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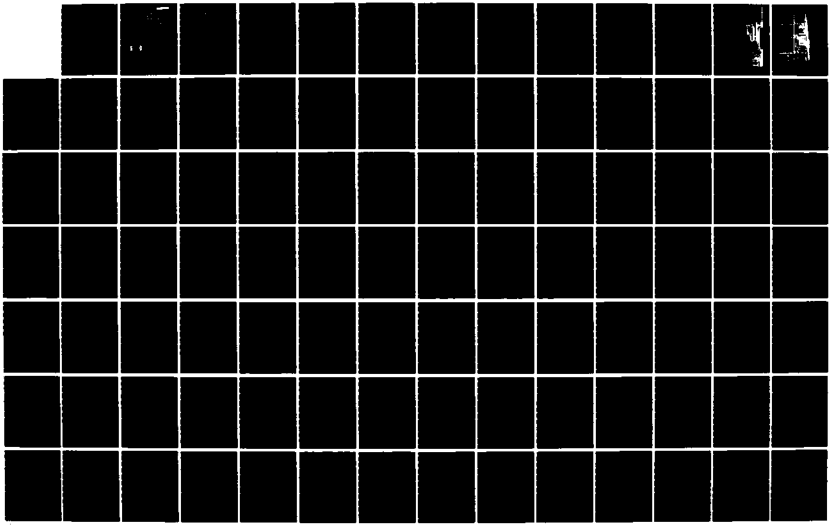

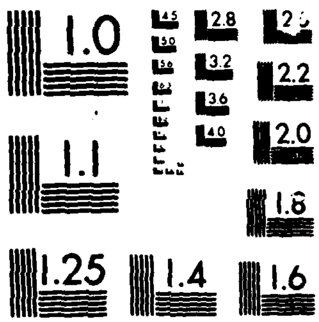

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PROJECT METEOR FEASIBILITY STUDIES ON THE CONVERSION OF THE SIR ROBERT TO AN OFFSHORE PLATFORM

FPO-1-77(17, VOL. II)
JUNE 1977

(Prepared for
Naval Research Laboratory Code 8322 B)

OCEAN ENGINEERING
AND CONSTRUCTION PROJECT OFFICE
CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON, D.C. 20374

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the conversion of the SIR ROBERT to a wheeled amphibious platform for use in a flat sand beach. Two of the concepts were feasible in terms of structural modifications. However, safe operation of the modified SIR ROBERT is strongly site dependent.

Included in the studies were the project planning, scheduling, and cost estimate. Both Navy Organizations and commercial contractors were contacted for their availability and estimated cost for participations. The estimated project cost ranged from $151,570 to $337,880 for fixed gravity platform and was $275,600 for wheeled amphibious platform. The variation of project cost for fixed gravity platform is mainly due to site foundation conditions.

Based on the available soil information supplied by the sponsor, studies on foundation stability, scour protection and wheel system trafficability were performed in conjunction with feasibility study. Favorable results were reported.

Construction weather window of July-October time from and vessel maintenance cost of $10,480 over the five year life time were also reported from studies in support of the project.

Due to the lack of sufficient environmental data available for the project, a recommendation that a thorough site survey be conducted prior to further engineering efforts was made at the conclusion of the feasibility studies.

Volume II

FEASIBILITY STUDIES ON THE CONVERSION OF THE SIR ROBERT TO AN OFFSHORE PLATFORM

June 1977

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Washington, D. C. 20374

ABSTRACT

Two feasibility studies were conducted to utilize the existing jack-up barge, SIR ROBERT, for use in Project METEOR. One of the studies was to install the SIR ROBERT as a fixed gravity platform offshore Thousand Springs Cove of the northwestern end of San Nicolas Island, California. The other study was the conversion of the SIR ROBERT to a wheeled amphibious platform for use in a flat sand beach. Two of the concepts were feasible in terms of structural modifications. However, safe operation of the modified SIR ROBERT is strongly site dependent.

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Due to the lack of sufficient environmental data available for the project, a recommendation that a thorough site survey be conducted prior to further engineering efforts was made at the conclusion of the feasibility studies.

TABLE OF CONTENTS

FIGURES

INTRODUCTION

1.0 Background

1.1 Project METEOR is the code name for experiments that determine the behavior of a laser beam through the marine atmosphere. San Nicolas Island, off the California coast, was chosen as a project site because the atmosphere on the island's northwest coast exhibits minimal terrestial effects. Part of the project involved the installation of a jack-up research barge, with meteorological instrumentation attached to gather data. Previously, such a barge, the SIR ROBERT, had been used successfully in the Chesapeake Bay (See Fig. 1). The SIR ROBERT was shipped to the West Coast for the continuation of Project METEOR (See Fig. 2). The plan called for the installation of SIR ROBERT offshore of the northwestern end of San Nicolas Island (See Fig. 3) to provide a platform where meteorological measurements could be made, free from surf and island atmospheric effects.

1.2 This volume II comprises the detailed engineering feasibility studies portion of a three volume report. Volume I of Report FPO-1-77(17) contains the executive summary of the work accomplished by CHESNAVFACENGCOM in support of Project METEOR. Volume III contains the results of the site survey performed in support of the engineering design efforts.

