traveling jib cranes with capacities of 20 tons at radii of 42 meters.

Located at about the center of the shore side of the fitting-out basin is a large hammerhead crane with a capacity of 250 tons at a maximum radius of 30 meters. This crane is also powered by electricity.

There is at SASEBO a 350 ton floating crane. While no plans of this structure were available, some notion of its construction may be obtained from the photographs included herein.

Table I
DATES OF CONSTRUCTION AND COSTS OF DRY DOCKS, SASEBO NAVY YARD

Dock	Construction		Total Cost				
	Started	Completed	Dry Dock	Pump House	Pumping Equipment	Main Caisson	Keel Blocks
No. 1	March 1893	October 1895	¥543,341	¥5,667	¥11,543	¥56,590	¥3,948
No. 3	January 1901	June 1905	¥523,306	¥4,706	¥21,408	¥89,278	¥8,925
No. 4	April 1905	November 1914	¥1,218,383	Combined Total ¥14,399	Combined Total ¥129,876	¥102,085	¥14,475
No. 5	April 1905	June 1914	¥874,774			¥76,486	¥11,331
No. 6	April 1905	August 1914	¥574,445			¥64,988	¥8,973
No. 7	April 1935	January 1941	Not Known	¥180,079	¥343,889	¥541,406	¥37,200

Table II
VOLUME AND PUMPING INFORMATION FOR DRY DOCKS AT SASEBO NAVY YARD

Dock	Volume		Time Req. to Pump Out				Time Req. to Flood				Pumps									Caisson		
	High Tide	Low Tide	High Tide		Low Tide		High Tide		Low Tide		Number			Horsepower			Capacity (Tons/hr)			Time Req. to Lift	Time Req. to Flood	Dimensions of Main Penstock
	(Tons)		hr	min	hr	min	hr	min	hr	min	Large	Medium	Small	Large	Medium	Small	Large	Medium	Small	(minutes)	(minutes)	(meters)
No. 1	40,795	33,531	2	33 (2 pumps)	2	06	3	00	2	30	1		1	425		50	8128		270	40	50	1.2x1.0
No. 3	71,341	60,287	4	20 (2 pumps)	3	42	2	00	1	40	1		1	425		50	8128		270	35	35	1.8x1.5
No. 4	113,549	96,055	4	39 (3 pumps)	3	56	3	10	2	40	3		2	1200		240				20	20	2.7x2.7
No. 5	96,612	82,605	3	58 (3 pumps)	3	19	2	50	2	30	3		2	1200		240	24,384 combined		1400 combined	18	18	2.7x2.7
No. 6	52,221	43,428	2	08 (3 pumps)	1	47	2	00	1	40	3		2	1200		240				16	16	2.7x1.8
No. 7	332,000	288,000	4	30 (6 pumps)	3	54	3	30	2	50	6	2	1	850	165	35	12,000	1500	200	Not Known	Not Known	1.9x1.95

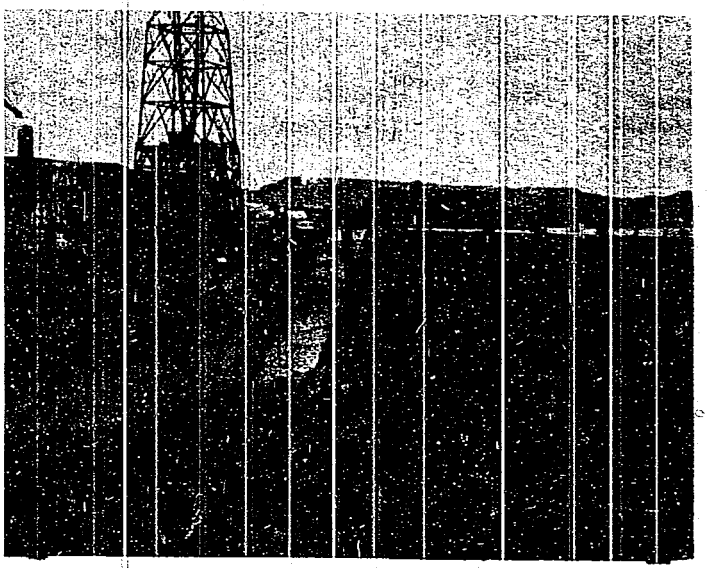


Figure 1
NO. 7 DRY DOCK, SASEBO, SHOWING MOUTH OF DOCK AND CAISSON

Figure 2
NO. 7 DRY DOCK LOOKING TOWARD HEAD OF DOCK

Figure 3
NO. 7 DRY DOCK LOOKING TOWARD HEAD FROM FLOOR OF DOCK

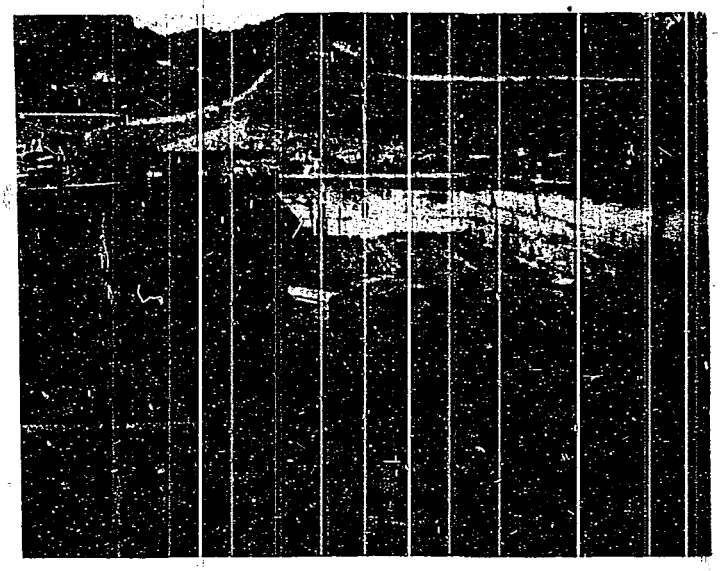


Figure 4
NO. 7 DRY DOCK FROM DECK OF CAISSON

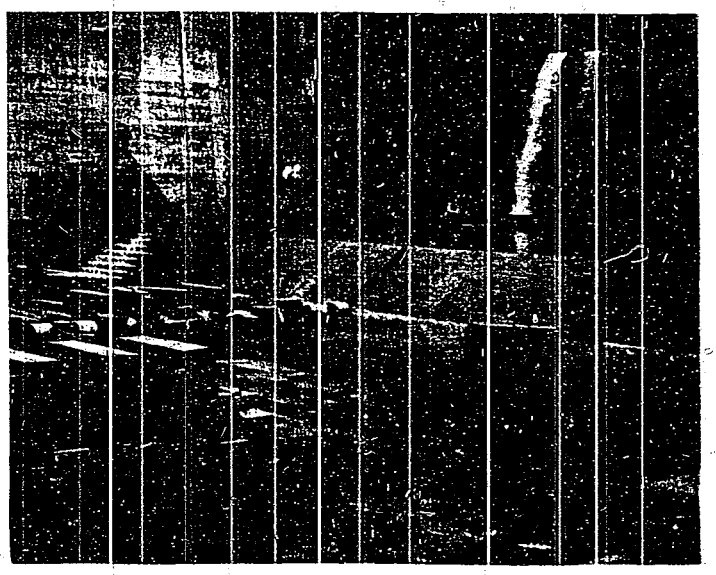


Figure 5
LOOKING TOWARD SILL AND CAISSON
FROM FLOOR OF NO. 7 DRY DOCK

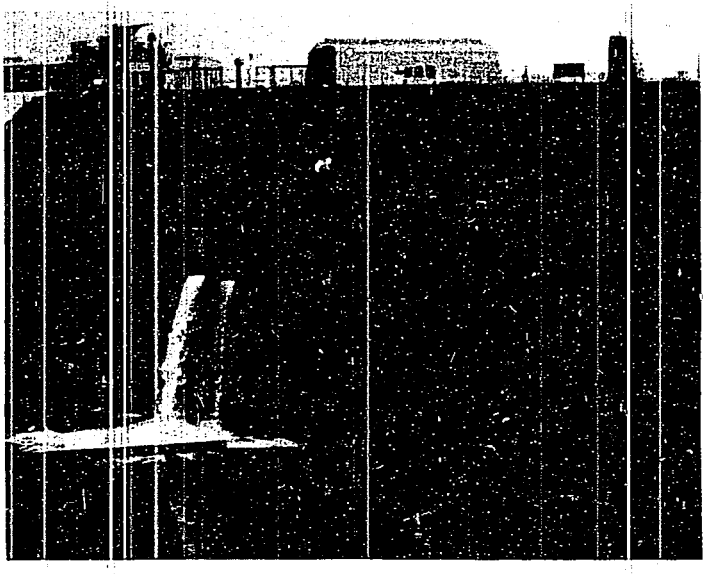


Figure 6
CAISSON, NO. 7 DRY DOCK

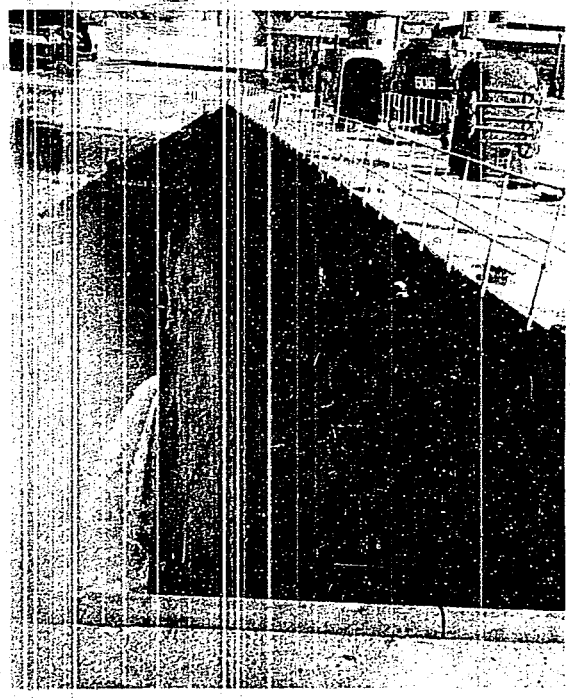


Figure 7
LENGTHWISE VIEW OF CAISSON, NO. 7 DRY DOCK

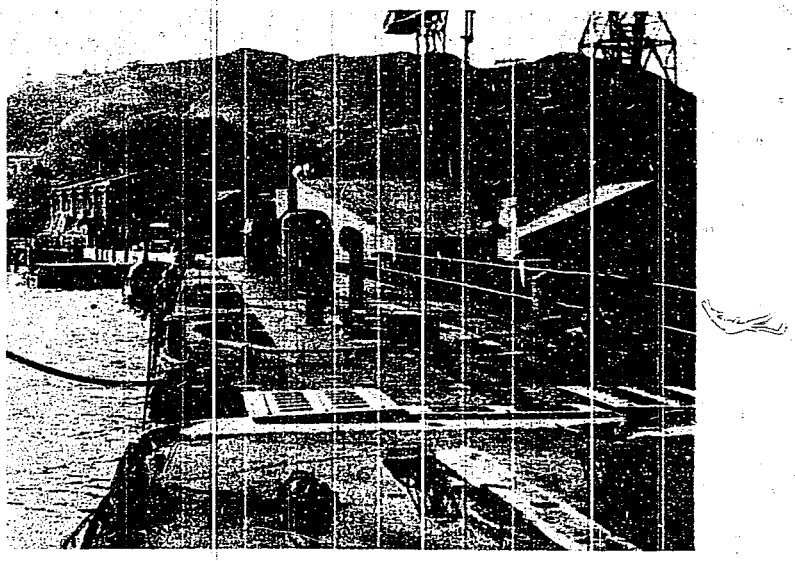


Figure 8
CAISSON IN PLACE AT OUTERMOST STOP

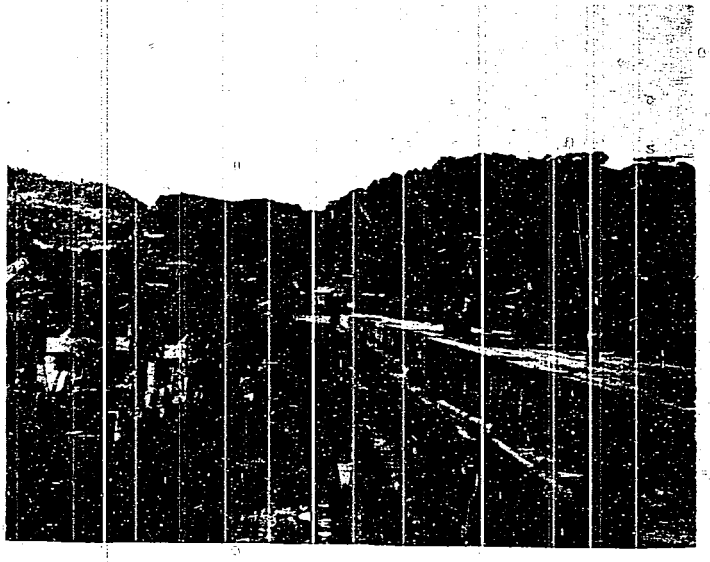


Figure 9
NO. 4 DRY DOCK, SASEBO, FROM DECK OF CASSION

Figure 10
CAISSON, NO. 4 DRY DOCK
(Framework of gantry crane supports at No. 2 building slip, visible in background.)

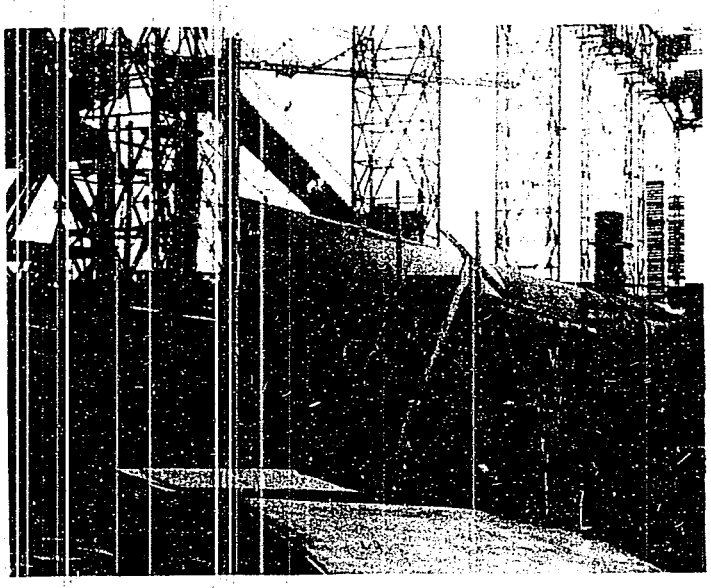


Figure 11
UPPER END OF NO. 2 BUILDING SLIP

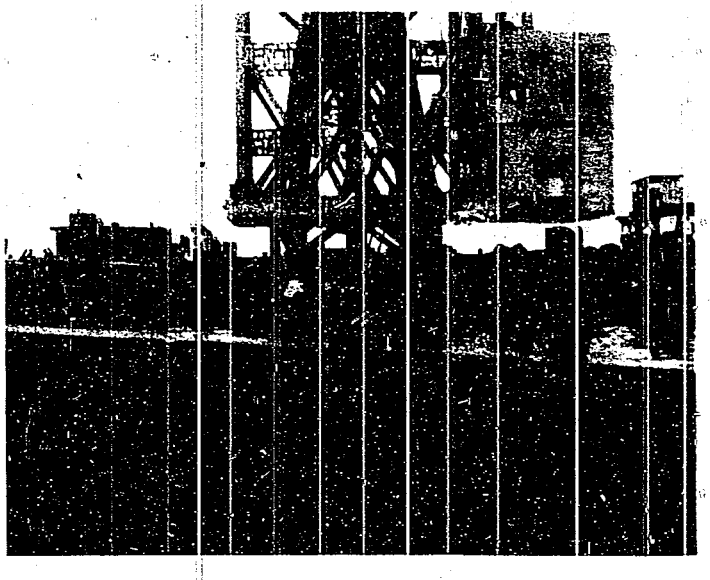


Figure 12
BASE OF TOWER STRUCTURE AND MACHINE ROOM OF 350 TON FLOATING CRANE, SASEBO
(Crane is mounted on a steel barge.)

Figure 13
BASE OF TOWER STRUCTURE AND MAJOR PORTION OF BARGE, 350 TON FLOATING CRANE

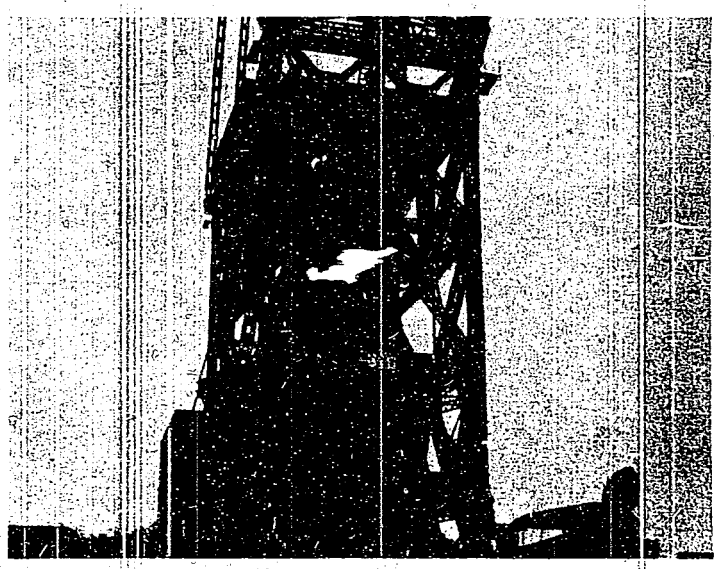


Figure 14
VIEW FROM DECK OF BARGE SHOWING TOWER STRUCTURE AND OPERATOR'S CAB

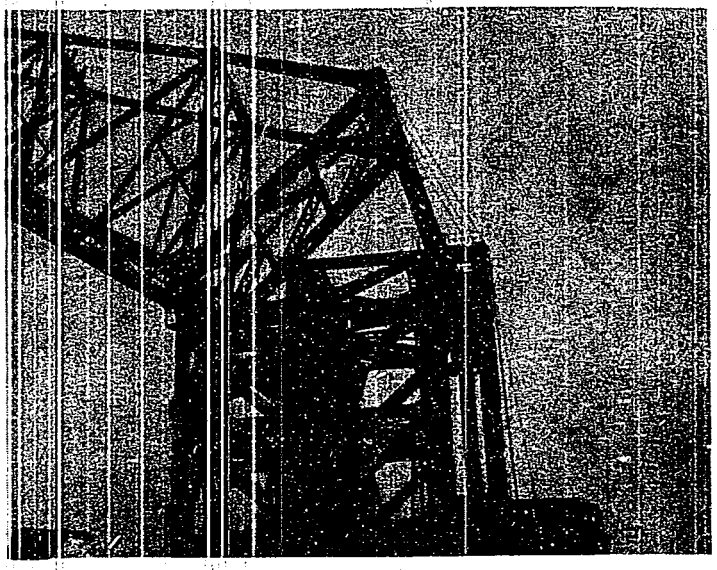


Figure 15
UPPER PART OF TOWER STRUCTURE AND BASE OF BOOM
(Note eye bars and screw jack mechanism for elevation of boom.)

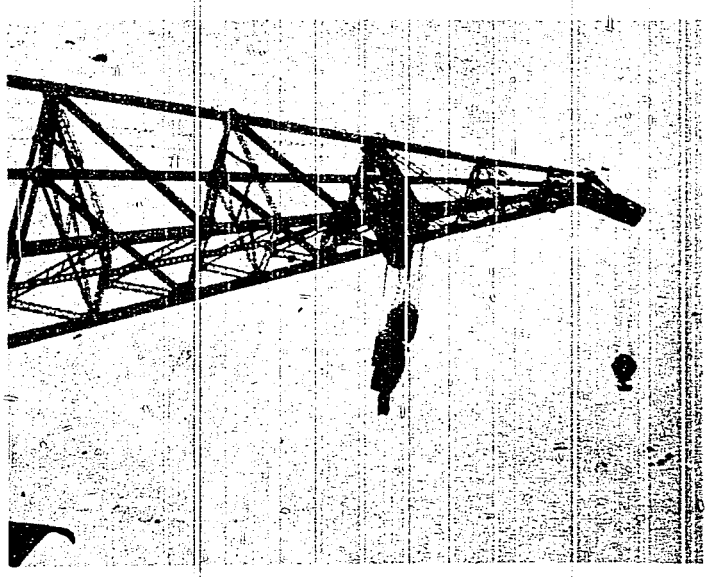


Figure 16
UPPER PART OF BOOM SHOWING MAIN HOOKS AND WHIPLINE

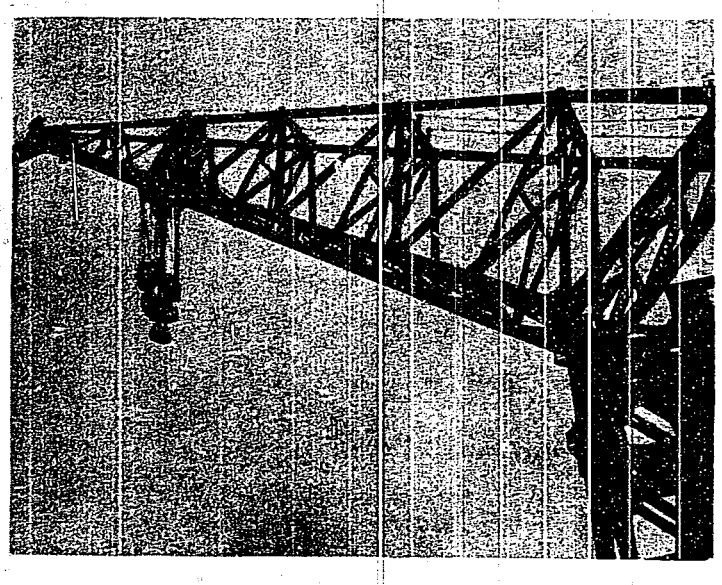


Figure 17
BOOM OF 350 TON FLOATING CRANE

D. YOKOSUKA NAVY YARD

All plans and specifications of the Yokosuka Navy Yard have been destroyed and it has been impossible to cover all the facilities. Since the British Admiralty was particularly interested in Dry Docks Nos. 5 and 6, and had submitted a questionnaire on these two docks, investigation was principally directed toward furnishing the data requested.