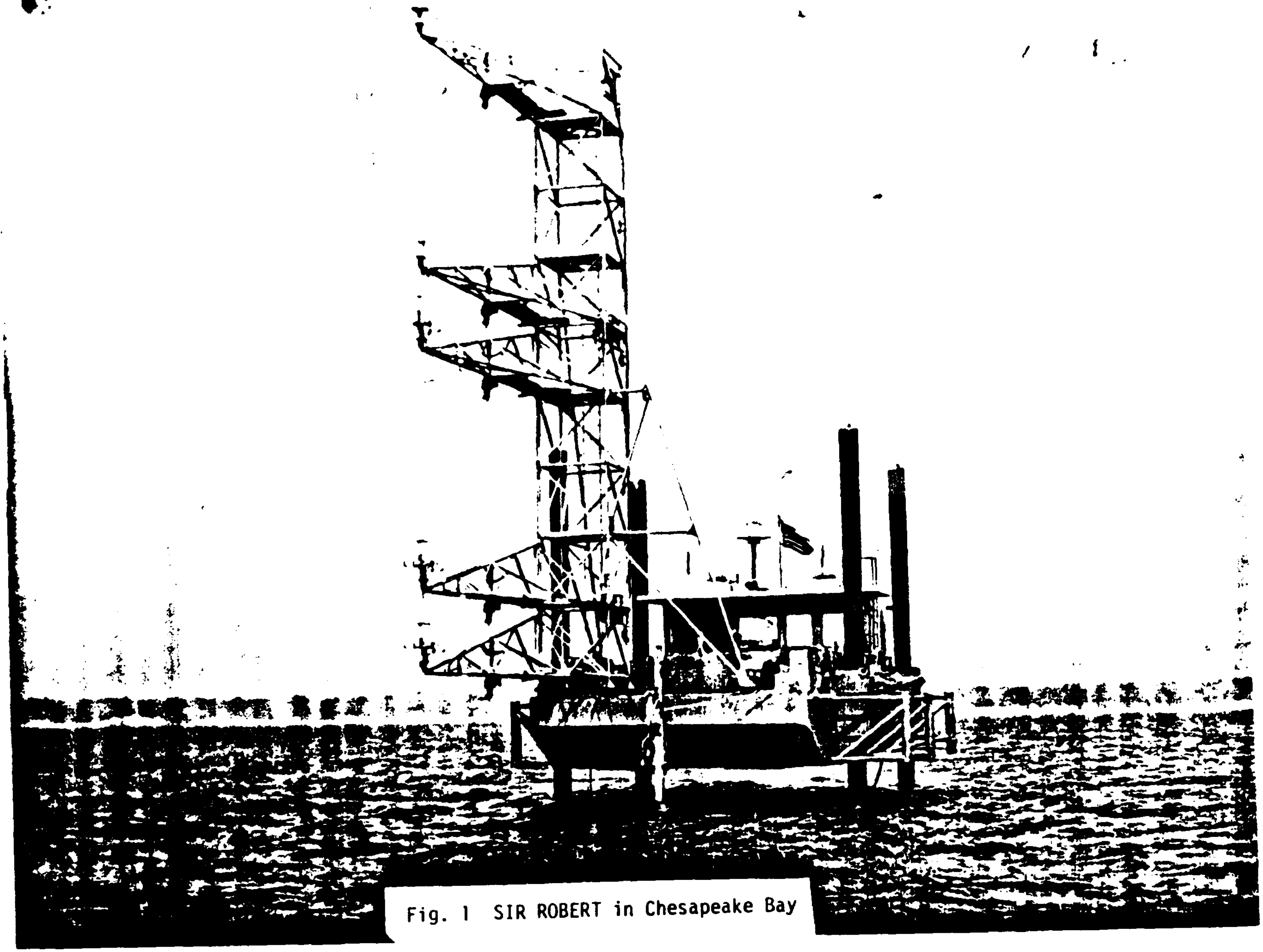

Fig. 1 SIR ROBERT in Chesapeake Bay

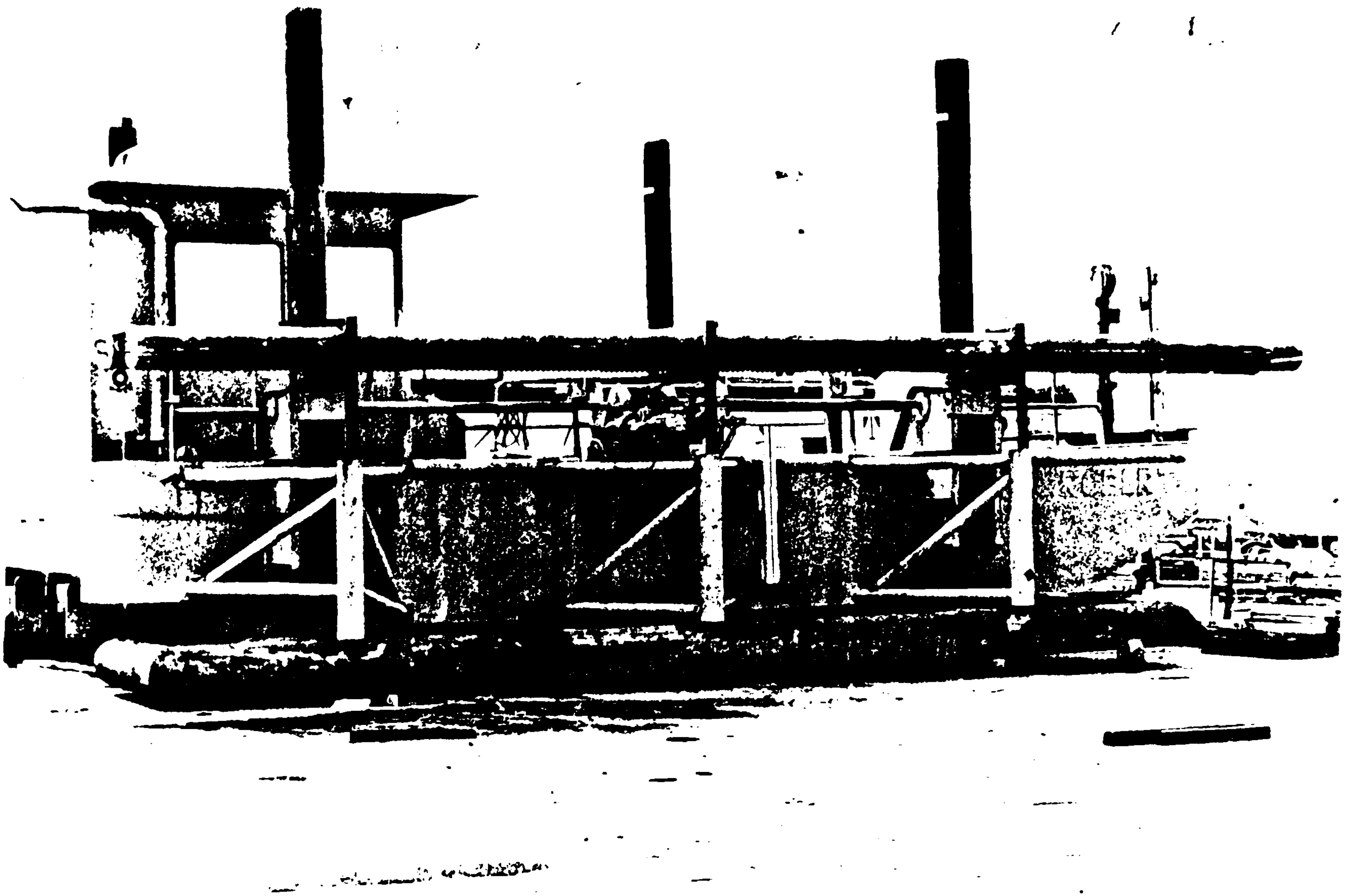

Fig. 2 SIR ROBERT in Port Hueneme, California

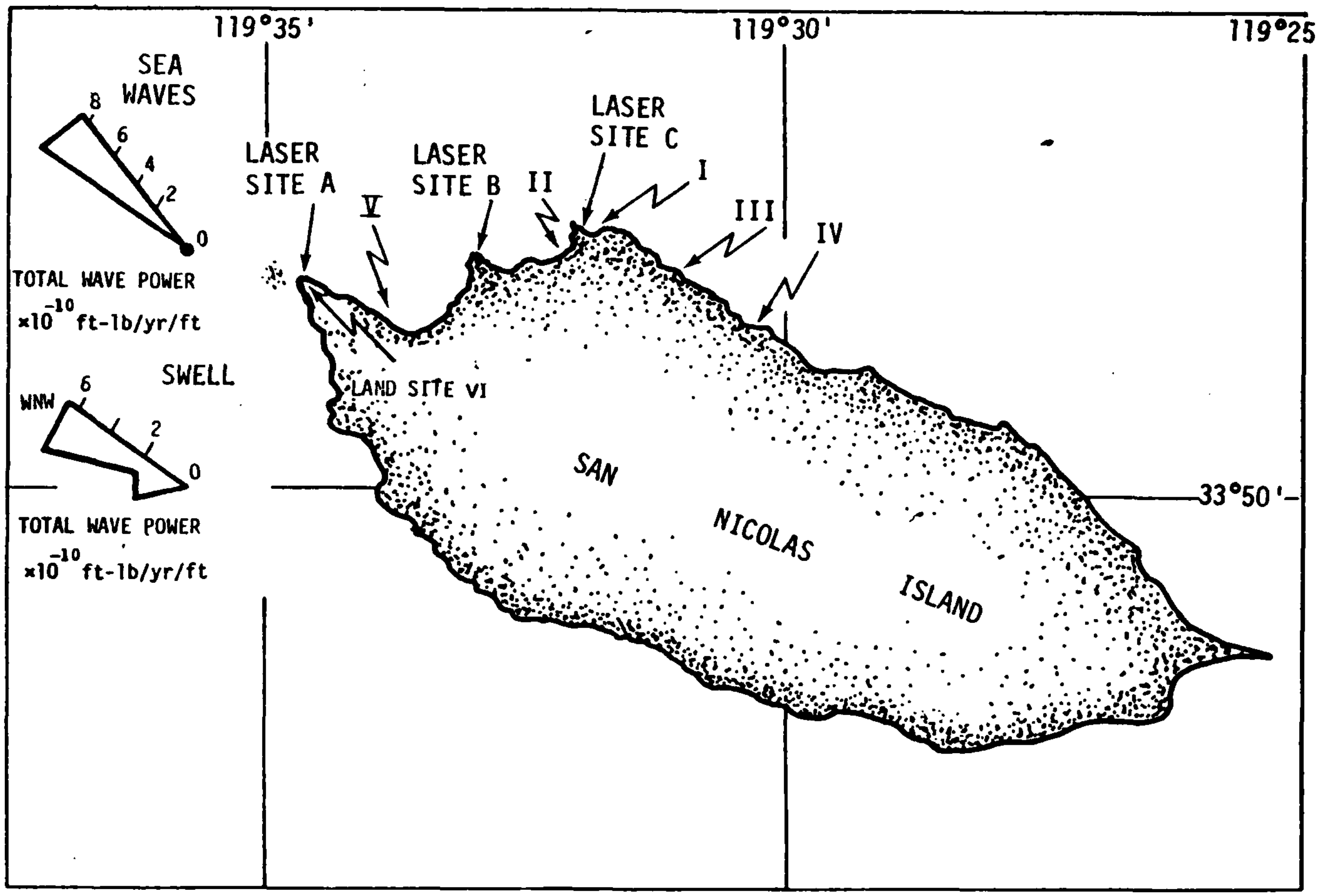

Fig. 3 Six Prospective Meteorological Tower Sites

2.0 Tasking

2.1 The studies reported in this volume were accomplished in response to Work Request N00173-77-WR-70136 from the Naval Research Laboratory (NRL), Code 8322B, requesting ocean engineering support for the use of SIR ROBERT in Project Meteor. The detailed Scope of Work from NRL is reproduced as an appendix in Part I of this volume.

3.0 Results of Studies

3.1 The detailed results of the individual studies are provided in Parts I to V of this volume and are summarized in the Volume I, executive summary. Parts I and II demonstrate the feasibility of modifying the SIR ROBERT into a fixed gravity or wheeled amphibious structure for assumed environmental conditions based on information available prior to the site survey. Neither concept was taken to final design as the site survey described in Volume III of this report determined the offshore environment off San Nicolas Island to be too hostile for the SIR ROBERT.

3.2 A third concept wherein SIR ROBERT would be jacked-up during meteorological measurements and would be moved under its own power to a sheltered cove or the lee side of San Nicolas Island for protective mooring was discussed within CHESNAVFAC-ENGCOM prior to site survey. However, the San Nicolas Island was surveyed for potential sites for the SIR ROBERT to operate in the jack-up/sheltered-moor mode. The conclusion of the site survey in Volume III was that the island presents an inhospitable environment for this type of operation.

3.3 Part III provides the backup foundation analysis in support of the fixed gravity structure and also the trafficability analysis associated with determining wheel loadings and number of wheels for the amphibious structure. It was shown that for the assumed sand conditions the seafloor would support the gravity structure. With the selection of the proper size and number of wheels, weight of the amphibious structure could be distributed safely for the assumed sand conditions. Scourability of the seafloor and the need for protective cover for scour prevention is discussed. The net result is that the builtup scour protection section under the gravity structure could cause premature wave breaking. The breakers would dissipate more spray into the air which could be disruptive of the planned meteorological measurements. The diver survey and visual observations of the surf detailed in Volume III confirmed the high nonsuitability of the seafloor off San Nicolas Island for SIR ROBERT as a fixed gravity structure. Furthermore, the site survey indicated poor trafficability conditions which also made the amphibious SIR ROBERT concept untenable.

3.4 Part IV indicates the weight of the existing SIR ROBERT to be 120,000 lbs to 128,400 lbs depending upon the significance of the waterline. The 120,000 lbs weight was calculated by assuming that the waterline was formed when the supporting mat was raised up to the bottom of the barge hull. On the other hand, the 128,400 lbs weight was calculated by assuming that the barge was floating free of the mat, i.e., the supporting mat was resting on the sea-floor by itself and the hydraulic jacking system was also set free so that the barge hull would be able to adjust to the water level. The waterline can be seen on the picture attached to Part IV of this volume. Since it was not known under which condition the waterline was formed, both weights were provided.

3.5 An estimate for corrosion protection and maintenance is also developed in Part IV. The cost of refurbishment for corrosion protection is estimated at $10,480. Protection for life expectancy of this refurbishment is six years with inspection at three years.