Enclosure (B) contains the questionnaire with the answers furnished by by the Japanese Government.

The docks were flooded at the time of inspection; consequently it was not possible to determine the condition of the walls and floors. The construction of the docks, judging from the portions which were visible, appeared to be of better than average quality and showed little signs of deterioration. Dockside services had received some damage from bombing raids, but the original facilities were not up to American standards. The pump house at No. 6 Dock was in operating condition but no regular maintenance schedule was in effect. The pump motors had been covered and probably will not be ruined. For details of No. 6 Dock, see Figures 18 through 26.

The pump house at Dry Dock No. 5 is located between No. 5 and No. 4 Docks and serves both docks. The pumps are in working order and have been used recently to dewater No. 4 Dock. It is certain that No. 5 Dock could likewise be dewatered. The main difficulties at both No. 5 and No. 6 Docks are in using the caissons, which are in poor condition and not very watertight. The dockside cranes at both docks are in usable condition. Minor damage to the wall of Dock No. 5 was observed, but it is certain this would not limit the dock's use. For details of No. 4 and No. 5 Dry Docks, see Figures 27 through 31.

Photographs were also taken of No. 4 Dry Dock and crane. (See Figures 32, 33, and 34.) Figures 35 and 36 show a 350-ton crane alongside of a loading dock, and are included as a point of interest.

At Yokosuka Navy Yard there were three small dry docks which were not investigated because of their relative unimportance.