3.6 Part V provides the results of an investigation of available meteorological information to arrive at a construction window and indications of expected sea and wind conditions. The most favorable weather conditions occur between July and October.

4.0 Conclusions

4.1 The two concepts, modification of SIR ROBERT to either a fixed gravity platform or a wheeled amphibious platform, appeared structurally feasible. However, both were very much site dependent and could not be pursued beyond the feasibility study efforts without a detailed site survey. The detailed site survey as described in Volume III of this report resulted in the determination that the San Nicolas Island offshore area is too hostile for the SIR ROBERT. Further design efforts on these two concepts were therefore curtailed.

4.2 The environment of San Nicolas Island also proved inhospitable for a third concept of jacking up SIR ROBERT for meteorological measurements in low operating seas and mooring it in sheltered areas during non-operational periods.

PART I

A FEASIBILITY STUDY

CONVERSION OF SIR ROBERT TO A

PERMANENT GRAVITY PLATFORM

MARCH 1977

By C. Chern

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ABSTRACT

An effort has been made to study the feasibility of converting the jackup barge, SIR ROBERT, to a permanent gravity platform to be located offshore in the vicinity Thousand Springs Cove, San Nicolas Island, California. Three possible structural stabilization schemes were investigated: (a) Anchor Stabilization System; (b) Ballast Stabilization System A: and (c) Ballast Stabilization System B.

Both Navy Organizations and commercial sectors are considered for possible structural modifications and barge transportation and installation. Depending on the availability of Navy support in the transportation and installation of the barge and also on the degree of foundation suitability for a permanent gravity platform site, a total of twelve possible cost estimates are tabulated. The ultimate decision on the best scheme for structural modifications and barge installation can be made only after the site selection process has been completed.

The recommendation has been made to conduct a thorough site survey before proceeding further with engineering services.

CONTENTS

FIGURES

CHARTS

TABLES

1. INTRODUCTION

1.1 Introduction

This feasibility study has been performed in response to a request by Mr. Ted Blanc of the Naval Research Laboratory (NRL), Washington, D. C., for engineering services. The study investigated the feasibility of installing the existing jack-up barge, SIR ROBERT, as a permanent fixed platform offshore of the northwest corner of San Nicolas Island, California, in the vicinity of Thousand Spring Cove.

San Nicolas Island (SNI) lies approximately 65 miles seaward from Point Mugu, and 75 miles from Los Angeles, California (See Figure 1-1). The island is approximately 10 miles long and 3½ miles wide and has an area of about 32 square miles. The longer dimension of the island is along a west-northwest to east-southeast axis, and is roughly elliptical in shape. SNI is subject to the typical southern California coastal weather--cool summers and mild winters with a relatively small range of mean monthly temperatures throughout the year. However, the island presents an obstruction to the prevailing northwesterly wind flow.

SIR ROBERT is to be installed approximately 1000 feet offshore from an optical site "C" designated by NRL on the northern-most tip of SNI (see Figure 1-2). The final site for the barge still needs to be finalized. However, the general location of the barge site shall be in the optical path of the test range.