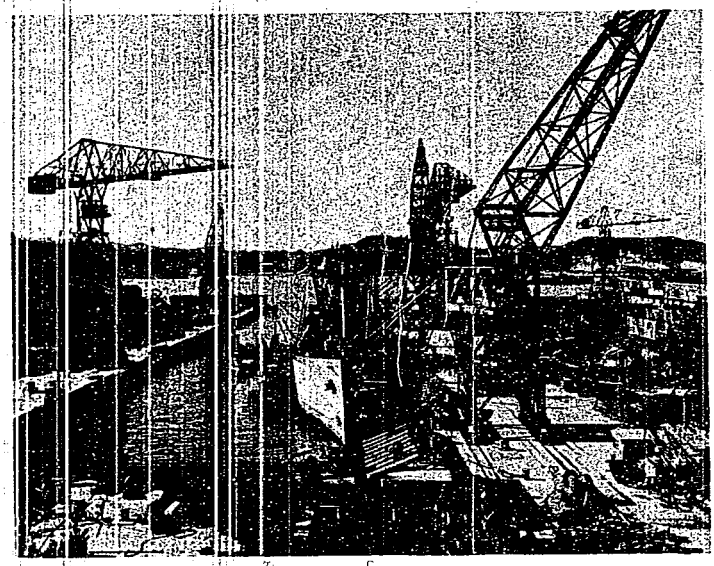


Figure 18
NO. 6 DRY DOCK AND DOCKSIDE CRANES, YOKOSUKA NAVY YARD

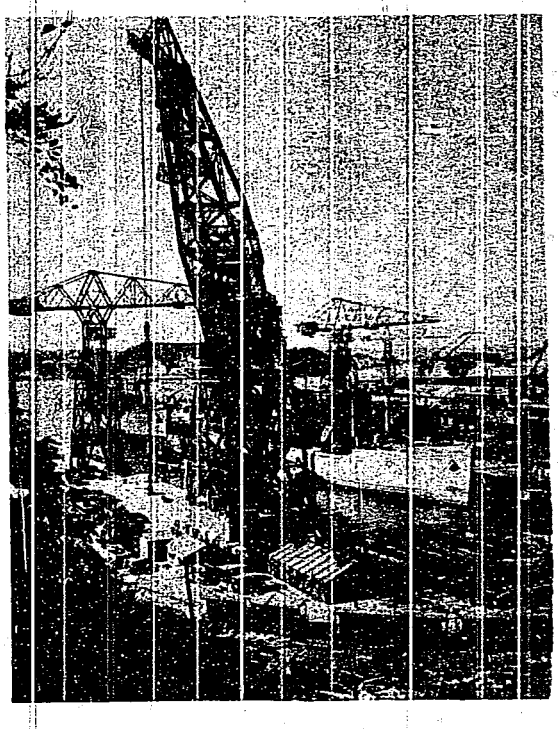


Figure 19
NO. 6 DRY DOCK AND DOCKSIDE CRANES

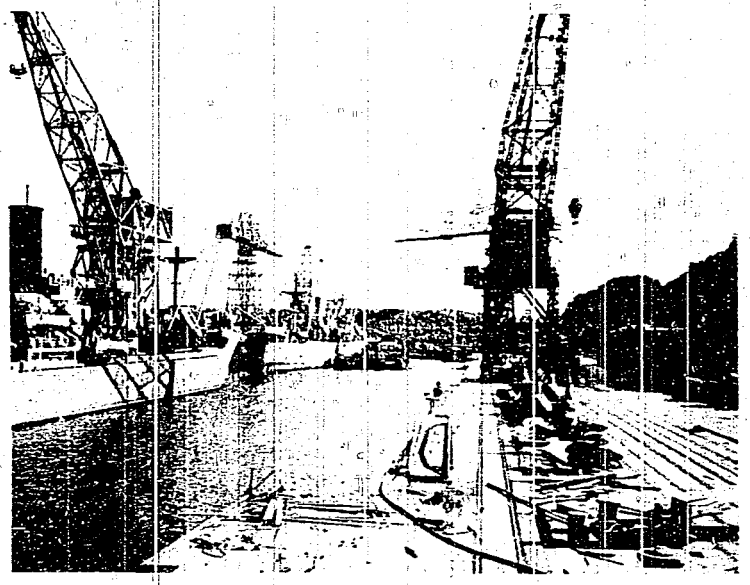


Figure 20
GENERAL VIEW OF NO. 6 DRY DOCK

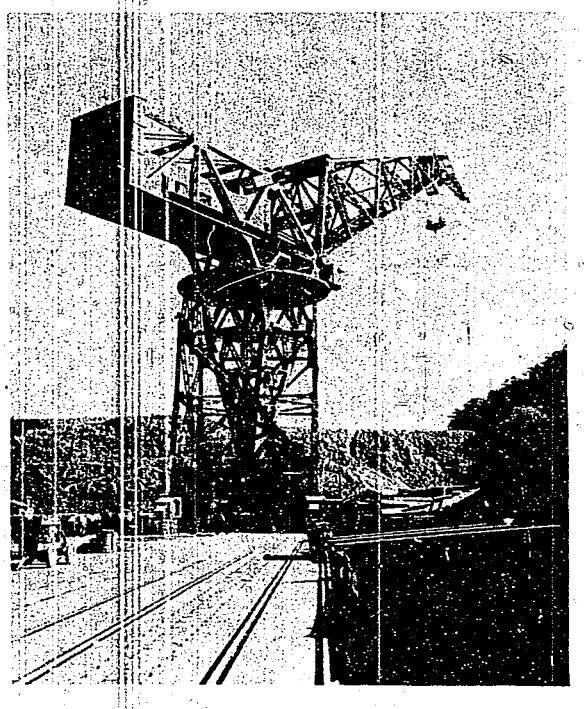


Figure 21
DETAIL OF TOWER CRANE AT NO. 6 DRY DOCK

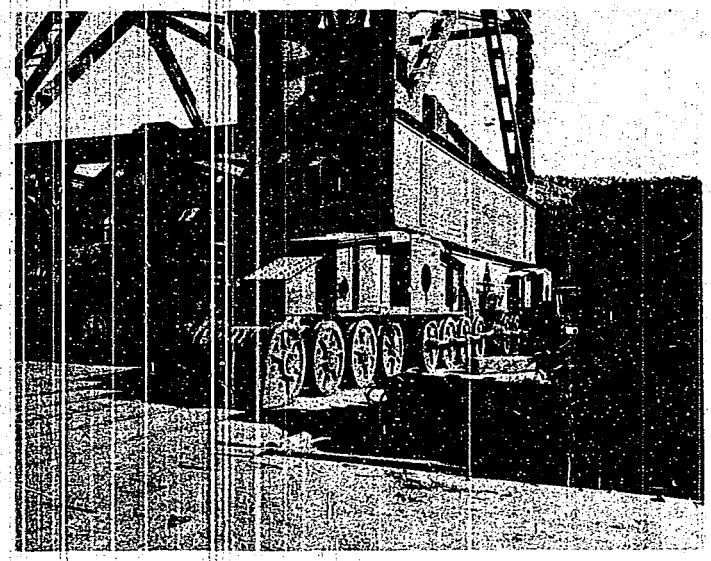


Figure 22
DETAIL OF BASE OF TOWER CRANE AT NO. 6 DRY DOCK

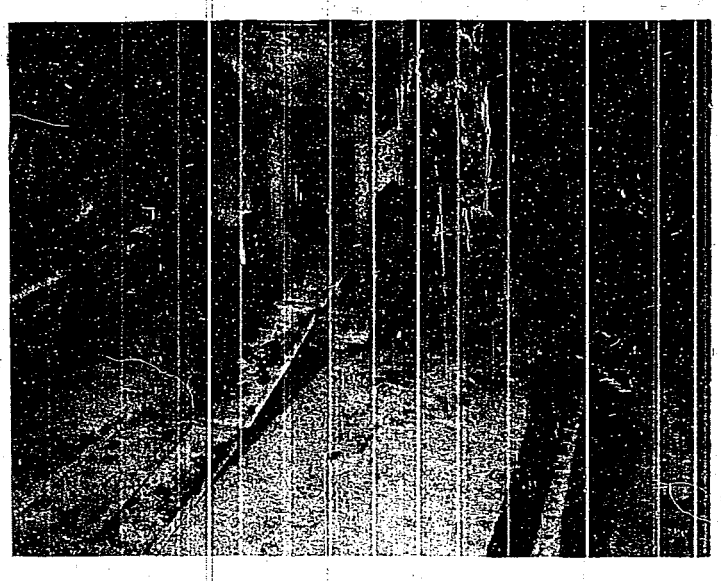


Figure 23
DETAIL OF POWER TAKE-OFF FOR TOWER CRANE AT NO. 6 DRY DOCK

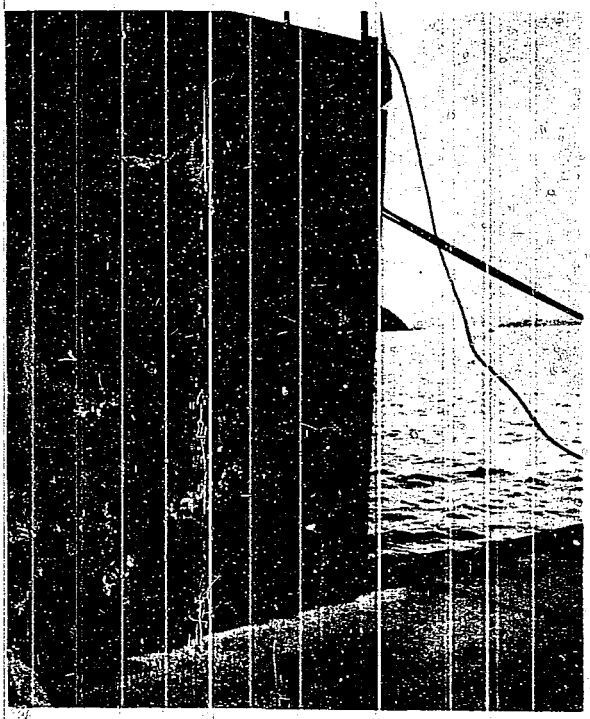


Figure 24
DETAIL OF CAISSON AT NO. 6 DRY DOCK

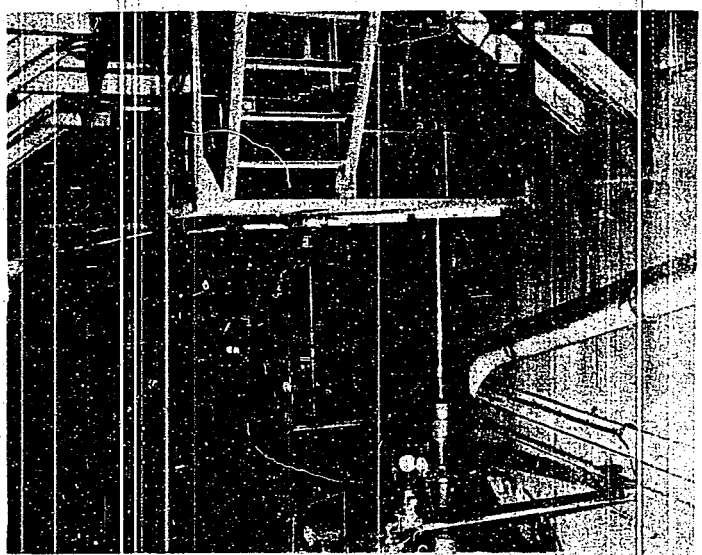


Figure 25
INTERIOR VIEW OF PUMP HOUSE AT NO. 6 DRY DOCK

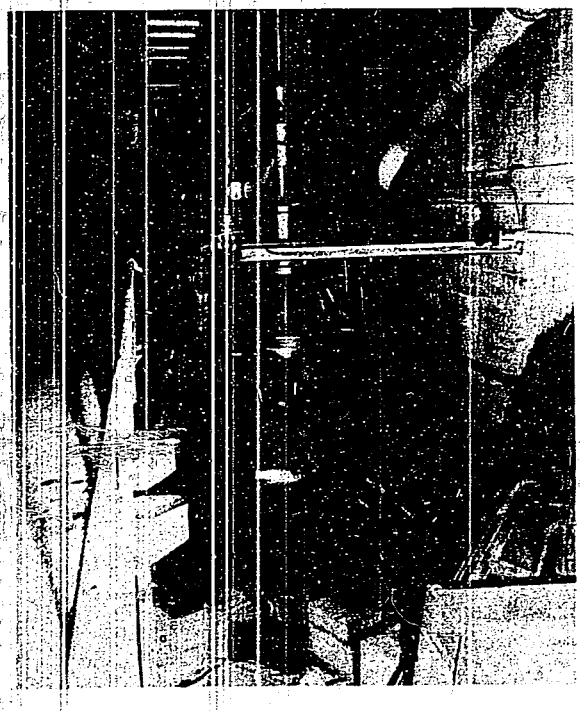


Figure 26
PUMP DETAIL AT NO. 6 DRY DOCK

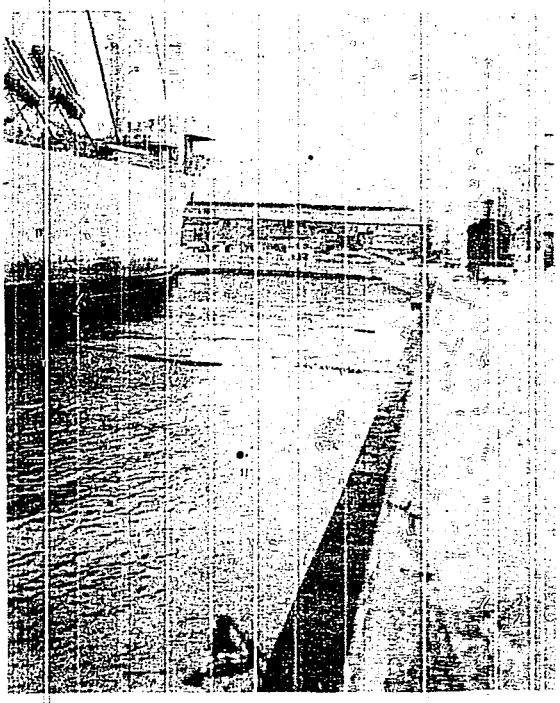


Figure 27
GENERAL VIEW OF NO. 5 DRY DOCK, YOKOSUKA NAVY YARD

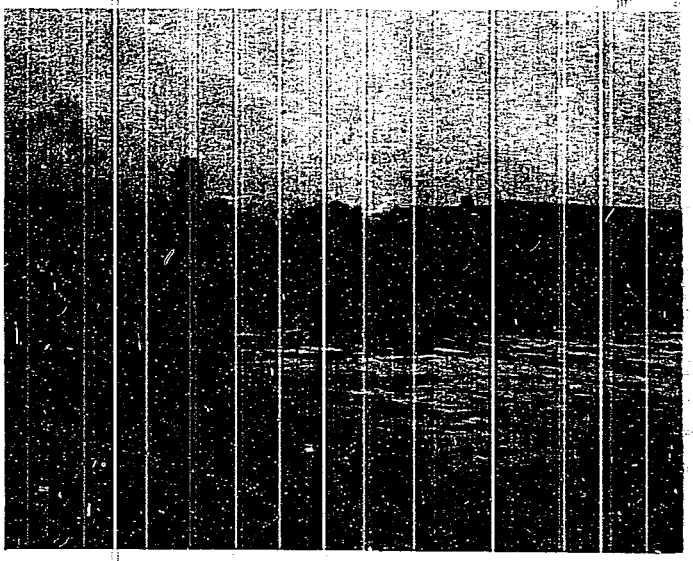


Figure 28
DOCK MOUTH OF NO. 5 DRY DOCK

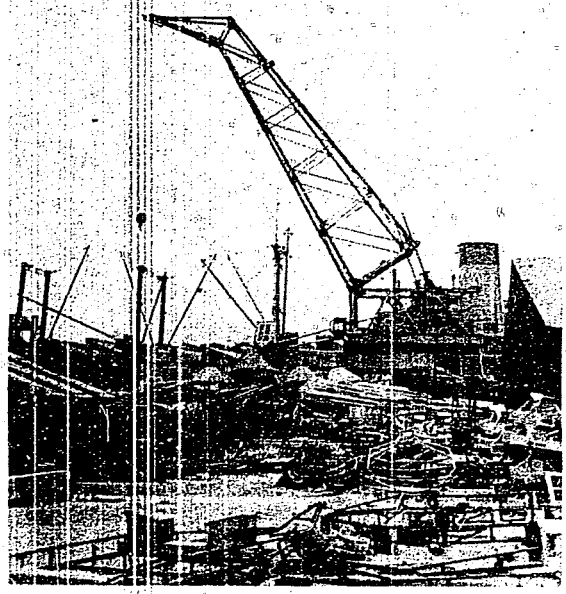


Figure 29
DOCKSIDE CRANE AT NO. 5 DRY DOCK

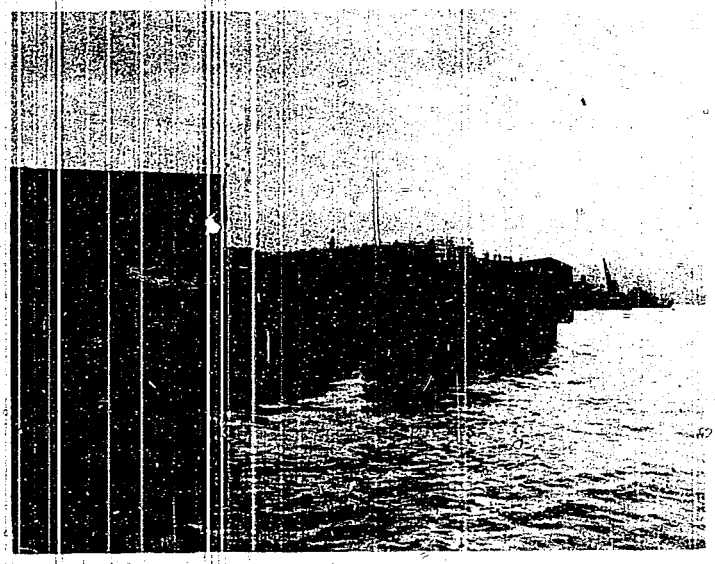


Figure 30
CAISSON, NO. 5 DRY DOCK

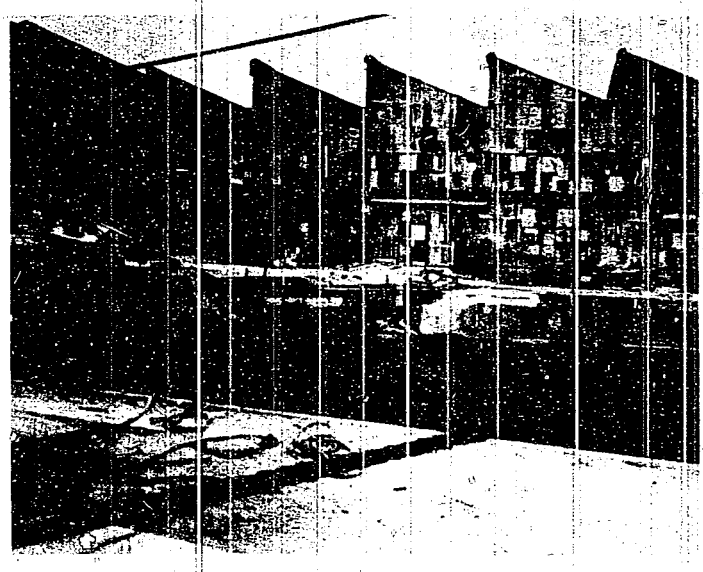


Figure 31
SIDE WALL DAMAGE, NO. 5 DRY DOCK

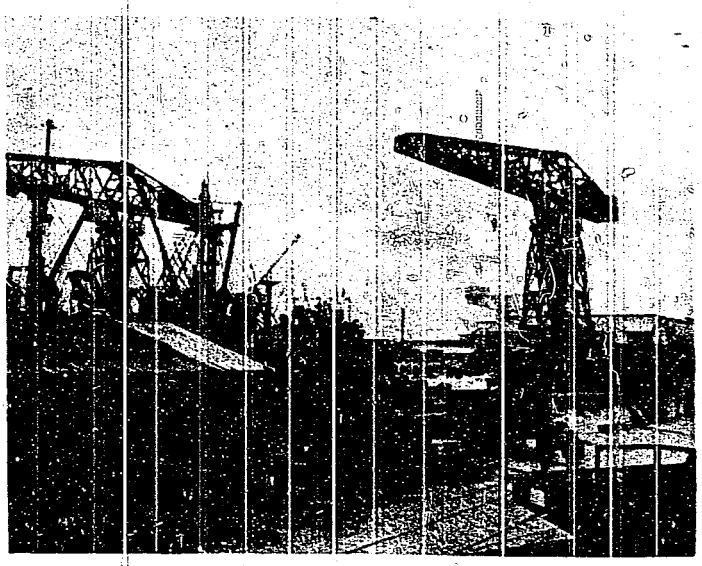


Figure 32
DOCKSIDE CRANES AT NO. 4 DRY DOCK, YOKOSUKA NAVY YARD

Figure 33
GENERAL VIEW OF NO. 4 DRY DOCK

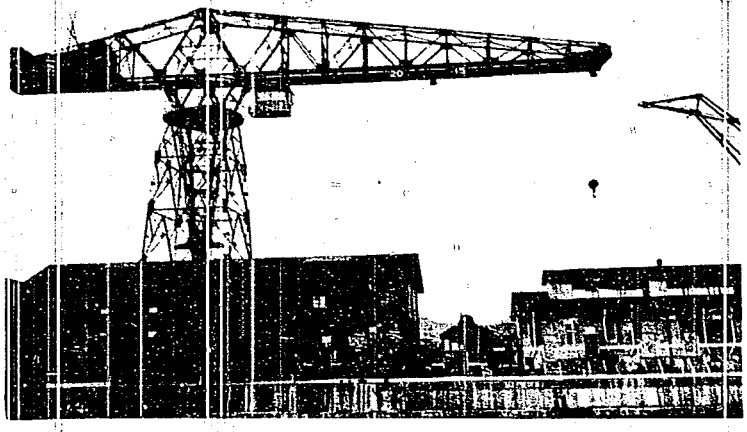


Figure 34
20 TON HAMMERHEAD CRANE AT NO. 4 DRY DOCK

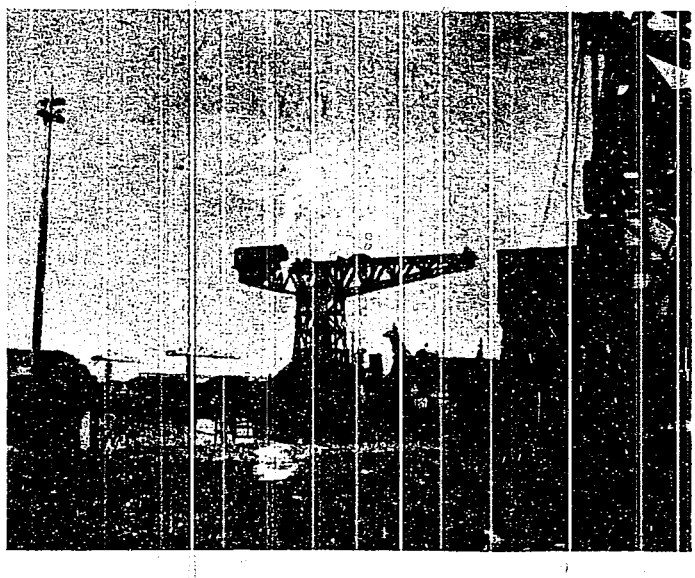


Figure 35
55 TON HAMMERHEAD CRANE, YOKOSUKA NAVY YARD

Figure 56
350 TON HAMMERHEAD CRANE, YOKOSUKA NAVY YARD

E. KOBE SHIPBUILDING YARD OF THE MITSUBISHI COMPANY

1. General Description of Facilities. The principal facilities at the Kobe shipbuilding yard of Mitsubishi Heavy Industries, Ltd., include the following items:

SHIPBUILDING SLIPS

		No. 1	No. 2	No. 3	No. 4	No. 5
Size of Vessel	Maximum Length	146 m	146 m	140 m	128 m	98 m
	Maximum Beam	13m	15 m	14 m	19 m	23 m

SHIP MOORING PIERS

	No. 1	No. 2	No. 3	No. 4	No. 5
Length	150 m	135 m	110 m	135 m	160 m
Depth of Water	9 m	9 m	6 m	8 m	9 m

FLOATING DRY DOCKS

Dock	Capacity (tons)	Overall Length	Overall Beam	Draft	Date of Mfg.
No. 1	7,000	125.74 m	25.92 m	5.30 m	1905
No. 2	12,000	162.32 m	30.50 m	6.00 m	1909
No. 3	16,000	134.14 m	39.00 m	8.00 m	1916

GRAVING DOCK

Dock No. 4: 155.3 m x 37.2 m x 13.0 m

The output of this Kobe shipbuilding yard during the last twelve months of the war, according to figures furnished by the Mitsubishi Company, is listed in the table below.

New Construction:

12 - Type 2A Cargo ships (6900 GT)	82,800 GT
19 - Warships (1130 DPT)	21,430 DPT

Repair:

218 ships - Average 5566 GT	1,213,423 GT

Engine Manufacture:

Steam turbines (5000 hp)	18
Internal combustion engines (500 hp)	70

Average total number of employees	11,000

2. Information on Floating Docks. Detailed information of Docks No. 1, 2, and 3 at this shipbuilding yard, as furnished by the Mitsubishi Company, is presented in Table III.

NavTechJap Document No. ND50-5322 shows the general layout, longitudinal section, and end elevation of Dock No. 1 (floating).

NavTechJap Document No. ND50-5323 shows the general layout, longitudinal section, transverse section, and end elevation of Dock No. 2 (floating).

The general layout, longitudinal sections, and detailed framing of Dock No. 3 (floating) are shown in NavTechJap Document No. ND50-5324. NavTechJap Document No. ND50-5325 shows a typical transverse section of this dock together with framing details.

3. Dry Dock No. 4 - Graving Dock. NavTechJap Document No. ND50-5326 shows the general layout of Dock No. 4 at the Kobe shipbuilding yard of the Mitsubishi Company. This dock was under construction at the close of the war and was not fully completed. The original design of the dock specified an effective length of 245 meters, but owing to the shortage of cement, the actual effective length was reduced to 155.3 meters. The width of the dock at the bottom of the mouth is 37.20 meters and the depth from coping to sill is 13.0 meters. The depth from coping to floor of the dock is 14.0 meters.

The pumping equipment for the dock consists of four main pumps and two auxiliary pumps. The main pumps are single-stage, vertical centrifugal type, with a total pumping capacity of 8000 tons/hour. The pump motors are of 150 hp each. Diameter of delivery pipe is one meter.

The auxiliary pumps are also single-stage, centrifugal type, but with a total capacity of 550 tons/hour. The pump motors are of 25 hp each. Diameter of delivery pipe is 0.30 meters. All pumping equipment is installed in a single pump house, the construction of which is not fully completed. The location and section through the pump house are shown in Figures 2 and 3 of NavTechJap Document No. ND50-5326.

The main caisson is a steel ship type, a section of which is shown in Figure 1 of NavTechJap Document No. ND50-5326. No extra caisson is provided. The main caisson sets against granite stops which are constructed without grooves. Figures 5 and 6 of the same Document show the dimensions and shape of the entrance to the dock as well as details of the stops. The side walls of the dock entrance are constructed with a batter of 1 to 20.

Figure 4 of the Document shows a cross-section through the body of the

Table III
FLOATING DRY DOCKS MITSUBISHI SHIPBUILDING YARD - KOBE

Item	Dock No. 1	Dock No. 2	Dock No. 3
Lifting power	7000 tons	12,000 tons	16,000 tons
Length (overall) of Pontoons	118.2 m	153.94 m	125.00 m
Total Length of Dock	125.74 m	162.32 m	134.14 m
Overall Beam	25.92 m	30.50 m	39.00 m
Clear Width Between Rub Timbers	18.29 m	21.33 m	28.50 m
Depth from Top of Side Wall to Bottom of Pontoon	12.68 m	15.12 m	18.91 m
Draft	5.30 m	6.00 m	8.00 m
Date of Manufacture	1905	1909	1916
Pumping Equipment	Steam Driven	Electric Driven	Electric Driven
Pumping Capacity	2000 tons/hr	3500 tons/hr	8000 tons/hr
Crane Equipment	One 1.5 ton jib	One 1.5 ton jib	
Electric Power		AC-3500Vx135A 455 kw	AC-3500Vx150A 525 kw
Size of Ships Accommodated	L 140.2 m B 17.1 m D 6.7 m	L 164.6 m B 20.2 m D 6.0 m	L 144.8 m B 27.0 m D 8.0 m
Names of Ships Most Recently Docked	BIYO MARU 5479 GT KAIO MARU 2283 GT SAN PEDRO MARU 7268 GT	TAKASAGO MARU 9347 GT KAMO MARU 7954 GT YOSHINO MARU 8990 GT	ORYOKU MARU 7362 GT NICHIRAN MARU 6503 GT FUSO MARU 8195 GT
Capable of Ocean Towage	No	No	No

dock with dimensions of the dock altars, height of keel blocks, and slope of dock floor to side drains; and Figure 2 is a general plan of the dock which shows the arrangement of the keel blocks, location of capstans, and the location of the pump house and water discharge culvert.

Services for fresh and salt water supply, electric power supply, and compressed air and steam supply to the dock were planned but their installation was not completed. No plans showing these services are available. Washing water, sewage, and sludge oil flow through the side drains and suction culvert to the auxiliary pump sump and are then pumped into the discharge culvert. No equipment is provided for flooding the magazines of a ship in dock. No services for oil supply to a ship in dock were planned.

Location of capstans is shown in Figure 2 of NavTechJap Document No. ND50-5326; data on their capacity is given below:

	75 hp Capstans	35 hp Capstans
Hauling Capacity (tons)	13.0 - 7.0	6.0 - 3.5
Operating Speed (meter/hr)	20.0 - 38.0	20.5 - 34.0
Diameter of Winding Drum (mm)	500 - 930	450 - 750

NavTechJap Document No. ND50-5326 shows a traveling hammerhead crane, the capacity of which is not indicated. However, during construction of the dock, this type of crane was replaced by a ruffing crane of 5-ton capacity. Installation of rails for this crane is not complete and therefore is is incapable of travel.

Fendering at the dock entrance has not been installed nor are plans available which show the type of installation intended.

No special protection against bomb or underwater attack is provided for the dock, caisson, pump house, or penstock tube.

F. NAGASAKI SHIPYARD AND ENGINE WORKS

1. Information on Dry Docks. The general layout of the Nagasaki Shipyard and Engine Works (Mitsubishi Heavy Industries, Ltd.) is shown in NavTechJap Document No. ND50-5330. The facilities at this shipyard include three dry docks of the following overall dimensions.

Dry Dock No. 1 - 523 ft. x 76 ft. x 32 ft. (sill)
Dry Dock No. 2 - 356 ft. x 70 ft. x 29 ft. (sill)
Dry Dock No. 3 - 700 ft. x 97 ft. x 37 ft. (sill)

Detailed dimensions and cross-sections of these docks are to be found in NavTechJap Documents No. ND50-5327, ND50-5328, and ND50-5329.

A questionnaire on dry docks, (prepared by the British Admiralty), was sent to the Mitsubishi Heavy Industries, Ltd., with the request that information on the dry docks at the Nagasaki Shipyard and Engine Works be furnished in answer to that questionnaire. Enclosure (C) contains the answers to the questionnaire as applicable to Docks Nos. 1, 2, and 3 at the Nagasaki Shipyard as submitted by the Mitsubishi Heavy Industries, Ltd.

Part II
AIRCRAFT HANGARS

A. HANGARS AT KISARAZU AIRFIELD

The main hangars at KISARAZU Airfield front on the parking area and are representative of the permanent type of hangar in use in Japan. Unlike the flat-roofed hangar with lean-to, so common at Navy airfields in America, these hangars are made up of twin two-hinged arches. This type of construction appears to be well designed and economical in the use of steel. The use of the double two-hinged arches serves to reduce the amount of steel over single two-hinged construction. However, the valley formed by this double type of arch construction is considered a disadvantage in localities subject to heavy snow loads. In addition, valleys always created serious drainage problems. But in Japan the economical use of steel was the deciding factor.

The steel frames of all the hangars were still standing and in a good state of preservation. The roofs and side walls of some of the hangars had been removed and since none of the structure appeared to have been bombed, it was assumed that the material had been removed late in the war, or just after the war, for use in more critical areas.

The end hangar, directly in front of the Japanese officers' quarters, appeared to be of more recent design than the other hangars, and it was on this structure that investigations were centered.

The hangar measured 85.4 meters wide by 74.2 meters long, with door clearance of 6.57 meters. The main two-hinged arches were spaced 9.275 meters on centers, with intermediate roof trusses subdividing the 9.275 meter bays. Enclosure (D) is a general drawing showing the controlling dimensions and lay-out of the hangar. The side walls of this structure were covered with corrugated siding with steel sash interspersed. The roof was made up of 12cm x 18cm wood purlins, fastened at the panel points of the roof trusses by means of slip angles. Wood planking was then spiked to the purlins and standing seam metal sheeting was used as the final weather surface. The sliding doors were metal-clad and approximately 7 meters to the section, thus allowing full opening of the hangar front.

Drawings of the main two-hinged arches and the intermediate roof trusses are shown in Enclosures (E), (F), and (G). These sheets give very complete information on the steel framing of this type hangar.

Along the sides and through the center of the hangar were areas devoted to shops and storage. The usual type of shop found in the hangar lean-to in the United States occupied these side areas. Overhead there were provided two 8-ton mono-rail hoists for each arch to be used in the overhaul of aircraft. The hangar deck was of concrete and was pitched toward the doors and side drains. Power and water were available in the hangar but no heating or head facilities were furnished.

Figures 37 through 45 cover various views and details of this twin two-hinged arch hangar.