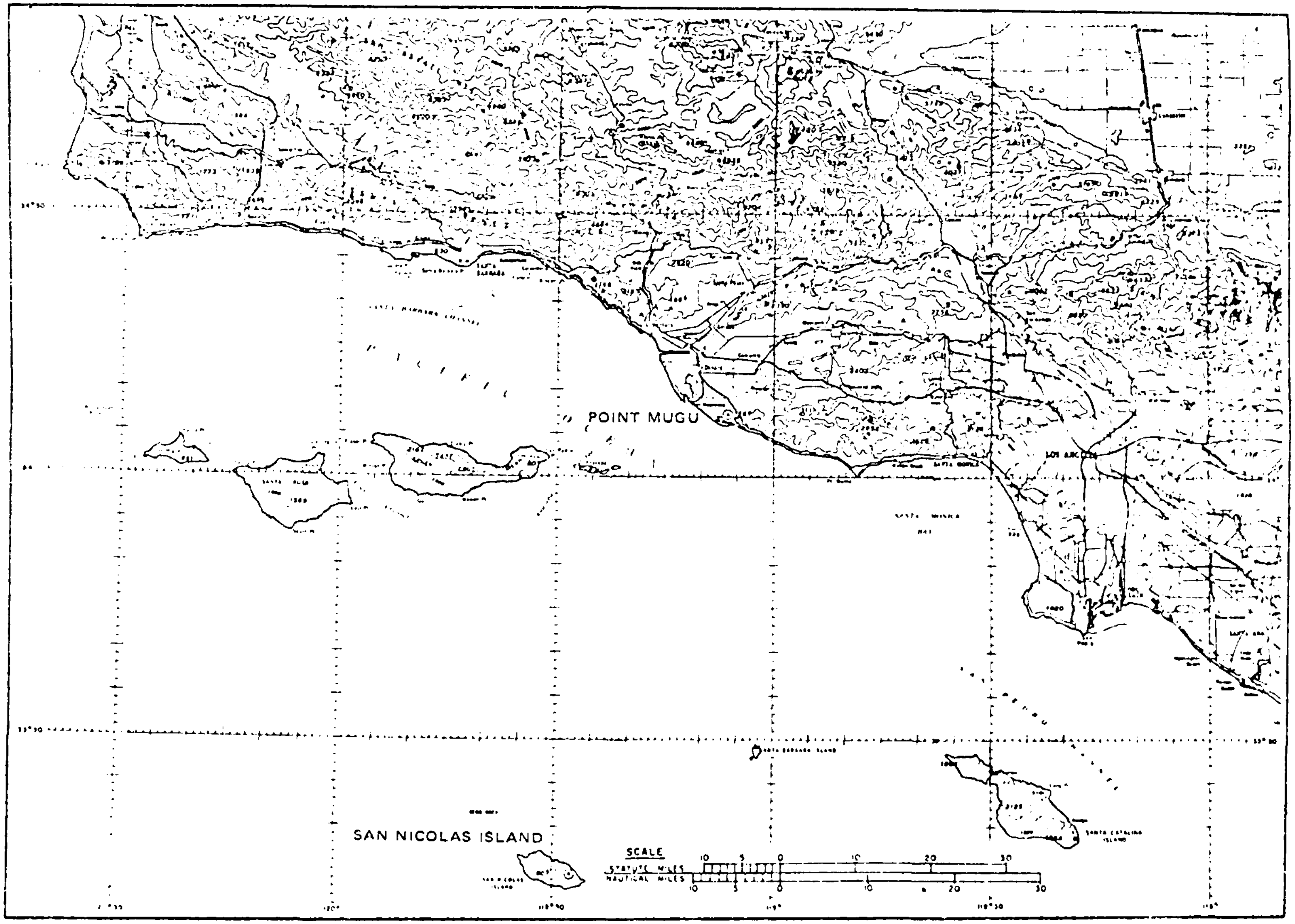

Figure 1-1 Southern California Coast and Channel Islands

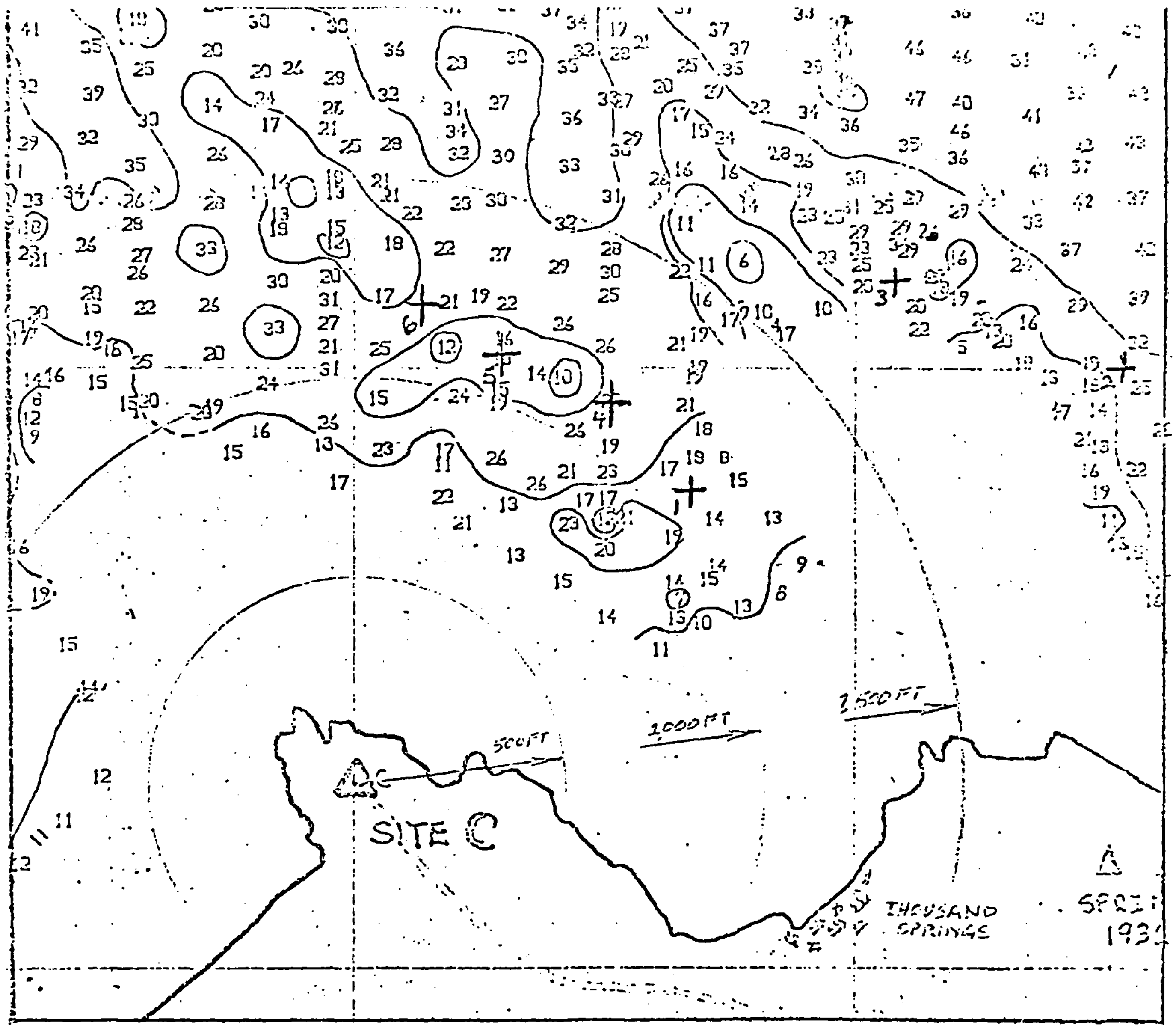

Figure 1-2 Possible Offshore Sites for SIR ROBERT

1.2 Background

In May 1976, a request for possible limited engineering services to support Project METEOR in installing the jack-up SIR ROBERT as a permanent platform was initiated from a conference among CDR L. Donovan of Naval Facilities Engineering Command (NAVFACENGCOM), Messers S. Ling and B. Brill of Chesapeake Division, Naval Facilities Engineering Command (CHESNAVFACENGCOM) and Mr. T. Blanc of NRL. A proposed plan of action for the engineering services was submitted to Mr. Blanc on 28 May 1976 (Reference 1). However, funding and subsequent action on this plan was delayed in accordance with Reference 2.

A telephone conference took place on 16 November 1976 among Mr. D. O'Gorman of Pacific Missile Test Center (PMTC), CDR R. Erchul, Messers S. Ling and B. Brill of CHESNAVFACENGCOM in which Mr. O'Gorman restated a possible need for more extensive engineering services than previously requested from CHESNAVFACENGCOM in support of Project METEOR. A new proposal for engineering services was then submitted to Mr. O'Gorman in response to the request (Reference 3).

On 1 February 1977, a project kick-off meeting among Mr. Blanc of NRL, LCDR D. Wells and Messers C. Bodey, S. Ling and C. Chern of CHESNAVFACENGCOM was held at CHESNAVFACENGCOM. A need for a broader planning of the engineering support required for Project METEOR was cited. Partial funding was therefore forwarded from NRL on 3 February 1977 to do the feasibility and initial planning aspects of the scope of work reproduced as Appendix 7.1 of this report.

On 15 February 1977, a progress meeting among Mr. Blanc of NRL, Lt. Pete Marshall and Messers S. Ling, C. Chern, E. Escowitz, and H. Dorin of CHESNAVFACENGCOM was held. It was emphasized at this meeting that all concepts were site dependent and that first priority should be given to the obtainment of usable seafloor and other environmental data. This report confirms and extends the findings presented on 15 February 1977.

1.3 Scope of Work

This feasibility study is directed to the installation of SIR ROBERT as a permanent platform in approximately 20 feet of water (MLW), off the northwest end of SNI. The study encompasses the following:

- Schemes for structural modifications
- Resource availability
- Project schedules
- Total initial cost and cost breakdown
- Recommendations for maintenance program
- Problem areas and potential solutions

Appendix 7.1 attaches a scope of work provided by NRL for the engineering services of the project METEOR.