Figure 37
GENERAL VIEW OF HANGAR AREA, KISARAZU AIRFIELD

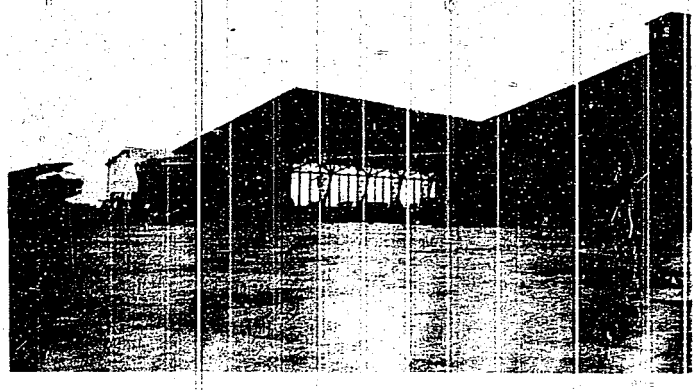


Figure 38
FRONT ELEVATION OF HANGAR

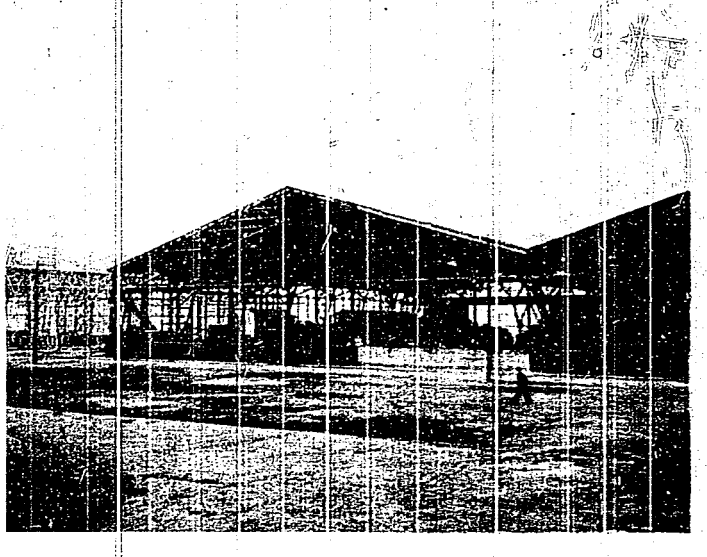


Figure 39
REAR ELEVATION OF HANGAR

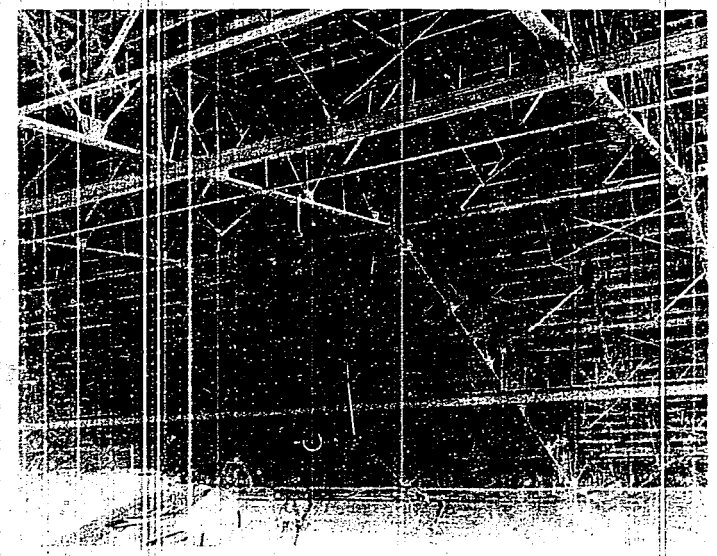


Figure 40
HANGAR ROOF TRUSSES

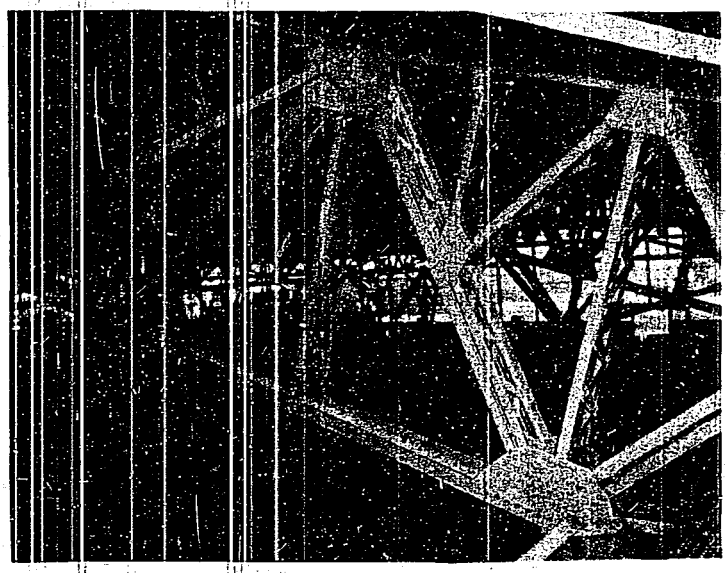


Figure 41
DETAIL OF HANGAR ROOF TRUSS

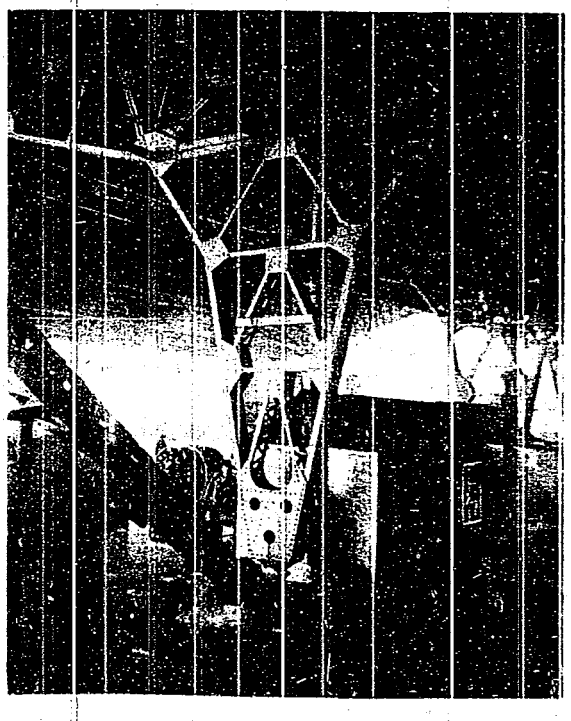


Figure 42
DETAIL OF INTERIOR COLUMN

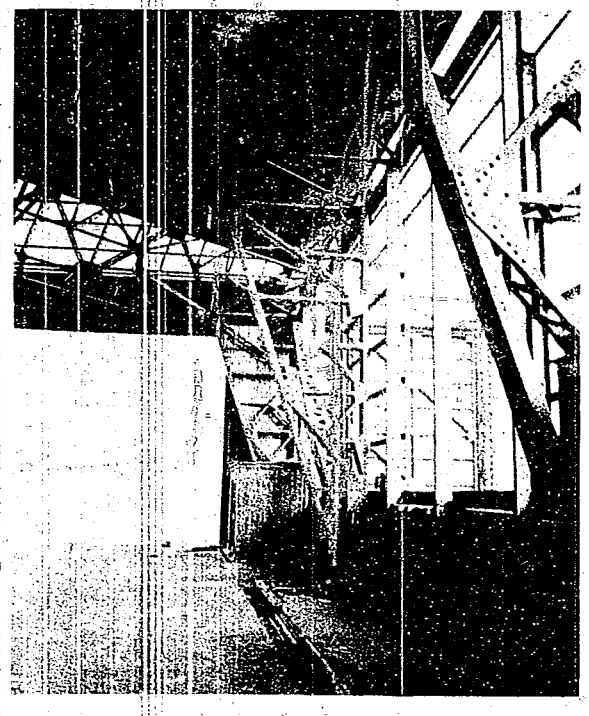


Figure 43
DETAIL OF EXTERIOR COLUMN

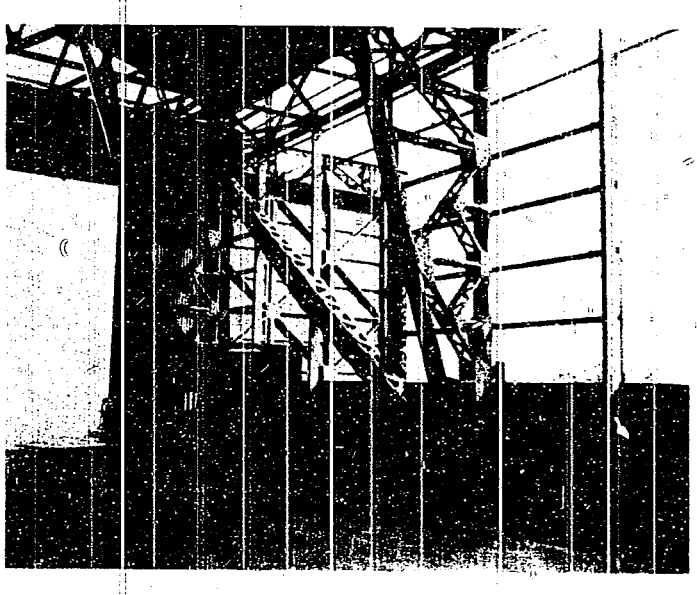


Figure 44
[illegible]

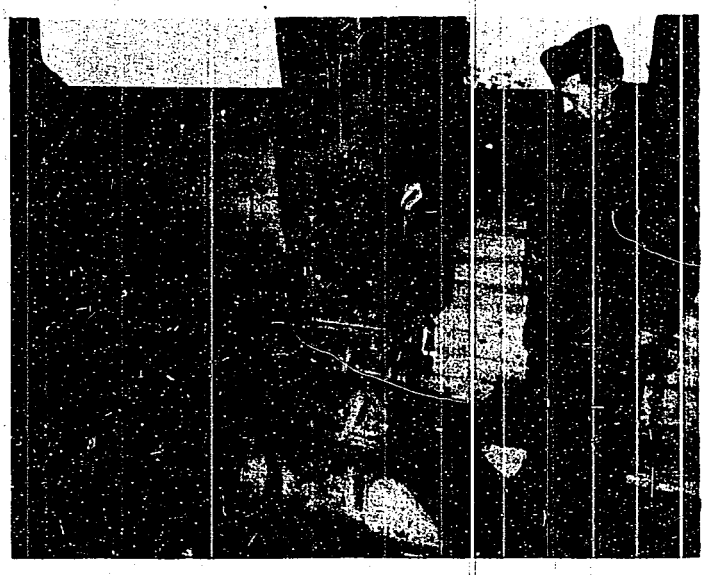


Figure 45
DETAIL OF HINGE AND COLUMN BASE

B. HANGAR AT YOKOSUKA AIRFIELD

The Tomoe Iron Works of TOKYO had developed an unusual type of hangar construction called the "Diamond Truss." The name is derived from the diamond-shaped pattern formed by the intersecting arches. It is in reality a hangar made of a series of intersecting skew arches. The reason for this novel type of design was that the skewed arches formed the longitudinal bracing of the structure in addition to taking the regular loading. This design therefore resulted in a tremendous saving in steel. At first glance it would appear that the cost of fabrication of such an unorthodox structure would be prohibitive but actually this was not the case, the reasons being that no bent plates or structural shapes were necessary, and standardization on the sizes of the hangars kept the steel detailing to a minimum. The entire structural frame is made up of plates and angles. To avoid complicated framing at the intersections of the arches, the top and bottom chords of the arches were cut and framed into gusset plates. This can readily be seen in Figure 50. The form of the arch itself was that of a 120° segment of a circle.

This type of hangar was fabricated in standard widths of 35 meters, 40 meters, 60 meters, and 80 meters. In Enclosure (H) is shown a steel framing plan of the 35 meter "Diamond Truss" hangar at Yokosuka Airfield, and Figures 46, 47, 48, 49, and 50 present various views and details of the structure. This particular hangar was of very recent construction and certainly not over one year old, but plans of the hangar were not available. It was possible, however, to secure a complete set of the standard 40 meter hangar plans which serves equally well. Enclosure (I) gives a general plan of the hangar. NavTechJap Document No. ND50-5333 gives the complete steel details.

Figure 46
INTERIOR VIEW OF HANGAR FRAMEWORK, WORCESTER, MASS.

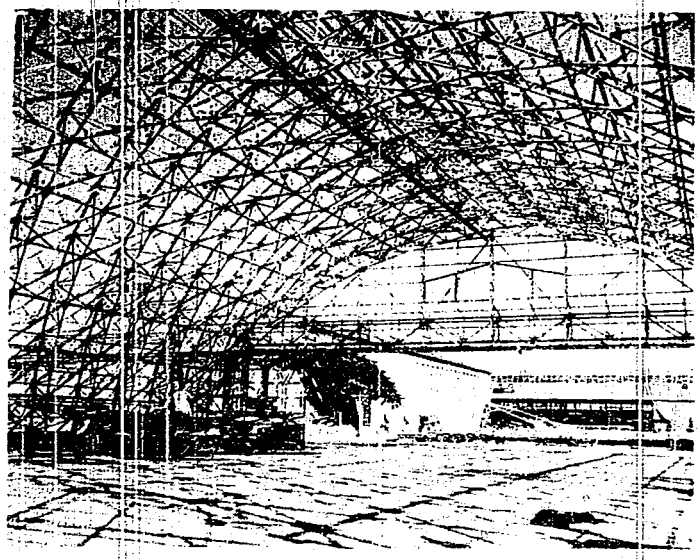


Figure 47
INTERIOR VIEW OF HANGAR FRAMEWORK

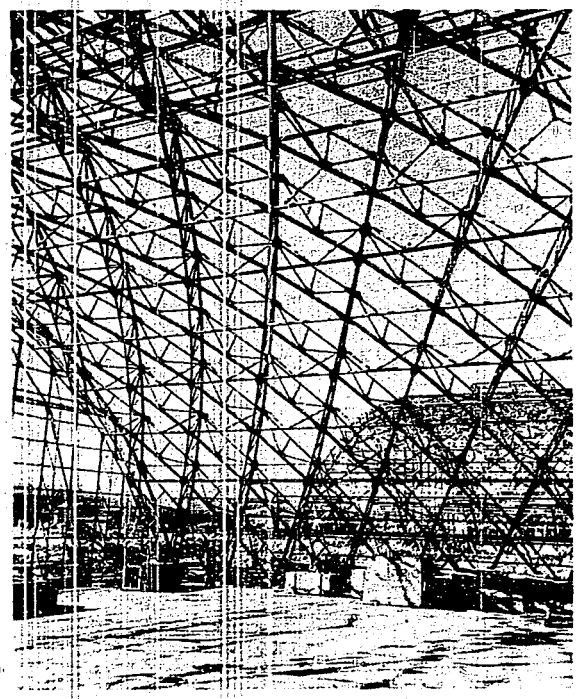


Figure 48
LOOKING ALONG SKEW ARCH RIB

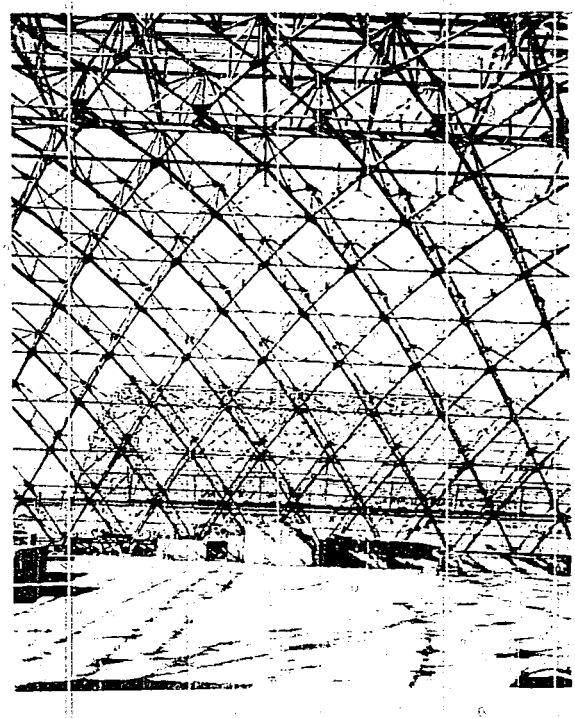


Figure 4[illegible]
TRANSVERSE VIEW OF [illegible] SKEW ARCHES

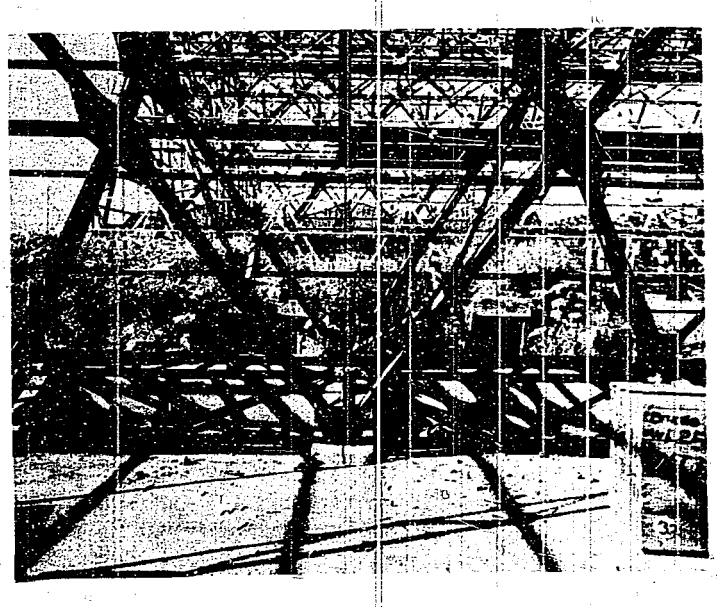


Figure 50

HANGAR FOUNDATION, YOKOSUKA AIRFIELD

Part III
WARTIME CONSTRUCTION MEASURES

A. WARTIME BUILDING STANDARDS

1. Introduction. Throughout the war, the Japanese Institute of Architecture was engaged in the drafting of emergency standards for wartime construction. As bills were drafted by the various committees of the institute, they were presented to the Cabinet for enactment into government regulations for the control of vital construction and conservation of restricted building material.

The progress made in the drafting of the emergency standards and their adoption by the Cabinet was reported by the Journal of the Institute of Architecture from time to time. NavTechJap Document No. ND50-5334 is a copy of the 9 August 1944 issue of the Journal. Translations of pertinent sections of this issue were made and are included in the text of this report to illustrate the measures adopted by the Japanese in their efforts to regulate wartime construction.

2. Emergency Standards for Design Loads. Emergency standards for loads to be used in building design, as adopted in May 1944, under Japanese Emergency Standards No. 532, are given on pages 281 to 285 of NavTechJap Document No. ND50-5334.

Translations of pertinent sections from these standards are given below.

Section 3, Article 1, states:

> "The following ordinary types of loading are to be considered in the design of a structure: Dead Load; Live Load; Snow; Wind; and Earthquake. In addition to the ordinary loadings, special loads are to be considered as warranted by the use for which the building is intended."

Section 5, Article 2, gives the following table for weights of basic materials to be used in design.

Table IV
WEIGHTS OF BASIC MATERIALS

	Material	Weight (Kg/cu.m)	Remarks
Earth	Dry Normal Saturated	1300 1600 1800	clay, loam
Sand	Dry Saturated Pumice	1700 2000 900	from pumice
Gravel	Dry Saturated Pumice	1700 2100 700	stone, volcanic ash, etc.
Sand & Gravel	Dry Saturated	2000 2300	
Cinders		1000	dry
Slag		1400	dry
Building Stone	Granite	2700	
	Agglomerate	1500	
	Sandstone	2000	
	Marble	2700	
	Pumice Stone	900	
Brick	Ordinary Slag Hollow	1900 2100 1100	
Concrete	Plain Reinforced Slag Scrab Brick	2300 2400 2100 2000	(ordinary brick)
Light weight concrete	No. 1	1800	ordinary sand, coal cinder and pumice stone
	No. 2	1400	pumice sand, coal cinders and pumice stone
	No. 3	1000	no sand, coal cinders and pumice stone

The above table is included as an illustration of the refinement of the emergency standards which were resorted to in an effort to conserve restricted materials needed for vital construction.

Table X on page 283 of NavTechJap Document No. ND50-5334 specifies the live load to be used in designing buildings for different classes of occupancy. A translation of this table is given as follows:

Table V
SPECIFICATION FOR LIVE LOADS (BUILDINGS)
(Units in kg/m^2)

Occupancy	Floor Systems	Girders, Columns, Foundations	For Live Load Due to Earthquake
Living rooms and sick rooms	180	130	60
Offices	300	180	80
Classrooms	230	210	110
Assembly rooms	360	330	210
Assembly halls	300	270	160

Section 9, Article 4, of NavTechJap Document No. ND50-5334, specifies the method of calculation of snow load on a building and states that $2 kg/m^2$ per centimeter of thickness on a flat surface is allowed. This allowance is to be increased to $3 kg/m^2$ per centimeter thickness in areas where the snow is likely to remain for a considerable period of time.

Sections 10 - 13, Article 5, of the Document specify the method of calculation of wind loads. The following basic formula is used for determining the wind pressure on a building:

$$P = c \cdot q$$

where P = pressure in kg/m^2
c = wind force coefficient
q = velocity pressure in kg/m^2

Values of "c" for various surfaces are given on page 285. Values of "q" are determined from the relation:

$$q = 40 h$$

where "h" is the height in meters of the surface. Values of "q" are also given in a table which is reproduced below:

Table VI
VALUES OF "q" FOR DETERMINING WIND PRESSURE

Height above ground - m	Value of "q" - kg/m^2
0 - 8	80
8 - 15	140
15 - 30	200

The above values of "q" are for use on the Pacific Coast side of Japan only. Percentages of increase or decrease for other areas are specified in Section 11 of the Document.

Sections 14 and 15, Article 6, of this Document deal with the allowances to be made for earthquake forces. Table V (above) gives the live load allowance for earthquake which must be added to the ordinary live load and dead load of the structure in calculating the horizontal force on the building. The seismic coefficient for average soil conditions is specified as 0.15 gravity, but for soft or alluvial soil the coefficient is to be increased to 0.20 gravity.

3. Emergency Standards for Allowable Stresses to Be Used in Design. Japanese Emergency Standards No. 533, pages 286-288, NavTechJap Document No. ND50-5334, specify the allowable stresses for various materials used in wartime construction. These standards were adopted in May 1944, and were in effect until the close of the war. Certain of these tables of allowable stresses are considered

of sufficient interest to include in the text of this report as illustration of the high design stresses resorted to as a means of conserving material. The following tables are translations of the original tables on pages 286-287 of the Document referred to above.

Table VII
ALLOWABLE STRESSES FOR WOODS (LENGTHWISE OF GRAIN)

Kinds of Wood	Allowable Stresses (kg/cm^2)		
	Compression	Tension and Bending	Horizontal Shear
Sugi, Momi, Ezomatsu, Todomatsu, Karamatsu	120	140	10
Hiba	140	160	12
Hinoki, Akamatsu, Kuromatsu, Tsuga	160	180	14
Kuri, Nara, Buna	140	190	20
Keyaki	160	220	24
Kashi	180	250	28

Remarks: When it is possible to select the pieces of timber, the above values may be increased up to 60%.
In the cases of selected hardwoods, the values shown above may be increased up to 100%.

Table VIII
ALLOWABLE STRESSES FOR STEEL

Material		Allowable Stresses (kg/cm^2)				Notes
		Tension	Compression	Bending	Shear	
Steel	Structural	2400	2400	2400	1200	Based on dia. of hole
	Rivet	2400			2000	
Bolts	black	1300			1800	Based on dia. of bolt at root of thread
	finished	1500			1800	

Table IX
ALLOWABLE STRESSES AT THROAT OF WELDED SEAM

Type of Weld		Allowable Stresses (kg/cm^2)				Notes
		Tension	Compression	Bending	Shear	
Shop weld	butt	2000	2200	2000	1000	Fillet welds show same figure
	fillet	1200	1200	1200	1200	
Field weld	butt	1800	2000	1800	900	For all types of stress
	fillet	1100	1100	1100	1100	

Table X
ALLOWABLE STRESSES FOR REINFORCED CONCRETE

Material	Type of Stress	Allowable Stresses (kg/cm^2)
Concrete	Compression	Maximum of 140
	Diagonal tension and shear	Maximum of 14
Reinforcing steel	Tension	2400
	Bond	14

B. WARTIME HOUSING

1. Emergency Standards for Wartime Housing. Japanese Emergency Standards No. 346 are given on pages 276 to 280 of NavTechJap Document No. ND50-5334. These standards were also designed for the purpose of economizing on the use of restricted materials and were officially adopted in December 1943. These standards cover the construction of four types of housing units as follows: (a) one family units, (b) two family units, (c) block type units for up to six families, and (d) dormitories.

General stipulations regarding floor space for the various types of units are as follows:

(a) One family unit - Maximum of 80 square meters of floor space, minimum of 36 square meters.
(b) Two family unit - Minimum of 15 square meters of floor space for each family.
(c) Block type units - Minimum of 15 square meters, maximum of 23 square meters per family.
(d) Dormitories - Each person alloted 10 square meters of floor space.
(e) Amount of space allotted for sleeping space as compared as compared to total area of units

1. Block type unit 55%
2. Two family unit 52%
3. Single family unit - 50%

The following tables, translated from the same Document, give the standards for exterior finish, interior finish, utilities, and communal installations:

Table XI
STANDARDS FOR EXTERIOR FINISH

Foundations	Gravel and hewn stone, post driven into ground. Lined cesspool.
Walls	Solid wall of wood sheathing.
Roof	Japanese cottage style gable (slope 4.5/10) with non-inflammable roofing.

Table XII
STANDARDS FOR INTERIOR FINISH

Type of Room	Floors	Fenestration	Exterior Doors	Interior Doors
Living-sleeping	Tatami and thin matting	Glass Amado and paper Shoji	Amado of wood and glass and paper Shoji	Fusuma or paper Shoji
Genkan (vestibule)	Concrete slab	None	High panelling and glass	None
Kitchen	Concrete slab	Glass	High panelling and glass	None
W.C.	Wood	Shoji (single)	Wood	Wood
Closet	Wood	None	None	Fusuma
Storage	Concrete slab	None	Wood	None

Note: All walls of plaster, all ceilings of wood sheathing.