2. CONCEPTS OF STRUCTURAL MODIFICATIONS

2.1 Introduction

The jackup barge, SIR ROBERT, was built in 1973. It consists of three major structural components: (a) a 40 feet long by 20 feet wide by 5 feet deep steel hull with a wheel house on the stern portion of the deck; (b) a 35 feet by 30 feet tubular framed supporting mat; and (c) four vertical legs of 14 inches diameter by 60 feet long steel pipes to connect the mat and the hull. Figures 2-1, 2-2, and 2-3, respectively, show the top view, side view, and the supporting mat of SIR ROBERT. A jacking mechanism consisting of four independently operable hydraulic motors was installed to jackup or lower down the supporting mat and barge. In its present configuration, the barge hull has approximately 1½ feet of free board in the stern portion when it is under tow. The barge weights approximately 130,000 lbs.

Delicate electronic atmospheric sensors are mounted on the forward end of five 25 feet long retractable arms which are attached at various levels to a 45 feet tall aluminum instrument tower mounted on the forward starboard deck of the barge. The aluminum tower and arms weigh approximately 2,300 lbs.

For accurate scientific measurement purposes, it required that the instrument tower platform shall be able to adjust to sea state and tidal variations for conducting the required air-sea interaction studies. The installed barge at SNI barge with the tower and sensors mounted on the front must face directly into the Northwest