Table XIII
UTILITIES

Lighting	One drop cord for 25-30 square meters. Two drop cords for 40-50 square meters
Water	Sunken well or common hydrant for every 4 to 8 families.
Drainage	Waste water carried in wooden conduit to beyond housing area.
W.C.	Kumitori - Benjo - Type which is cleaned out nightly by soil-collector.

Table XIV
COMMUNAL INSTALLATIONS

Playgrounds	4 square meters per unit (allowance for total area)
Baths	4 square meters per unit (allowance for total area)
Commodity store	4 square meters per unit (allowance for total area)
Water for fire	40 cubic meters storage for an area of 80 meters radius

The following tables give the general standards for dormitory units.

Table XV
SPACE REQUIREMENTS FOR DORMITORIES
(Units in m^2)

	100 Persons	200 Persons	500 Persons	1000 Persons
Quarters - sleeping, corridors stairways, W.Cs and lavatories	6.2	6.0	5.8	5.6
Administration, dining halls, baths	2.8	2.5	2.2	1.9
Total allowance per person	9.0	8.5	8.0	7.5

Table XVI
ALLOWANCES FOR SANITARY FACILITIES - DORMITORIES

	50 Persons	100 Persons	150 Persons	200 Persons	250 Persons
No. of men's W.C.	5	8	10	12	13
No. of women's W.C.	7	10	12	14	15
Length of urinal	3 m	5 m	6 m	7 m	8 m
Length of sink	6 m	10 m	12 m	14 m	15 m

C. EXAMPLES OF WARTIME CONSTRUCTION

As a result of heavy bomb damage to certain critical industries, it became necessary to disperse and conceal them. Tunnels and caves provided the safest means of dispersal and were extensively used. Another means of dispersal was the use of earth-covered, camouflaged huts. Apparently the Japanese had not the necessary material to spare for the construction of a pre-fabricated hut similar to the American Quonset Hut, and as a result they

used two types of hut, designated W-1 and W-2. This construction required no prefabrication or use of highly critical materials. In addition, unskilled labor could be used to a great extent. Some of the best examples of these types of huts existed at OAMI which was one of the main dispersal centers of the Hitachi Aircraft Company of CHIBA. These huts were equipped as machine shops, offices, and quarters.

The W-1 type, as shown in Enclosure (J), was of wooden arch construction. The arch, approaching the catenary in shape, was formed by the lamination of seven layers of boarding, each approximately 15mm in thickness. By staggering the end joints and side joints of the boarding, maximum strength was obtained and the arch could be constructed progressively and without the use of shoring. Upon completion, vertical end walls were fitted to the arches and wooden ventilators installed on the top. The entire roof was then covered with earth to a minimum depth of 10cm and then the entire area was seeded. This type of hut varied in width from 8 to 10 meters and was 30 meters in length. The refinements which Americans would normally have installed were missing. The floor was of earth; concrete or wood was used only for foundations for machines or other equipment. Power and lighting were just sufficient to meet requirements. Heating and head facilities were non-existent. It was common practice in the construction of the W-1 hut to use the timber found near the building site. At OAMI there was an abundance of Sugi wood (similar to spruce), and this was used in the construction of the 31 huts of this type. Figure 51 shows an interior view of a W-1 hut which was set up as a machine shop for the manufacture of fuselage parts. Mr. IITSUKA, former commander of the construction battalion which performed all the construction at OAMI, stated that one of these huts could be built in two days by 16 men.

The W-2 hut, which is shown in Enclosure (K), measured 10 meters in width by 30 meters in length and was approximately the same shape as the W-1. The roof, however, was made up of transverse arches spaced 70cm on centers. Each arch was made up of 8 pieces of timber measuring 12x12cm fastened together at the ends by wooden gusset plates. This type of construction is illustrated in Figure 53. A roof covering of 3cm boarding was used to cover over the arches. The entire area was then covered with earth and seeded in the same manner as in the W-1 hut. This W-2 type became popular late in the war because it could be built entirely from salvaged lumber, which became more plentiful as the bombings increased. At OAMI, 13 W-2 type huts were constructed and seven more were under construction when the war ended. An exterior view of this type is shown in Figure 52. The uses for this hut were the same as for the W-1 hut.

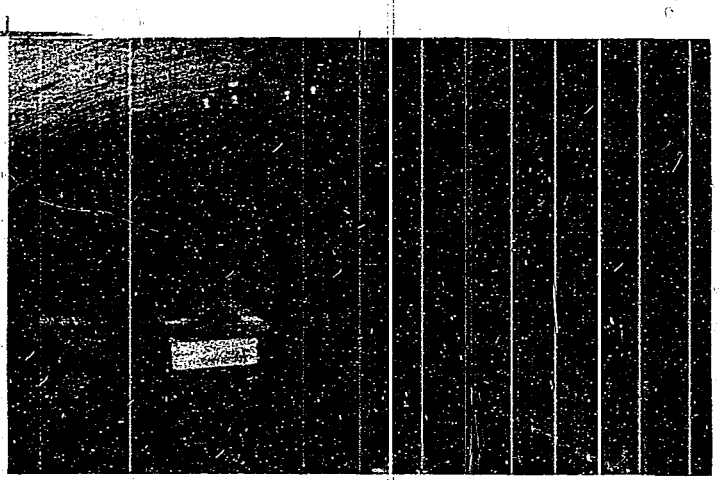


Figure 51
INTERIOR VIEW OF W-1 HUT

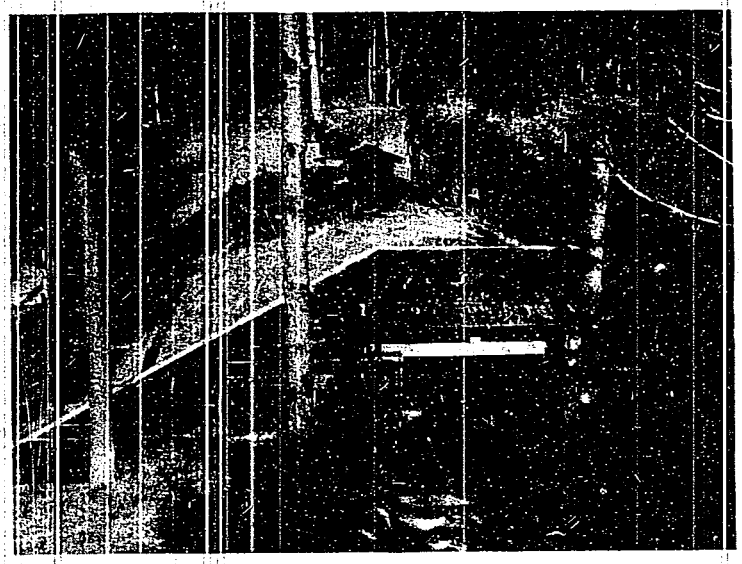


Figure 52
EXTERIOR VIEW OF W-1 HUT

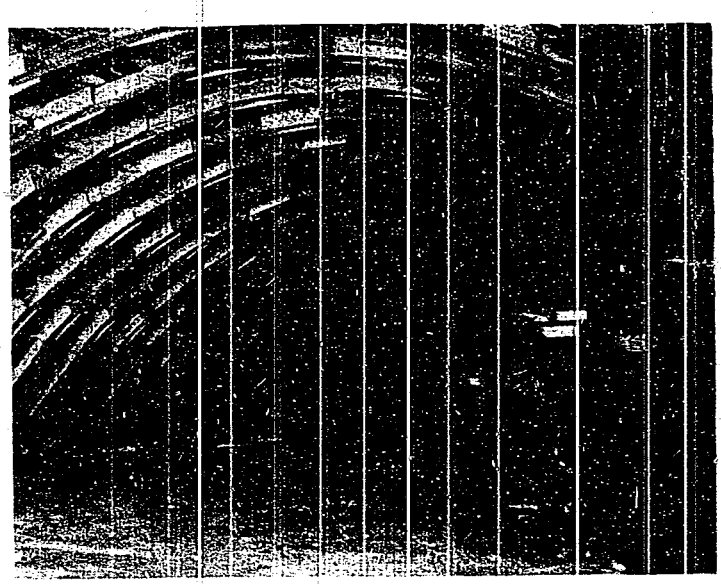


Figure 53
INTERIOR VIEW OF W-3 HUT

ENCLOSURE (A)

LIST OF DOCUMENTS FORWARDED VIA ATIS TO WDC

NavTechJap No.	ATIS No.	Title
ND50-5299	4123	Information on No. 7 Dry Dock, Sasebo Navy Yard (9 sheets)
5300	3850	Layout of Dry Docks at Kure Navy Yard
5301	3851	Specifications, Dry Dock No. 4, Kure Navy Yard
5302	3852	Chart of Dry Dock No. 4, Kure Navy Yard
5303	3853	Dock Manual, Kure Navy Yard Dry Docks
5304	3854	Water Intake and Exhaust Arrangements, No. 4 Dry Dock
5305	3855	General Chart of Water Mains, Kure Navy Yard
5306	3856	Chart of Magazine Flooding and Exhaust Arrangements, No. 4 Dry Dock
5307	3857	Chart of Electric Power System, Building Dock and No. 4 Dry Dock
5308	3858	Chart of Oil and Compressed Air Services for Shipbuilding Area
5309	3859	Details of Air-Raid Protection for Pump House, No. 4 Dock and Building Dock
5310	3860	Chart of Dockside Cranes, No. 4 Dock and Building Dock
5311	3861	Specifications, Shipbuilding Dock
5312	3862	General Plan, Shipbuilding Dock
5313	3863	Details of Fendering for Shipbuilding Dock
5314	3864	Plan of Oil and Compressed Air Services, Part 2
5315	3865	Dock Manual, Kure Navy Yard Dry Docks. (Extra copy not translated)
5316	3866	Organization of Departments at Sasebo Navy Yard
5317	3867	Summary of Work Accomplished During Last One Year of War, SASEBO
5318	3868	General Plan of Sasebo Navy Yard
5319	3869	Dock Manual, Sasebo Navy Yard Dry Docks
5320	3870	Details of Shipbuilding Slips, Sasebo Navy Yard
5322	3872	Plan of No. 1 Floating Dock, Kobe Shipbuilding Yards
5323	3873	Plan of No. 2 Floating Dock, Kobe Shipbuilding Yards

ENCLOSURE (A), continued

NavTechJap No.	ATIS No.	Title
ND50-5324	3874	General Layout and Equipment Plan, No. 3 Floating Dock, KOBE
5325	3875	Transverse Section, No. 3 Floating Dock, Kobe Shipbuilding Yards
5326	3876	General Arrangement, No. 4 Dry Dock, Kobe Shipbuilding Yards
5327	3677	General Plan of No. 1 Dry Dock, Nagasaki Shipyard
5328	3878	General Plan of No. 2 Dry Dock, Nagasaki Shipyard
5329	3879	General Plan of No. 3 Dry Dock, Nagasaki Shipyard
5330	3880	Chart of Compressed Air Supply System, Nagasaki Shipyard
5333	3883	Steel Erection Details for Skew Arch Hangar, Yokosuka Airfield (16 sheets)
5334	3884	Journal of the Japanese Institute of Architecture, Issue of 9 August 1944 (Sheet 2 of 2)

ENCLOSURE (B)

QUESTIONNAIRE AND REPLY CONCERNING NO. 5 AND 6 DRY DOCKS AT YOKOSUKA NAVY YARD

The following information is required in connection with the two large dry docks at YOKOSUKA. Answers are to be made to each question for each of the docks - answer (a) for Dock 5, answer (b) for Dock 6. Drawings are to be provided.

1. What are the exact dimensions of Dock 5, and what are the dimensions of the largest ship that can be accommodated?

2. What are the dimensions of Dock 6, and what are the dimensions of the largest ship that it can hold?

3. What types of main caisson are used? Give dimensions, weight, etc.

4. Is a spare caisson provided? If so, of what type is it?

5. What protection is fitted to the caissons against bomb and underwater attack?

6. Are the sides at the entrance to the docks battered or vertical?

7. Are grooves and stops provided for the caissons?

8. Give details of the blocks.

9. Give details of the dock altars.

10. Are lifts provided? If so, give particulars, power, dimensions, etc.

11. What fittings are provided for vessels in the dry docks?

12. What are the details of the fresh and salt water supply? What arrangements are made for the flooding of magazines of docked ships?

13. What are the details of the electricity supply?

14. What compressed air supply is available?

15. What steam supply is available?

16. What oil supply is available?

17. What method is used for the disposal of washing water and sewage?

18. What are the provisions against air attack for the pump house and penstocks?

19. Are single or multiple pump houses provided?

20. What are the particulars and specifications of the capstans?

21. What are the hauling capacities of the capstans?

22. What method is used for controlling the speeds of the capstans?

23. Can the capstans be stalled?

ENCLOSURE (B), continued

24. Give full details and specifications of the dockside cranes.

25. Describe the fendering arrangements for the passage of large ships through the dock entrances and into the dock.

INFORMATION IN CONNECTION WITH THE TWO LARGE DOCKS AT YOKOSUKA

QUESTION NO.	ANSWER FOR DOCK 5 (a)	ANSWER FOR DOCK 6 (b)
1. AND 2.	DIMENSION OF DOCK	DIMENSION OF DOCK

LENGTH OVER ALL	BREADTH MOULDED	BREADTH ENTRANCE UPPER	BREADTH ENTRANCE BOTTOM	DEPTH
M 325.0	M 49.9	M 37.75	M 34.85	M 15.45

LENGTH OVER ALL	BREADTH MOULDED	BREADTH ENTRANCE UPPER	BREADTH ENTRANCE BOTTOM	DEPTH
M 340.0	M 62.0	M 51.0	?	M 18.0

DIMENSION OF LARGEST SHIP

LENGTH OVER ALL	BREADTH MOULDED	DRAFT
M 295.0	M 32.0	M 9.0

DIMENSION OF LARGEST SHIP

LENGTH OVER ALL	BREADTH MOULDED	DRAFT
M 310.0	M 40.0	M 11.0

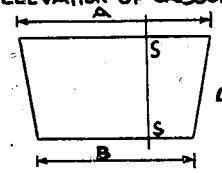
3.

TYPE OF CAISSON
SELF FLOATING TYPE

DIMENSION WEIGHT OF CAISSON

LENGTH UPPER (A)	LENGTH BOTTOM (B)	BREADTH MOULDED (C)	DEPTH (D)	DISPLT.	DRAFT (D)
125'-10"	117'-0"	15'-0"	49'-8"	?	29'-2"

ELEVATION OF CAISSON



SECTION OF SS

TYPE OF CAISSON
SELF FLOATING TYPE

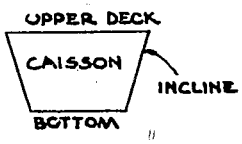
DIMENSION WEIGHT OF CAISSON

LENGTH UPPER (A)	LENGTH BOTTOM (B)	BREADTH MOULDED (C)	DEPTH	DISPLT.	DRAFT (D)
M 52.83	M 49.33	M 10.00	M 17.56	T 3300	M 10.16

4. NO — NO

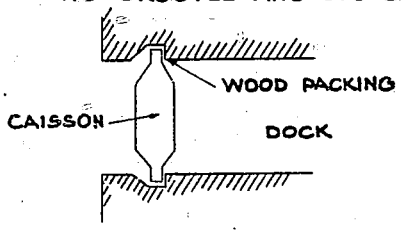
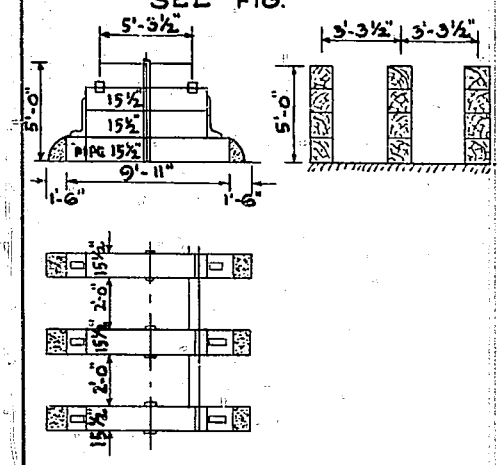
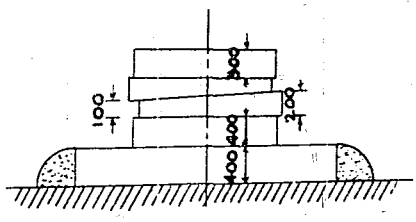
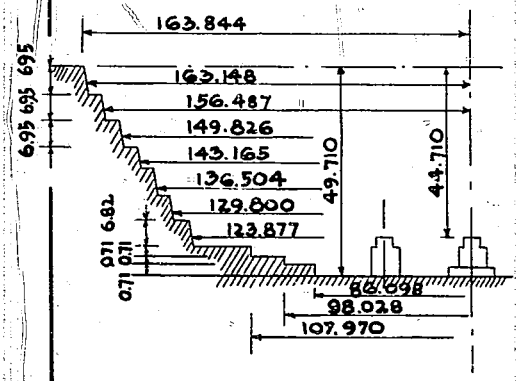
5. NONE — NONE

6. INCLINE SUCH AS FIGURE

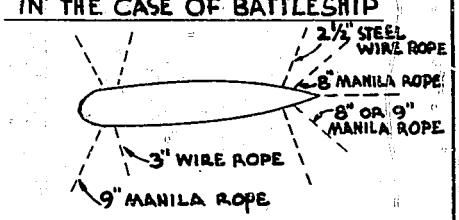
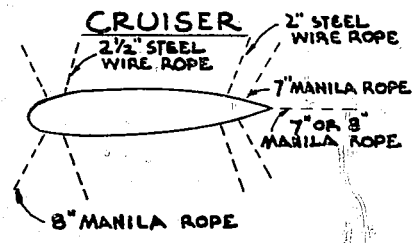
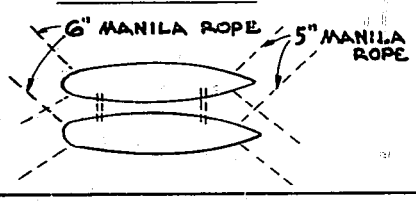
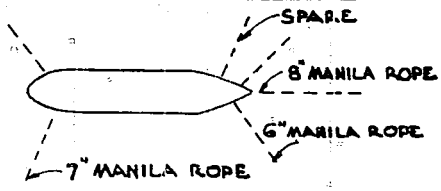
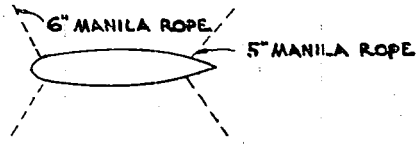
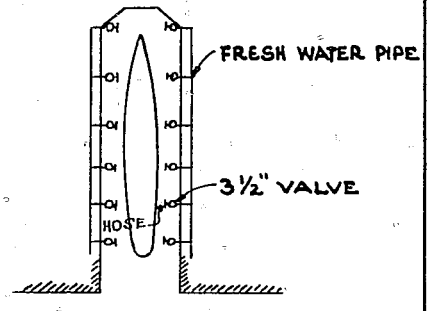
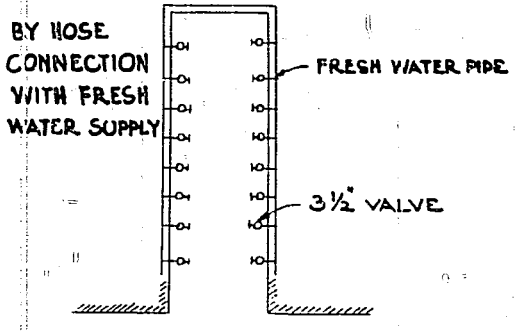


DO (SAME AS DOCK 5)