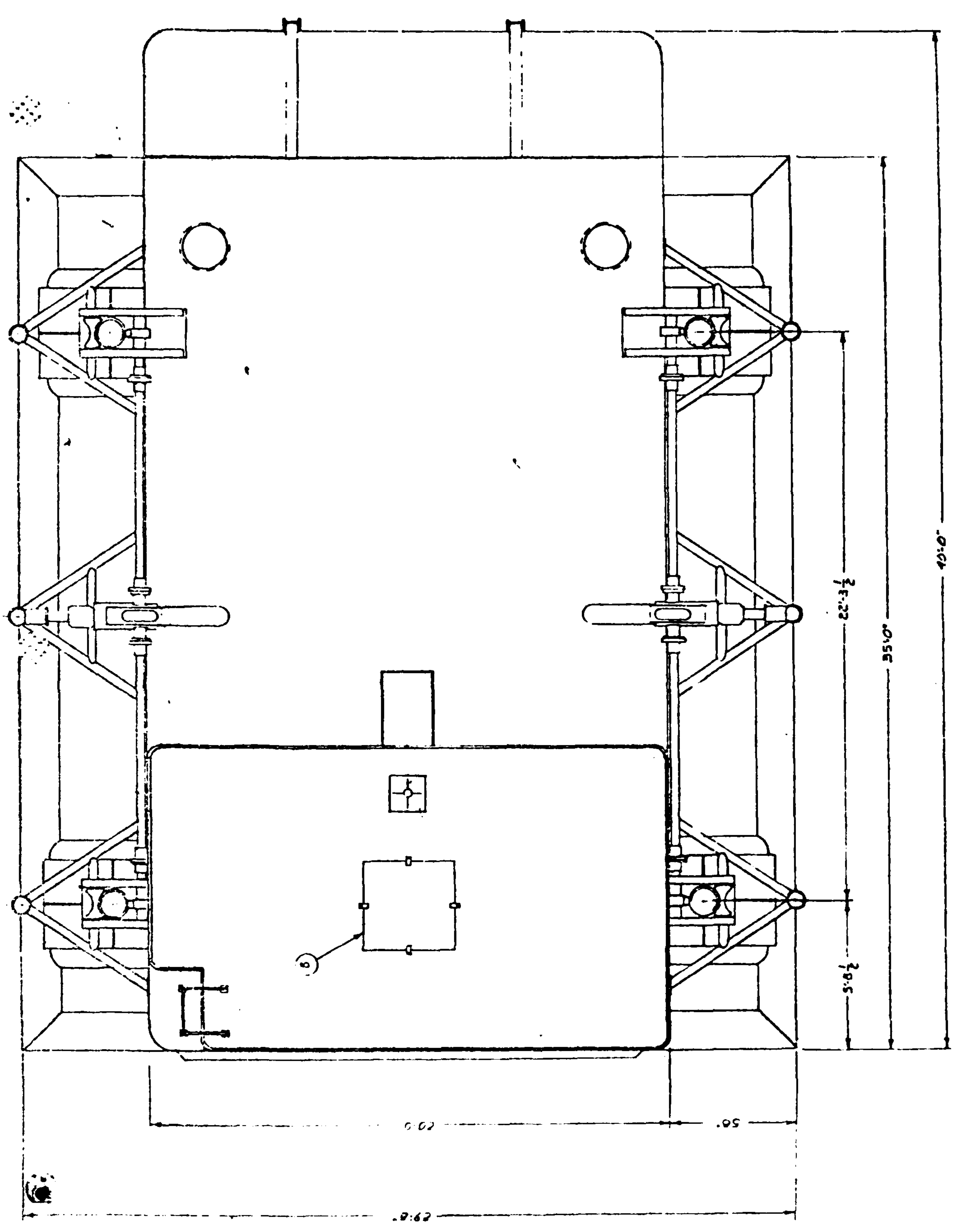

FIGURE 2-1 Top View of SIR ROBERT

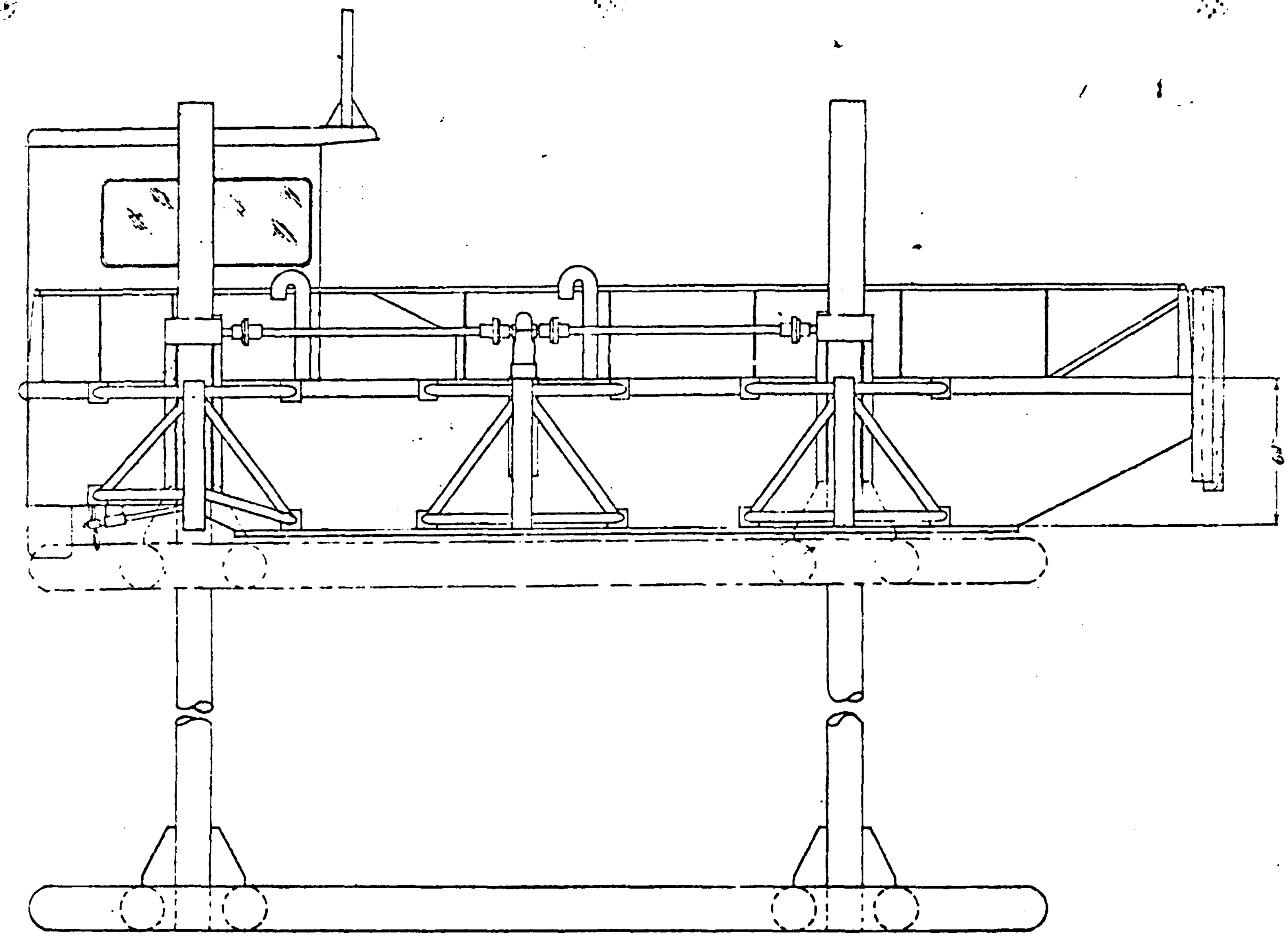

FIGURE 2-2 Side View of SIR ROBERT

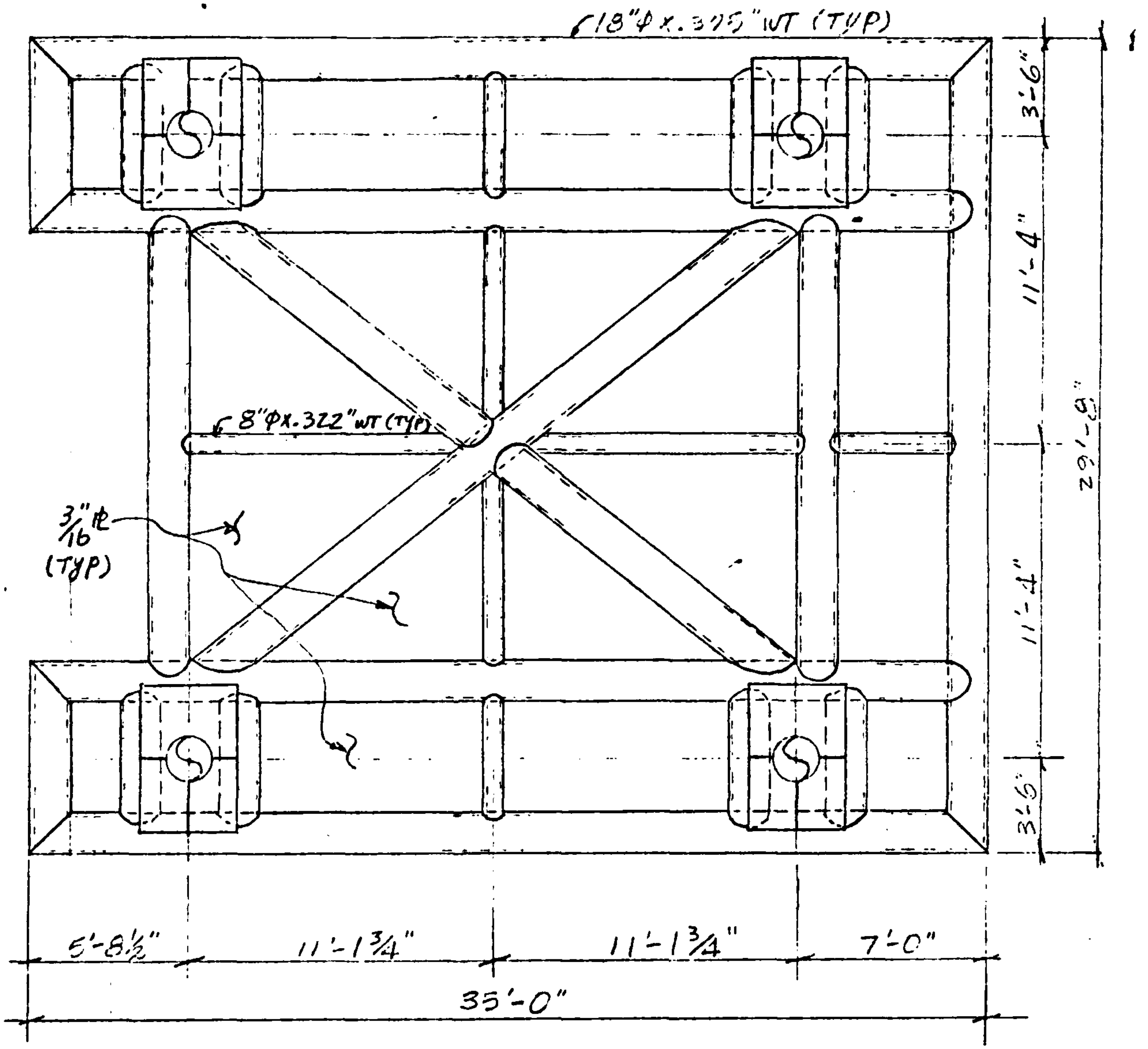

FIGURE 2-3 Supporting Mat of SIR ROBERT

(315^{o} from true North), the predominant wind direction in SNI.