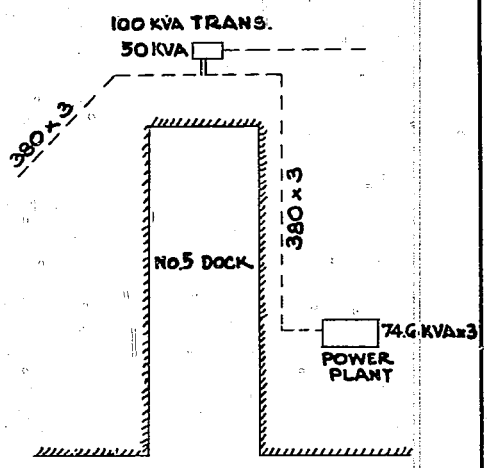
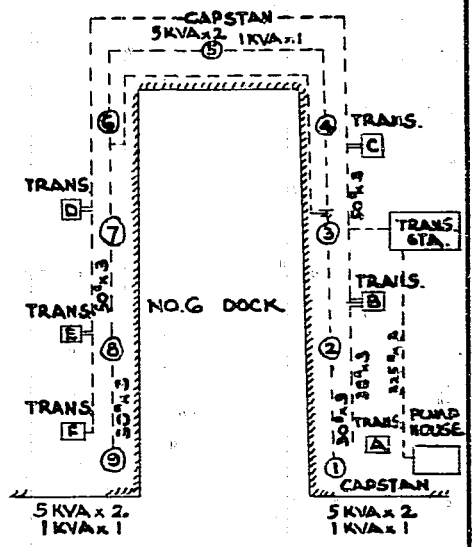
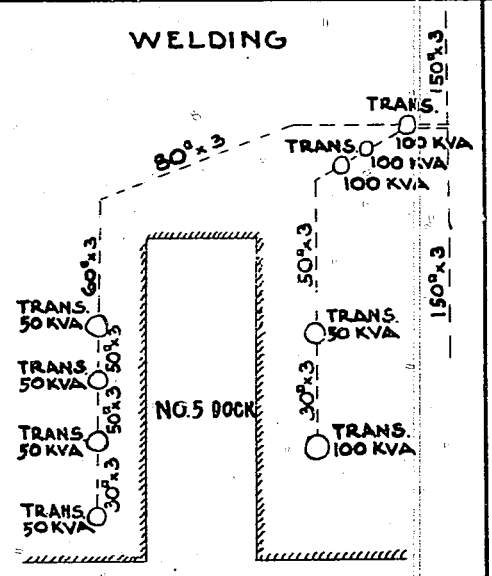
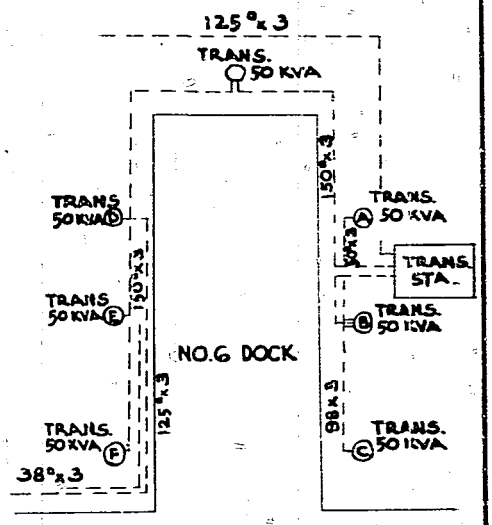
ENCLOSURE (B), continued

QUESTION NO.	(a)	(b)
7.	NO GROOVES AND STOPS 	DO. (SAME AS NO. 5 DOCK.)
8.	SEE FIG. 	
9.		NO DETAILS AVAILABLE

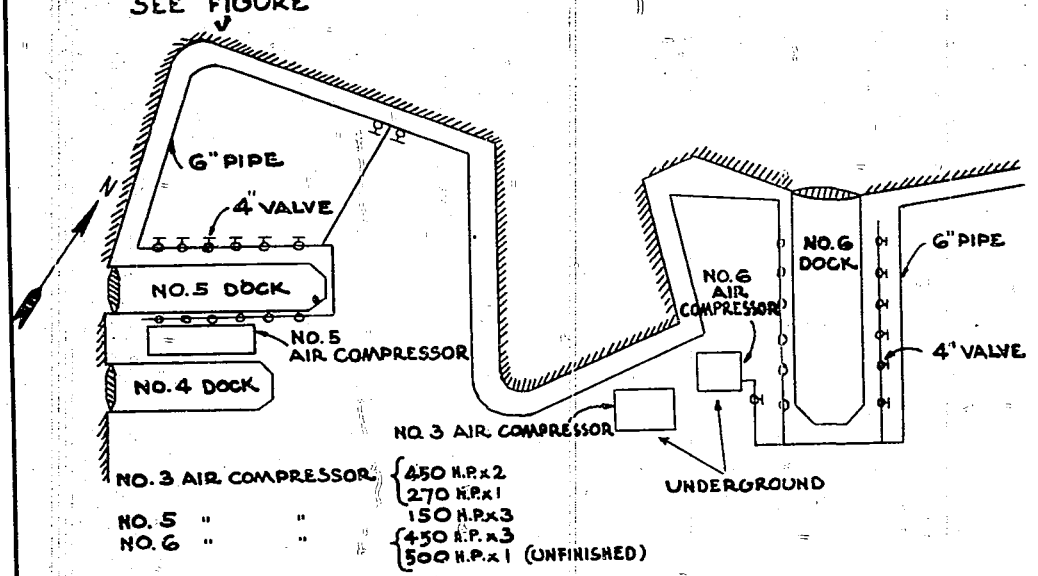
ENCLOSURE (B), continued

QUESTION NO.	(a)	(b)
10	NONE	NONE
11.	IN THE CASE OF BATTLESHIP  CRUISER  SUBMARINE  	SPECIAL SERVICE SHIP  DESTROYER 
12.	FRESH WATER SUPPLY NO SALT WATER SUPPLY  	DO. (SAME AS ON NO.5 DOCK.) 

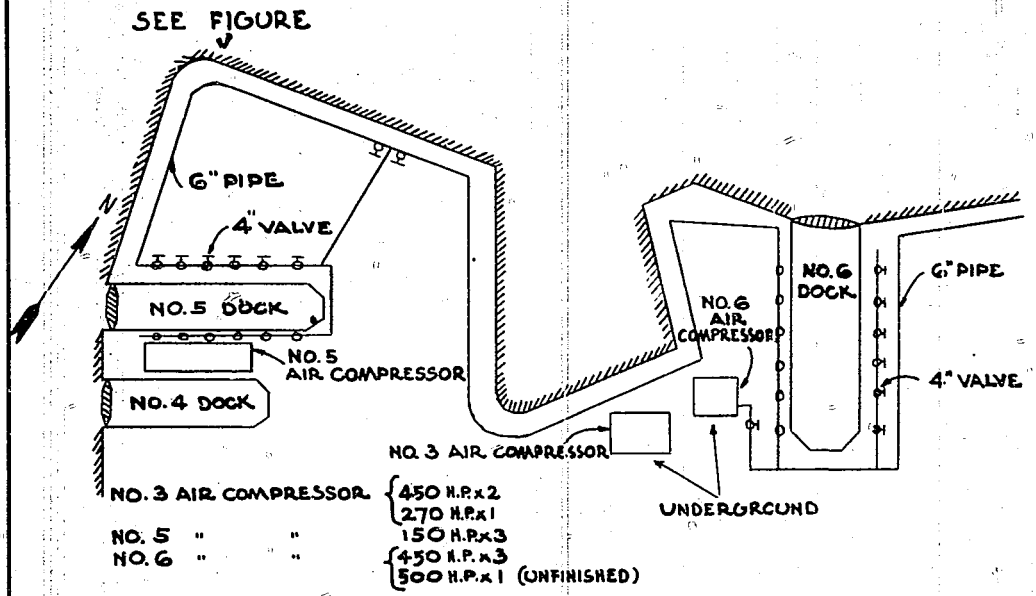
ENCLOSURE (B), continued

QUESTION NO.	(a)	(b)
13.	POWER  	
	WELDING  	

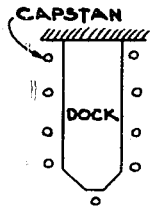
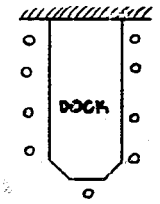
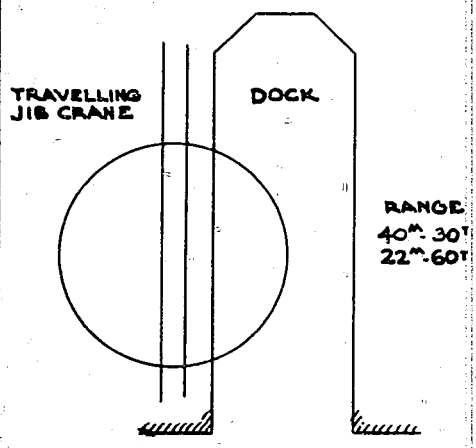
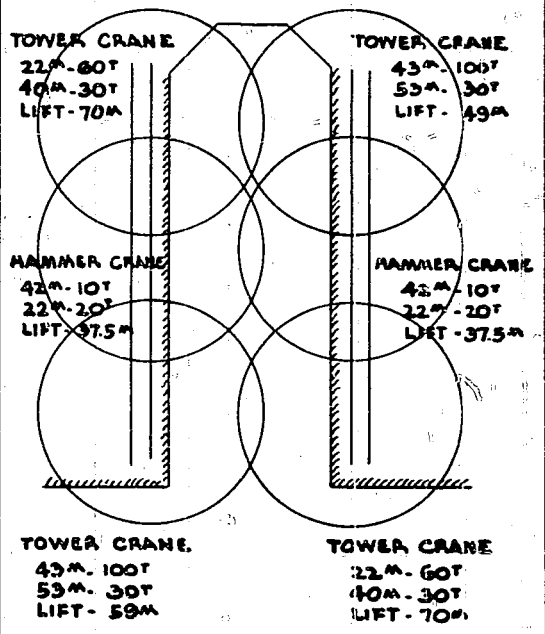
ENCLOSURE (B), continued

QUESTION NO.	(a)	(b)
14.	SEE FIGURE  NO.3 AIR COMPRESSOR { 450 H.P.×2, 270 H.P.×1, 150 H.P.×3 NO.5 " " { 450 H.P.×3, 500 H.P.×1 (UNFINISHED) NO.6 " "	
15.	NOT AVAILABLE	DO.
16.	NOT AVAILABLE	DO.
17.	50T DRAINAGE PUMP THAT IS IN THE DISCHARGE PUMP ROOM IS USED	NO. OF PUMPS : 4 PUMP DATA { DISCHARGE 12,000 M³/HR. LIFT 13m DIAM. 1.1m
18.	6 SHEETS OF 25 m/m STEEL PLATE ARE PLACED ON THE HEAD OF PUMP HOUSE AND ARE NOT PLACED FOR THE PENSTOCKS.	DO.

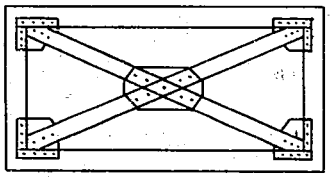
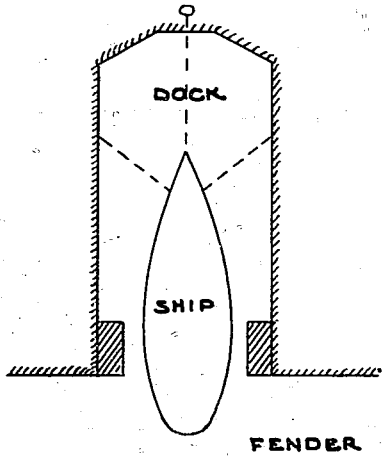
ENCLOSURE (B), continued

QUESTION NO.	(a)	(b)
14.	SEE FIGURE  NO. 3 AIR COMPRESSOR { 450 H.P.x2, 270 H.P.x1 NO. 5 " " 150 H.P.x3 NO. 6 " " { 450 H.P.x3, 500 H.P.x1 (UNFINISHED)	
15.	NOT AVAILABLE	DO.
16.	NOT AVAILABLE	DO.
17.	50T DRAINAGE PUMP THAT IS IN THE DISCHARGE PUMP ROOM IS USED	NO. OF PUMPS : 4 PUMP DATA { DISCHARGE 12,000 M³/HR. LIFT 13M DIAM. 1.1M
18.	6 SHEETS OF 25 m/m STEEL PLATE ARE PLACED ON THE HEAD OF PUMP HOUSE AND ARE NOT PLACED FOR THE PENSTOCKS.	DO.

ENCLOSURE (B), continued

QUESTION NO.	(a)	(b)
19.	PUMPHOUSE IS MULTIPLED FOR	SINGLE
20. AND 21.	9 CAPSTANS EACH 65 H.P. MOTOR 440V 87A 375 R.P.M. 	9 CAPSTANS EACH 150 H.P. MOTOR 3300 V 26A 580 R.P.M. 
22.	BY HANDLING THE ELECTRIC CONTROLLER.	DO.
23.	YES	DO.
24.		

ENCLOSURE (B), continued

QUESTION NO.	(a)	(b)
25.	FENDERS AS IN FIGURE ARE ARRANGED FOR THE PASSAGE OF LARGE SHIPS.  FURTHER DETAILS ARE NOT SURE. 	DO.

ENCLOSURE (C)

QUESTIONNAIRE AND REPLY ON NO. 1, NO. 2, AND NO. 3 DRY DOCKS AT NAGASAKI SHIPYARD AND IRON WORKS

Name of firm: Mitsubishi Jukogyo Kabushiki Kaisha
Address: Kojimachi-Ku 2-Chome, TOKYO
Name of plant: Nagasaki Shipyard and Engine Works
Location of plant: Akunoura-Machi, Nagasaki

1. Q. What type of main caisson is used?
   A. Vessel type.

2. Q. Is a spare caisson provided? If so, what type is it?
   A. No spare caisson.

3. Q. What protection is provided against bomb and underwater attack?
   A. No protection.

4. Q. Are the sides at the entrance battered or vertical?
   A. Battered.

5. Q. Give details of grooves and stops provided for the caisson.
   A. No grooves; caisson stops are as follows:

	No. 1 Dock	No. 2 Dock	No. 3 Dock
At bottom	1' 6"	1' 8"	1' 6"
At both sides	2' 0"	2' 0"	1' 6"

6. Q. Give details of blocks.
   A. Materials used are oak and pine.

	No. 1 Dock	No. 2 Dock	No. 3 Dock
Length of top	3' 6"	3' 0"	3' 6"
Length of bottom	6' 6"	8' 0"	8' 0"
Breadth of blocks	1' 0"	1' 8"	1' 6"
Interval of blocks	4' 0"	4' 2"	3' 0"
Height of blocks	5' 0"	4' 3"	4' 6"

7. Q. Give details of dock altars.
   A. Number of altars

   No. 1 Dock 5
   No. 2 Dock 7
   No. 3 Dock 7

   Note: For arrangement of dock altars refer to the attached dock plans. (Ed. note: See NavTechJap Documents No. ND50-5327, ND50-5328, and ND50-5329.)

8. Q. Are lifts provided?
   A. No.

9. Q. Give details of fresh and salt water supplies for ships in dock.
   A. No. 1 Dock right side ..... 3 fresh water pipes (dia. 2½")
   left side ..... 2 salt water pipes (dia. 2½")
   No. 2 Dock right side ..... 1 fresh water pipe (dia. 2½")
   left side ..... 3 fresh water pipes (dia. 2½")
   No. 3 Dock right side ..... 4 fresh water pipes (dia. 2½")
   left side ..... 2 fresh water pipes (dia. 2½")

ENCLOSURE (C), continued

10. Q. Give details for flooding magazines of ships in dock.
A. Flood the docks by caissons' valves.

No. 1 Dock caisson ..... 4 valves
No. 2 Dock caisson ..... 2 valves
No. 3 Dock caisson ..... 6 valves

11. Q. Give details of electric power available.
A.

Pump	Capacity (hp)	Voltage	Set	Speed (RPM)
No. 1 Dock				
Pump Main	260	3300 AC	2	233
Drain	66	220 DC	1	900
Air	15	220 AC	1	840
Caisson	25	220 AC	1	680
No. 2 Dock				
Pump Main	250	220 DC	1	180
Drain	60	220 DC	1	500
No. 3 Dock				
Pump Main	180	220 DC	3	195
Drain	147	220 DC	1	1100
Air	12	220 DC	1	807
Caisson	22	220 DC	1	640

12. Q. Give details of compressed air supply.
A. Refer to the attached plan of compressed air supply. (Ed. note: See NavTechJap Document No. ND50-5330.)

13. Q. Give details of steam and oil supply.
A. No steam and oil supply.

14. Q. Explain the method of disposing of washing water and sewage, also of recovery of sludge oil from water surface.
A. Pump out the bilge water in dock by the drain pump only.

15. Q. Give details of any protection against air attack fitted to pump house or penstocks and whether single or multiple pump houses are provided.
A. Single pump houses are provided.

	No. 1 Dock	No. 2 Dock	No. 3 Dock
Thickness of protection	56mm(steel plate) +300mm(concrete) +55mm(steel plate)	56mm(steel plate) +300mm(concrete) +55mm(steel plate)	56mm(steel plate) +300mm(concrete) +55mm(steel plate)
Area (of [illegible])	45 sq. meters	84 sq. meters	192 sq. meters

ENCLOSURE (C), continued

16. Q. Give particulars of capstans, including hauling capacity, controlling speeds, and state whether capstans can be stalled.
A. No. 1 Dockside capstan (3)

Motor
Type ..... 3 phase induction
Voltage 220
Amperes 80
Cycles 60
RPM 800
hp 30
Controlling speed ..... 18.4 meters/min. by actual test
Hauling capacity ..... 3.5 tons

No.2 Dockside capstan (3)

Motor
Type ..... 3 phase induction
Voltage 220
Amperes 54
Cycles 60
RPM 860
hp 30
Controlling speed ..... 16.8 meters/min. by actual test
Hauling capacity ..... 2 tons

No. 3 Dockside capstan (5)

Motor
Type ..... DC
Voltage 220
RPM 500
hp 20
Controlling speed ..... 35.2 meters/min. by actual test
Hauling capacity ..... 5 tons

17. Q. Give full particulars of dockside cranes.
A. No. 1 Dockside Crane (one electric travelling jib crane.)

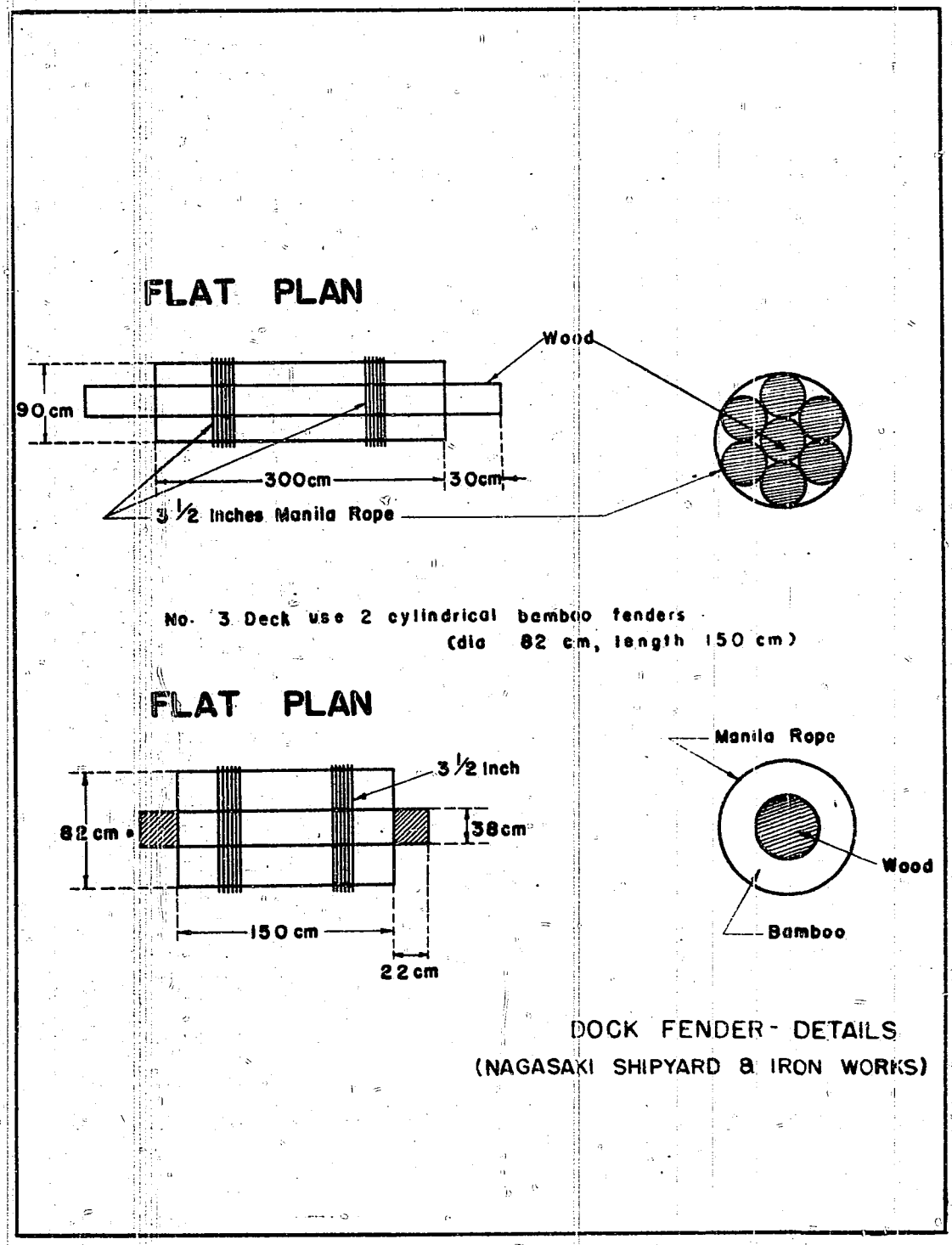
Lead ..... 3 tons at the radius of 29.8 meters
Max. lead ..... 5 tons at the radius of 22.8 meters
Source of electricity ..... 60~220v AC current
Speed for lifting ..... 15 meters/min.
Speed for travelling ..... 30 meters/min.

No. 3 Dockside Crane (one electric travelling jib crane)

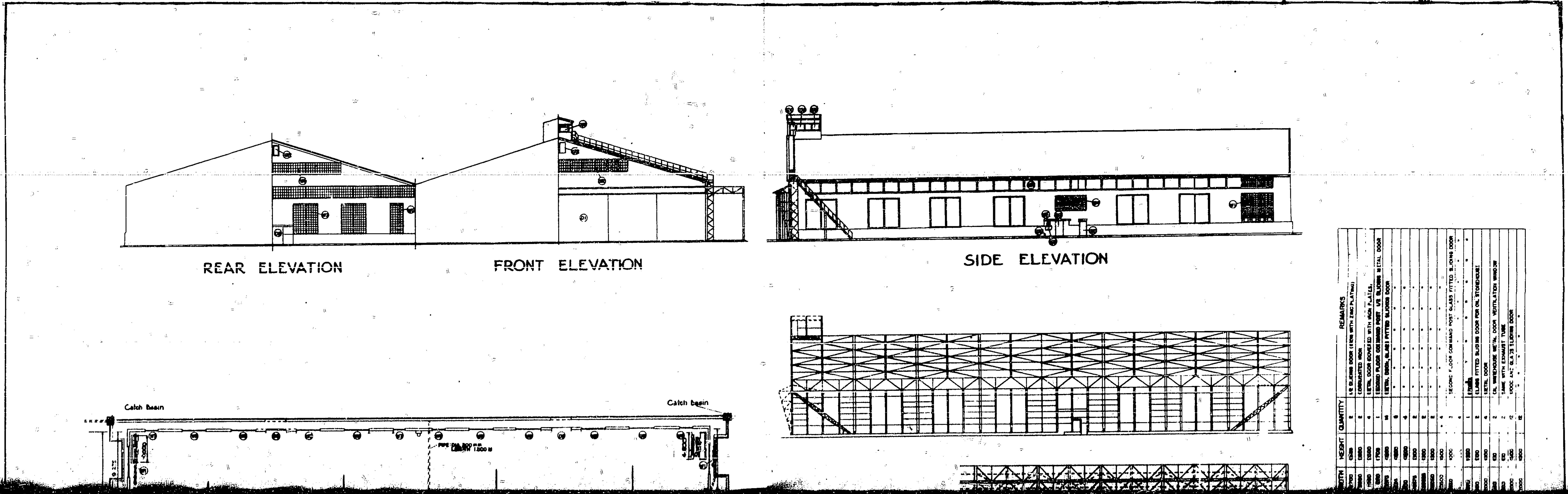
Lead ..... 3 tons at the radius of 29.8 meters
Max. lead ..... 5 tons at the radius of 22.8 meters
Source of electricity ..... 60 220v AC current
Speed for lifting ..... 15 meters/min.
Speed for travelling ..... 30 meters/min.

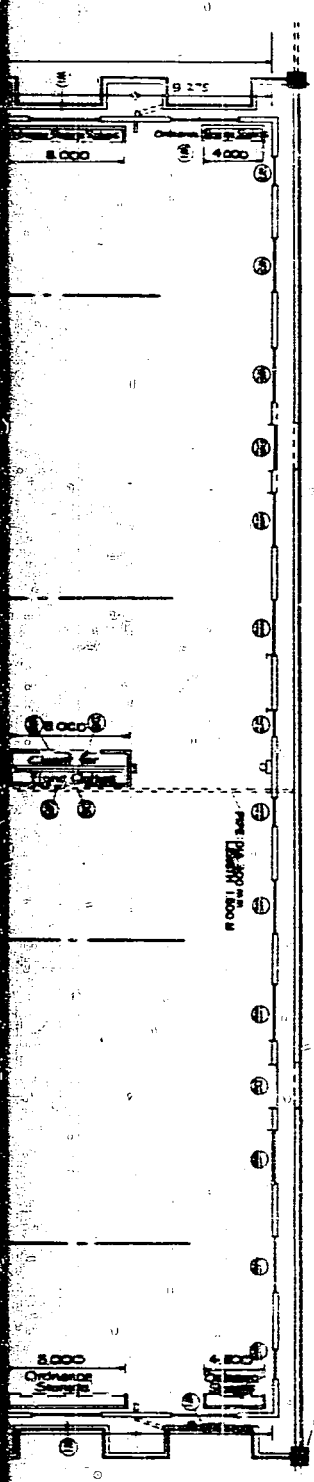
18. Q. Give details of fendering arrangement for the passage of large ships through dock entrances and into the dock.
A. No. 1 Dock uses 2 cylindrical bamboo fenders (dia. 90cm, length 300cm.) (See sketch for fender details.)

ENCLOSURE (C), continued

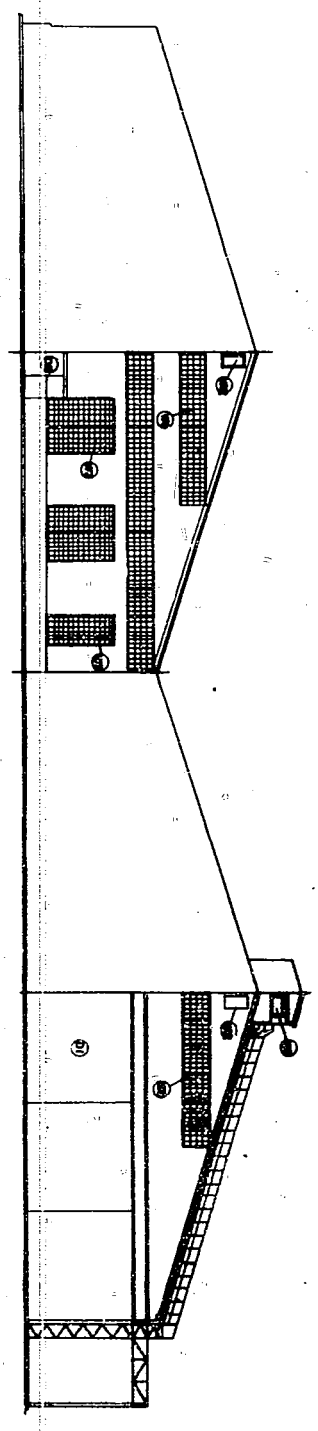


DOCK FENDER - DETAILS
(NAGASAKI SHIPYARD & IRON WORKS)

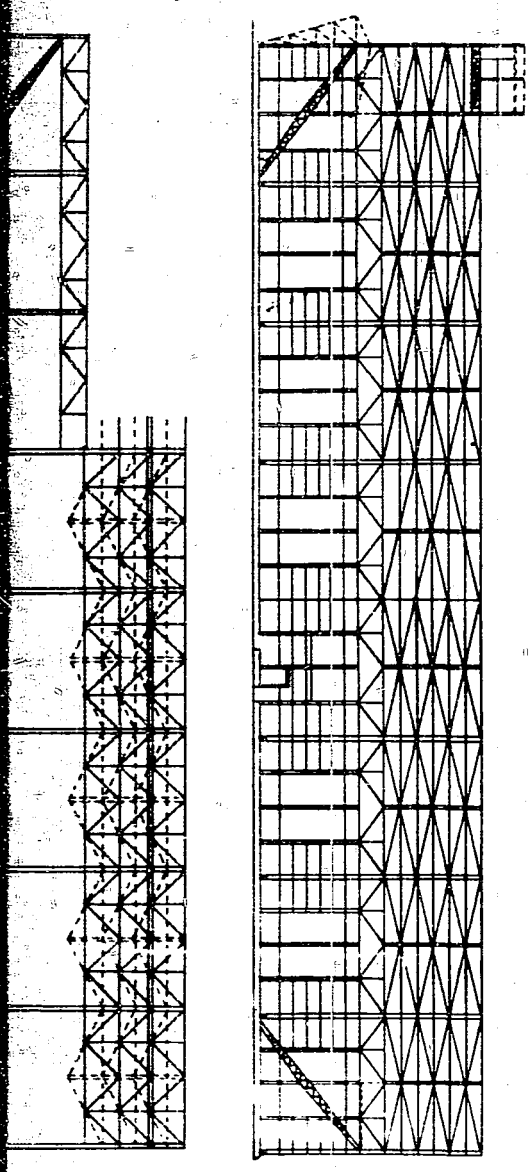

REAR ELEVATION
FRONT ELEVATION
SIDE ELEVATION
Catch Basin
Catch Basin
REMARKS
HEIGHT
QUANTITY



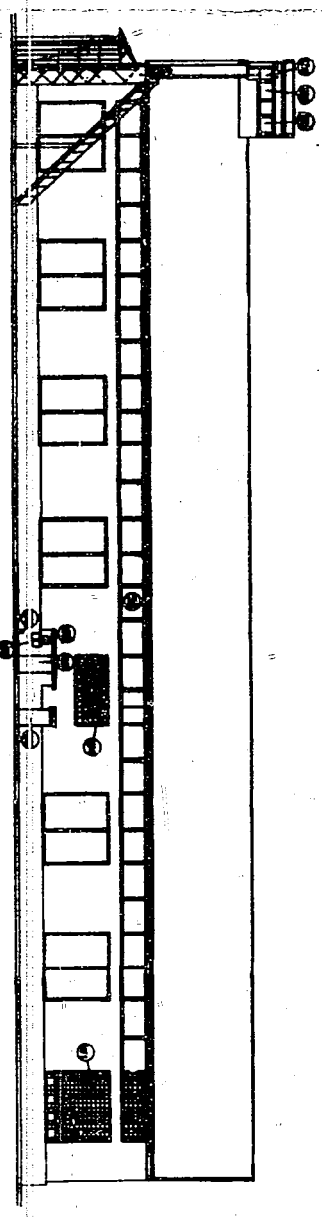
REAR ELEVATION



FRONT ELEVATION

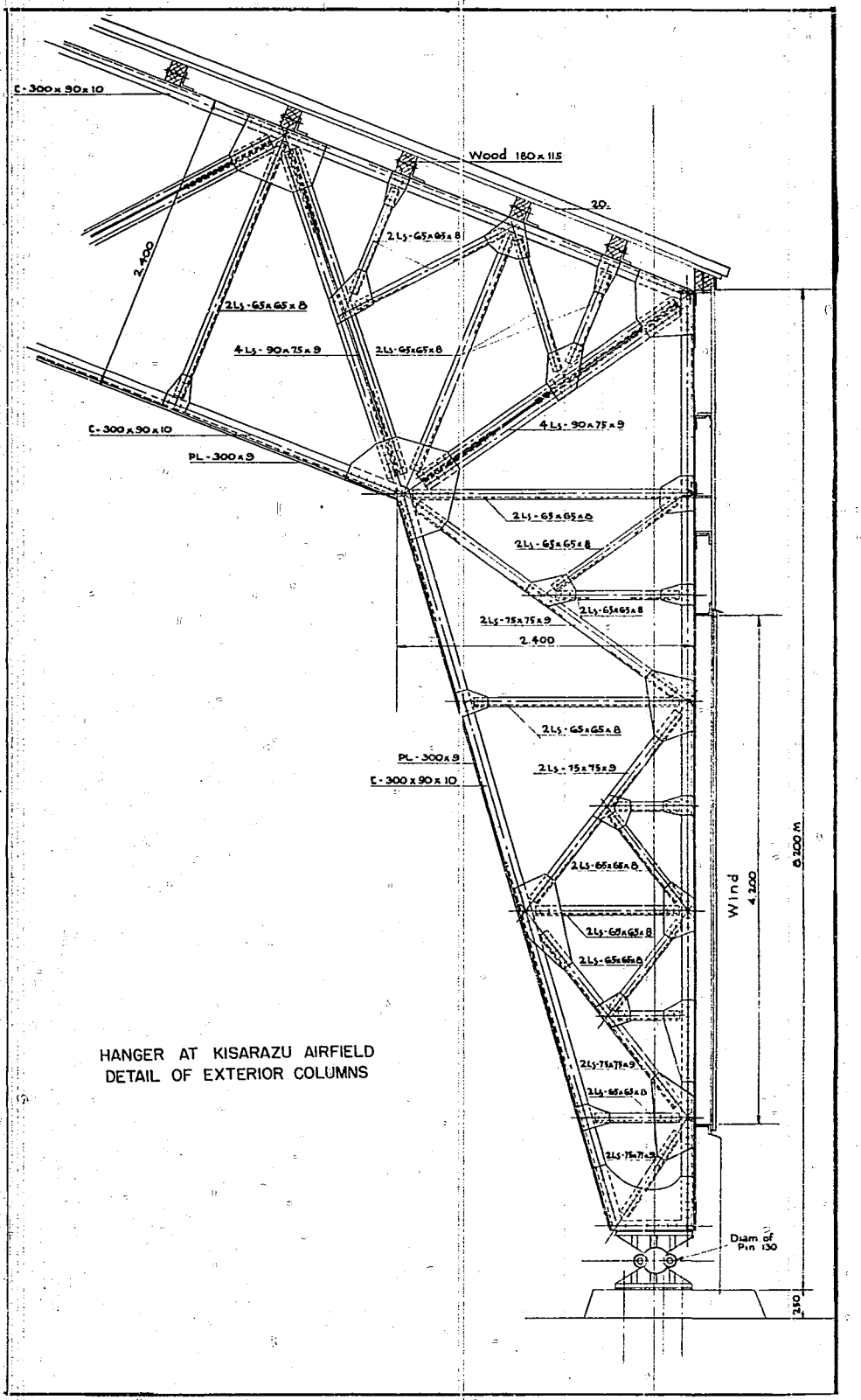


SIDE ELEVATION



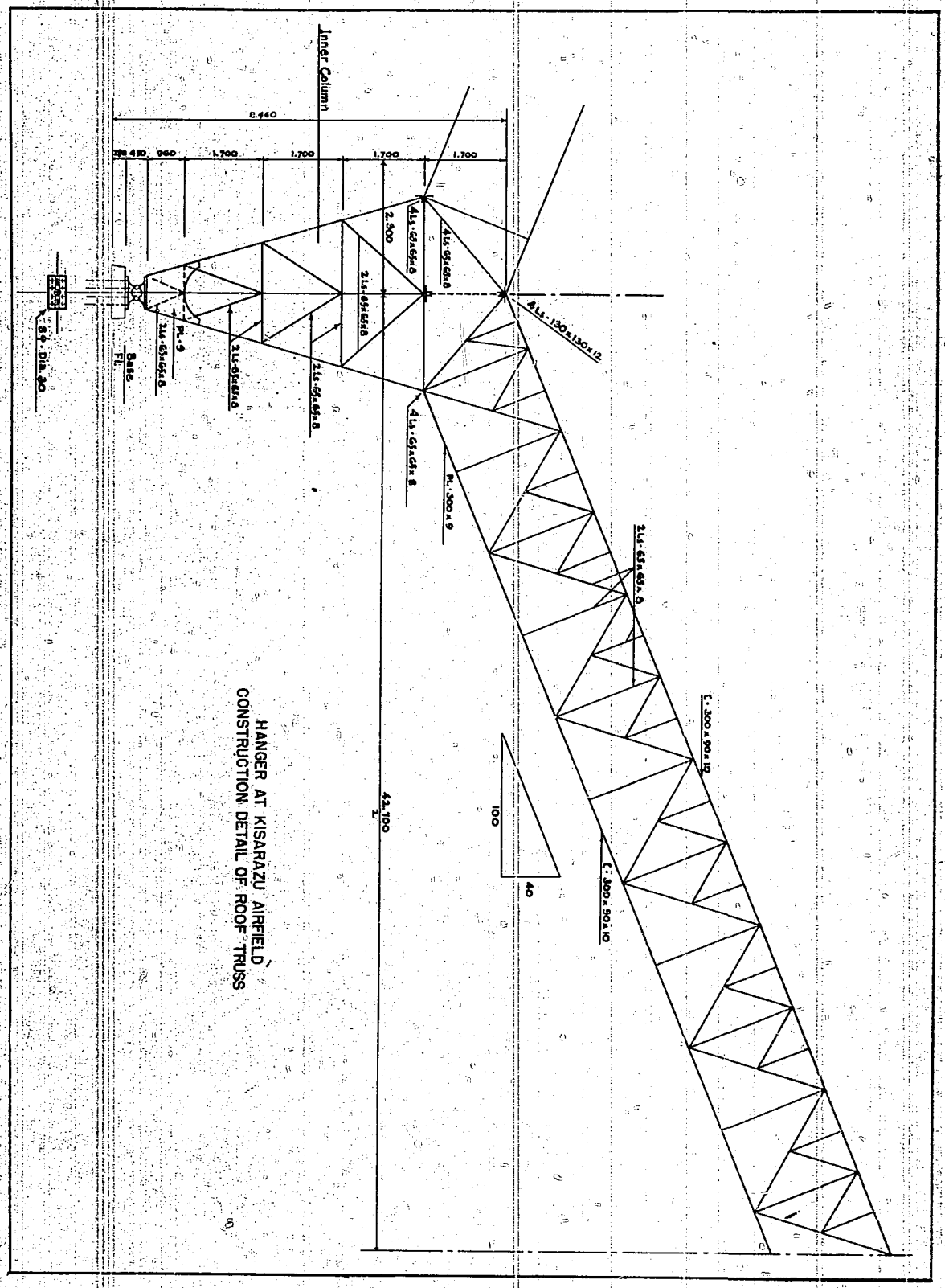
NAME	WIDTH	HEIGHT	QUANTITY	REMARKS
DOORWAYS	42700	6869	2	I/S SLIDING DOOR (IRON WITH ZINC PLATING)
"	3000	2850	2	CORRUGATED IRON
"	1000	2000	4	METAL DOOR (COVERED WITH IRON PLATES)
"	850	1700	1	BRICKED FLOOR REMAINED FOOT I/S SLIDING METAL DOOR
WINDOW	46875	4500	16	METAL SASH, GLASS FITTED SLIDING DOOR
"	8804	4850	8	" " " " " "
"	8850	4850	4	" " " " " "
"	46875	2500	2	" " " " " "
"	[illegible]	4500	2	" " " " " "
"	48000	4500	2	" " " " " "
"	22500	4500	4	" " " " " "
"	8250	1000	3	SECOND FLOOR COMMAND POST GLASS FITTED SLIDING DOOR
"	[illegible]	[illegible]	4	" " " " " "
"	4650	2250	1	STORE
"	500	900	2	GLASS FITTED SLIDING DOOR FOR OIL STOREHOUSE
"	2000	4500	4	METAL DOOR
VENTILATOR	300	450	2	OIL WAREHOUSE METAL DOOR VENTILATION WINDOW
EXHAUST TUBE	500	850	2	SAME WITH EXHAUST TUBE
DOORWAY	2000	4500	12	WOOD AND GLASS SLIDING DOOR
WINDOW	2000	4500	12	" " " " "

ENCLOSURE (E)



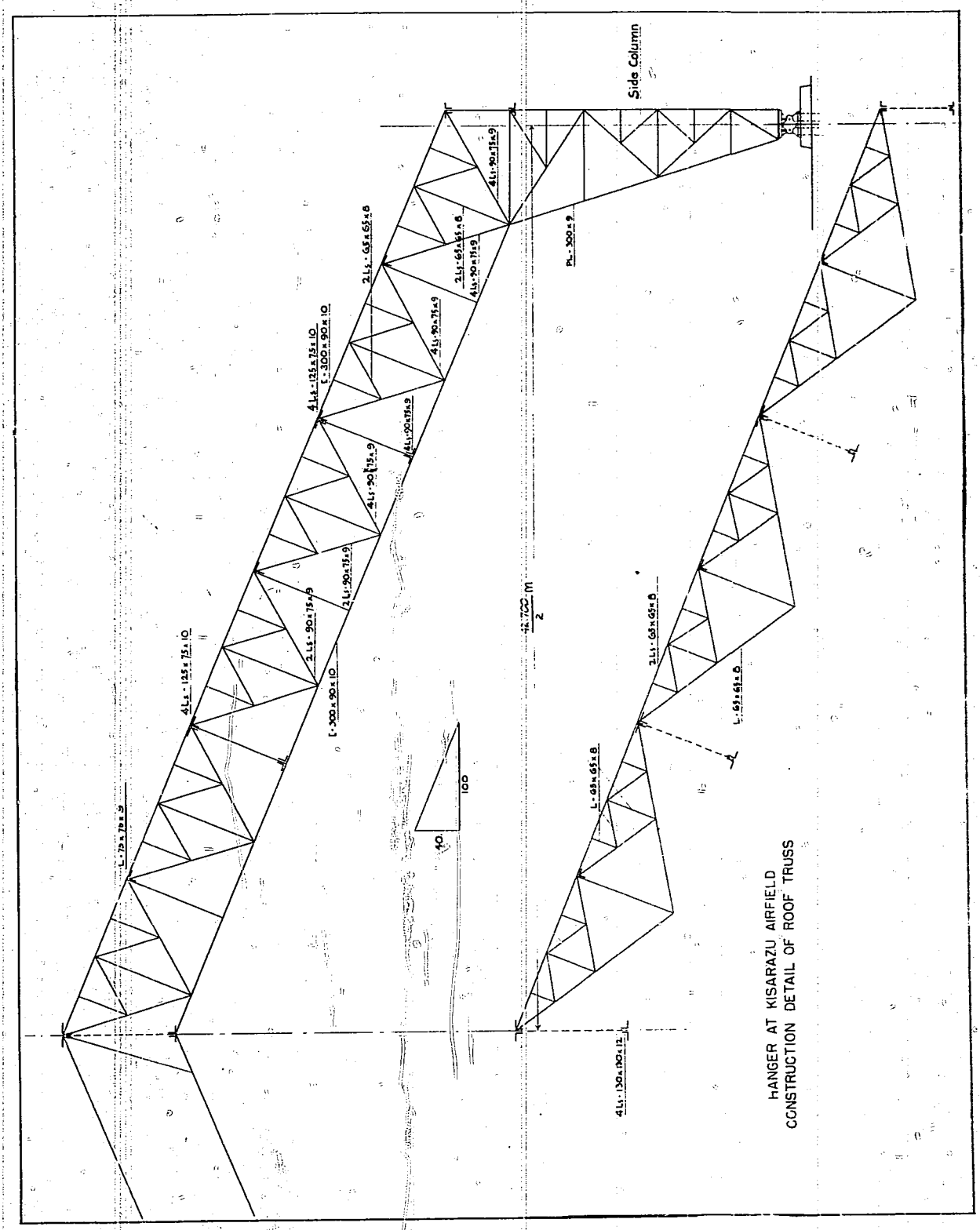
HANGER AT KISARAZU AIRFIELD
DETAIL OF EXTERIOR COLUMNS

ENCLOSURE (F)

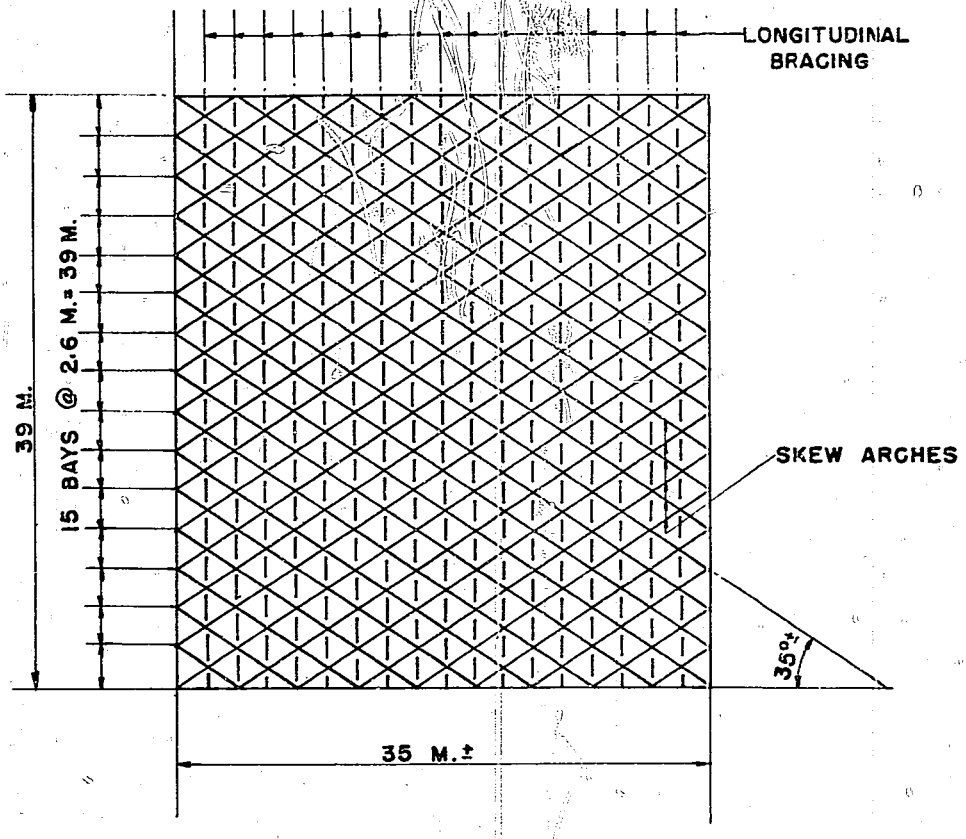


HANGER AT KISARAZU AIRFIELD
CONSTRUCTION DETAIL OF ROOF TRUSS

ENCLOSURE (G)

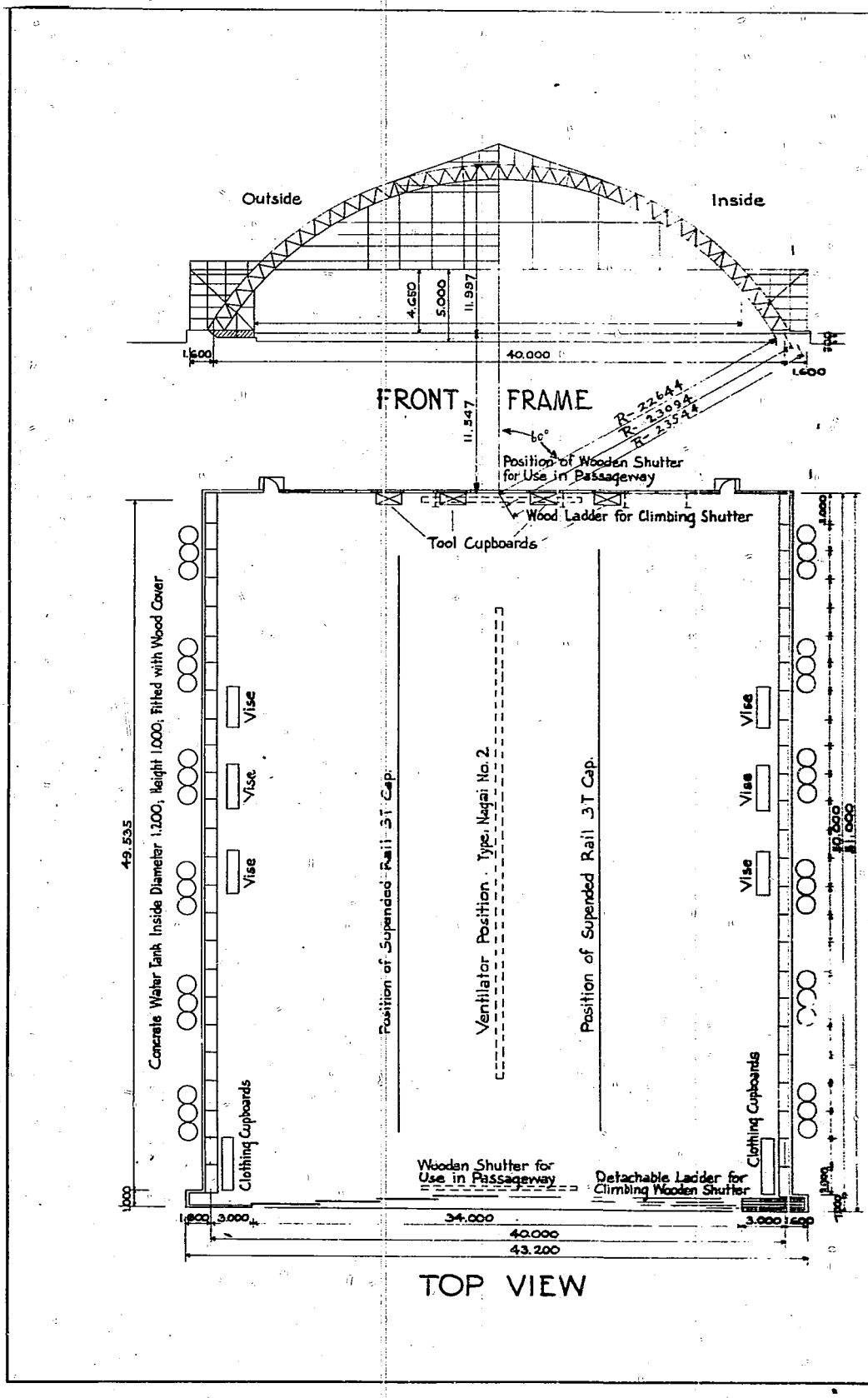

Side Column
HANGER AT KISARAZU AIRFIELD
CONSTRUCTION DETAIL OF ROOF TRUSS

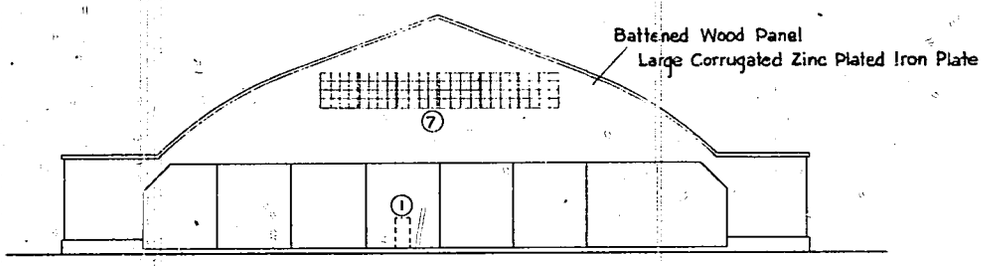
ENCLOSURE (H)



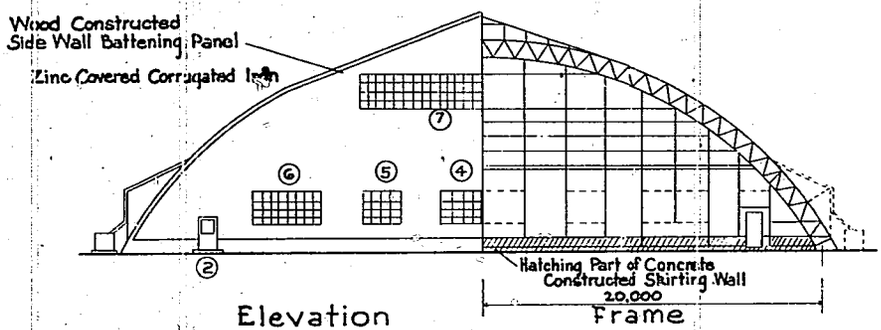
PLAN OF STEEL FRAMING

HANGAR AT YOKOSUKA AIRFIELD

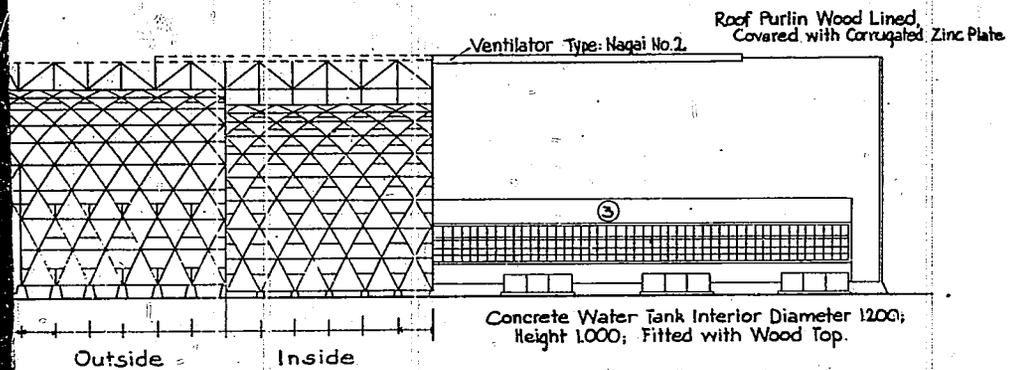

Outside
Inside
4.650
5.000
11.997
1.600
40.000
1.600
FRONT FRAME
11.547
R-22644
R-23094
R-23544
60°
Position of Wooden Shutter for Use in Passageway
Wood Ladder for Climbing Shutter
Tool Cupboards
Concrete Water Tank Inside Diameter 1.200, Height 1.000, Fitted with Wood Cover
49.535
Vise
Vise
Vise
Vise
Vise
Vise
Position of Supended Rail 3T Cap.
Ventilator Position . Type. Nagai No. 2
Position of Supended Rail 3T Cap.
Clothing Cupboards
Clothing Cupboards
Wooden Shutter for Use in Passageway
Detachable Ladder for Climbing Wooden Shutter
1.800
3.000
34.000
3.000
1.600
40.000
43.200
TOP VIEW



FRONT VIEW



REAR VIEW

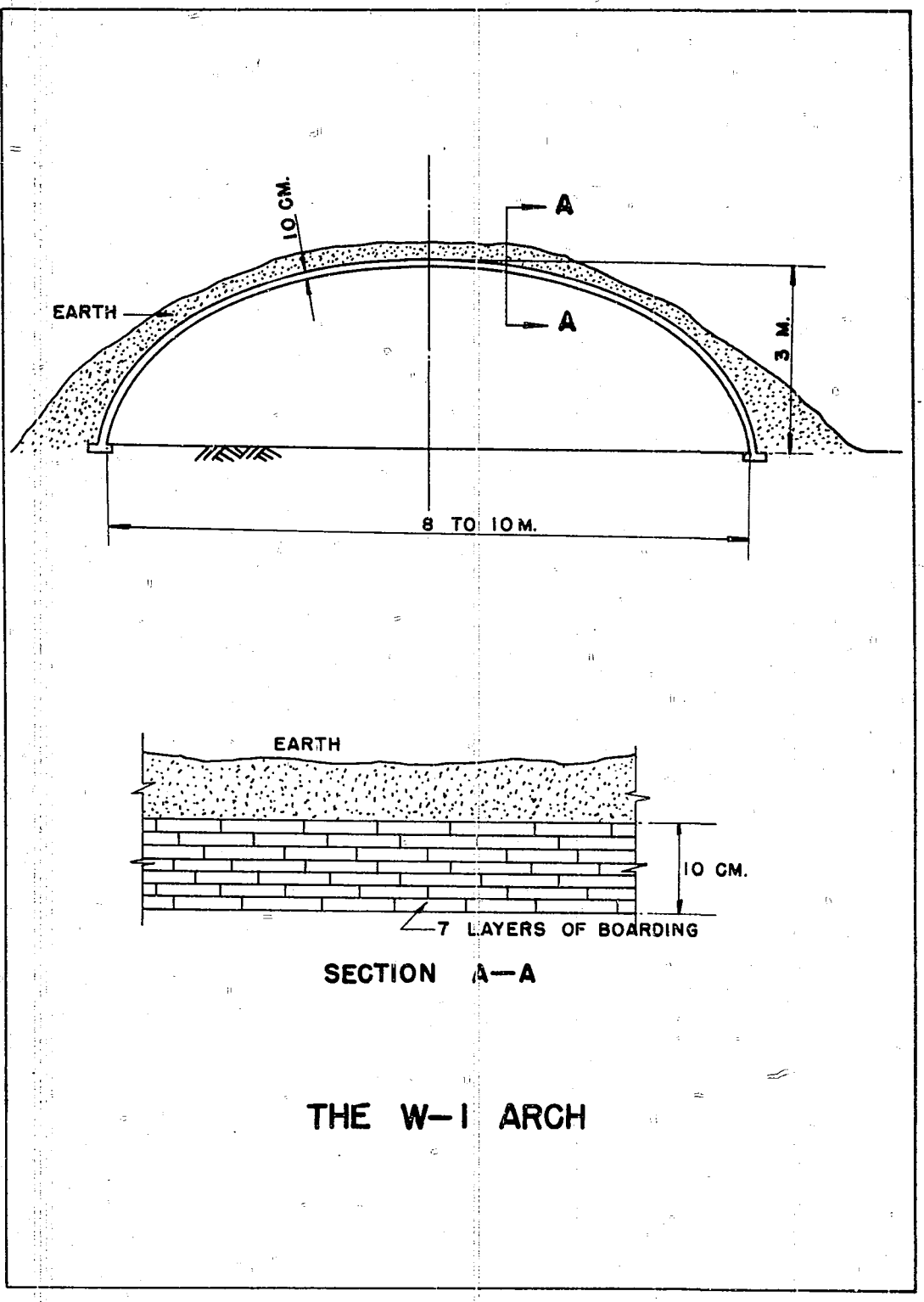


SIDE VIEW

NO	DIMENSIONS	QUAN.	CONSTRUCTION DATA
1	WIDTH: 34.000 HEIGHT: 5.000	1	8 PIECE LARGE DOOR IN STEEL FR. FITTED WITH WICKET DOOR COVERED WITH CORRUGATED IRON
2	WIDTH: 900 HEIGHT: 1.800	2	HALF OPEN WOOD DOOR AT BACK
3	WIDTH, POST INCLUDED: 46.000 HEIGHT, INSIDE MEASUREMENTS: 1.900	2	WOODEN SLIDING SIDE WINDOW REVOLVING TOP, 2 3 SECTIONS COMBINED
4	" " " 4.600 " " " 1.900	1	2 WOODEN SLIDING WINDOWS AT BACK
5	" " " 2.250 " " " 1.900	2	SAME AS ABOVE SINGLE WINDOW
6	" " " 4.100 " " " 1.900	2	SAME AS ABOVE 2 COMBINED
7	" " " 13.800 " " " 1.975	2	WOOD FIXED SKYLIGHT FRONT & BACK, 2 WINDOWS DOUBLE TYPE

DIAMOND TRUSS DESIGN

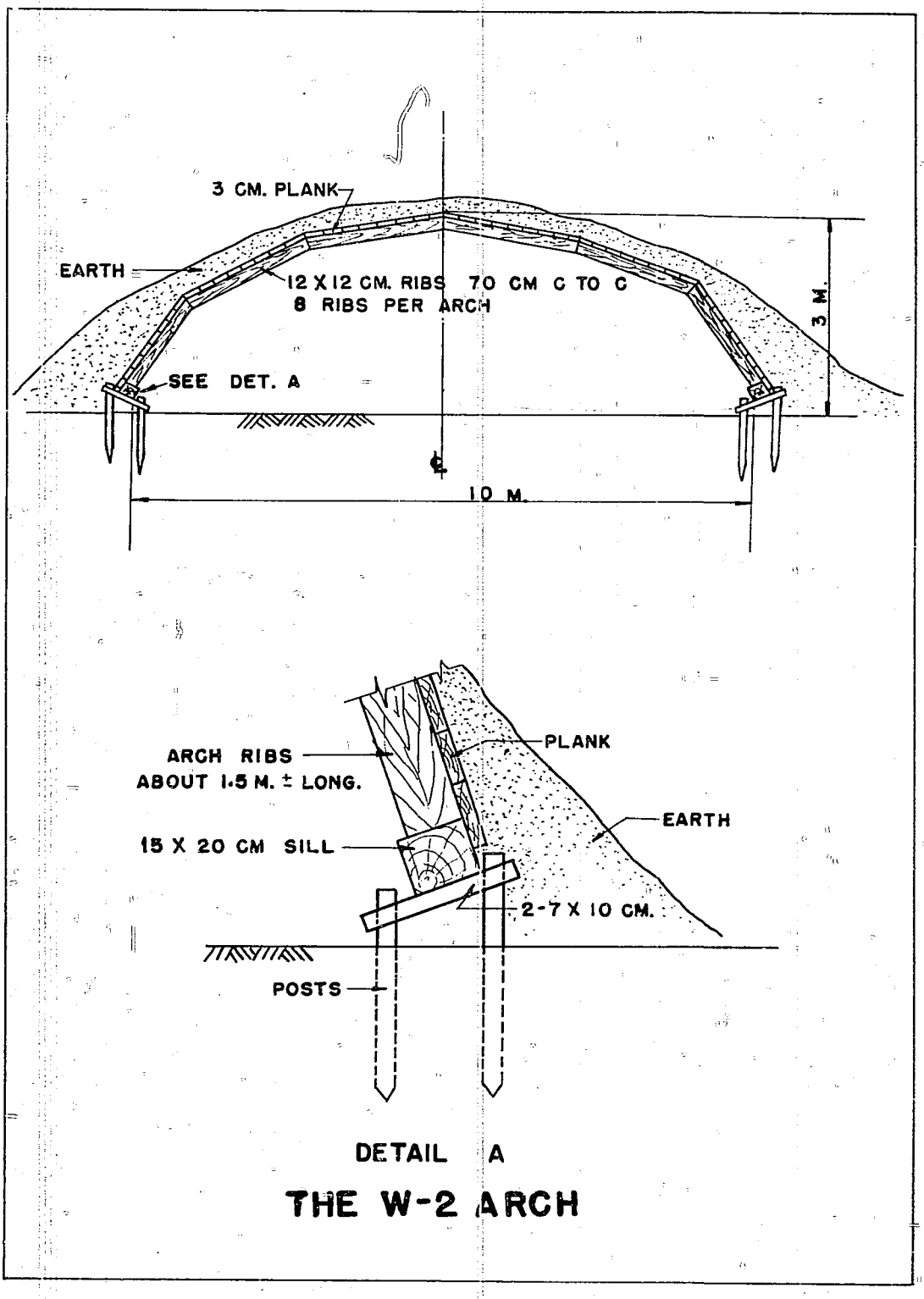
ENCLOSURE (J)



SECTION A—A

THE W—I ARCH

ENCLOSURE (K)



DETAIL A

THE W-2 ARCH