2.2 Environmental Loads

Environmental loads are those loads imposed on the structure (barge and instrument tower platform) by the environment. In this feasibility study, the environmental loads are anticipated from any direction relative to the barge. Loads and specific engineering data considered in the study are:

Storm Wave Load Condition

Mean Low Water Depth (MLW)	20 ft
Average Max. Wave Height	13 ft
Wave Period	10.5 sec.
Tidal Range	8.5 ft
(Max. tide above MLW	6.5 ft)
(Min. tide below MLW	1.8 ft)
Drag Coefficient	C_D^* = 1.05
Inertia Coefficient	C_M = 1.5

---

*C_D = 1.05 is a conservative value allowing for marine fouling in the tubular members. For tubular members with clean and smooth surface, C_D = 0.75 may be used. In the later case, inspection for the cleanness of the member surface shall be conducted at a proper time interval.

Wind Load Condition

Max. Wind Velocity	60 MPH
Shape Factor for Cylindrical Member	$C_S = 1.0$
for Flat Face	$C_S = 1.5$

Earthquake Load Condition

Zoning	Zone 3

Combinations and severity of environmental loads used for engineering analysis shall be consistent with the probability of natural simultaneous occurrence of those phenomena. The loading combinations in this study are:

Survival Condition:

- Storm Waves and Winds
- Earthquake and 30% of Storm Waves and Winds

Operating Condition

- Earthquake and 30% of Storm Waves and Winds

It is noted that 30% of Storm Waves and Winds is used to simulate the maximum waves and winds under operating condition. Further refinement of this assumption will be conducted in the design phase of this project.

2.3 Feasible Concepts

The barge with instrument tower at its existing configuration is first treated as a gravity platform situated in a 20 feet of water depth and subjected to the environmental loads as described in the previous article. The factor of safety of the structure is measured by the stability of the structure against the overturning moment and base sliding induced by the environmental forces. The reinforcing requirement of structural components is thus determined by calculating the stresses in the existing member in a stable configuration. Three feasible concepts are developed as follows:

Anchor Stabilization System -- Figure 2-4 presents a schematic diagram of the system. Eight CEL 100K propellant anchors are employed to stabilize the barge from overturning and horizontal sliding. Reinforcement in four verticle legs has to be done for resisting earthquake load under operating condition.

Ballast Stabilization System A -- Figure 2-5 shows the basic configuration of this system. Horizontal and diagonal braces are used to reinforce the leg-to-mat joints and also to serve as "rock crib" to retain rocks in the core portion of the backfill gravel. The gravel for ballast stabilization requirement is approximately 3 feet above the mat surface and spread out all over the entire area of the mat. Smooth sloped rip rap around the ballast stabilization gravel is then applied for scour protection. Leg reinforcement is also required for lateral load resistance.

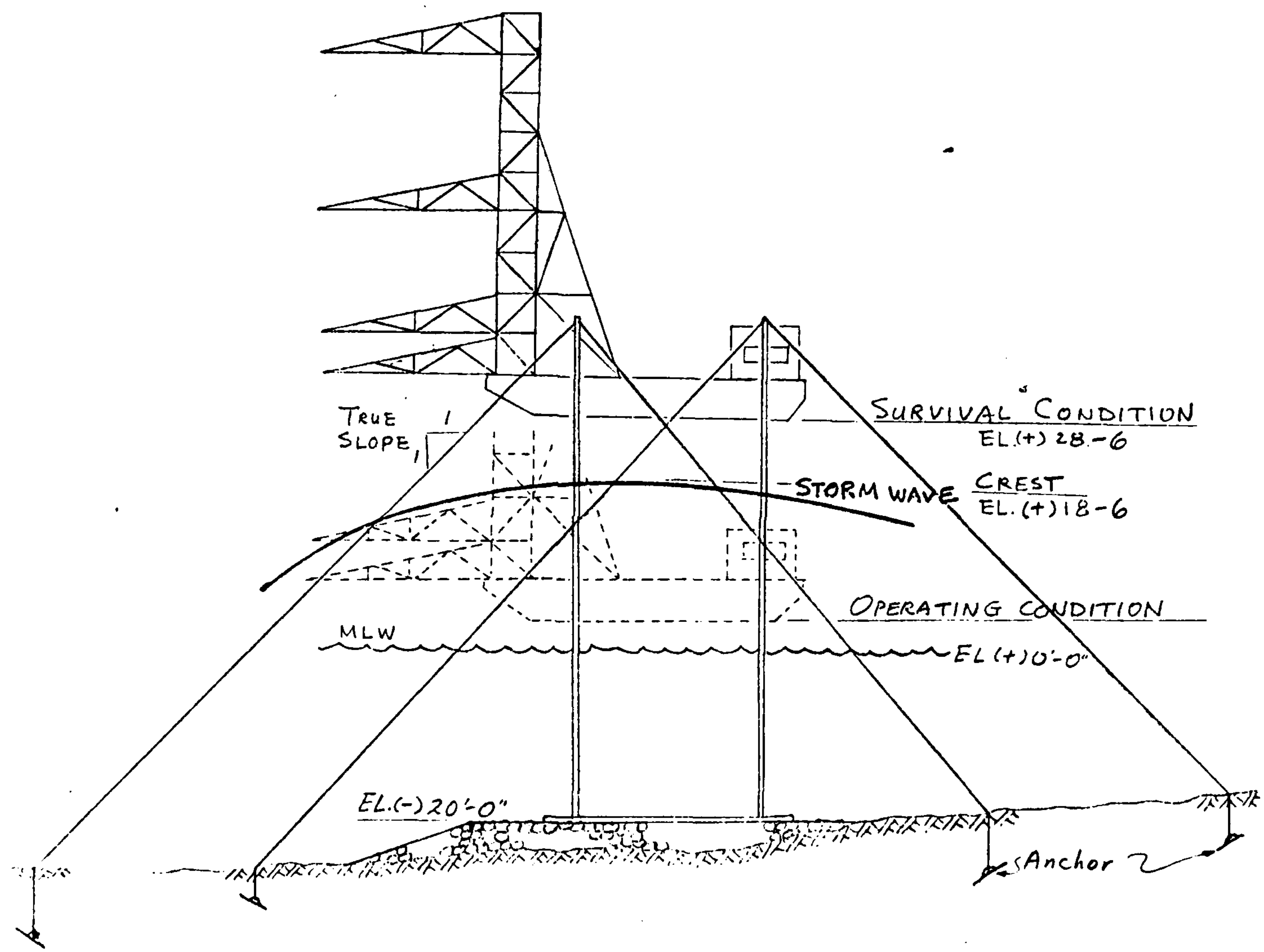

FIGURE 2-4 Anchor Stabilization System

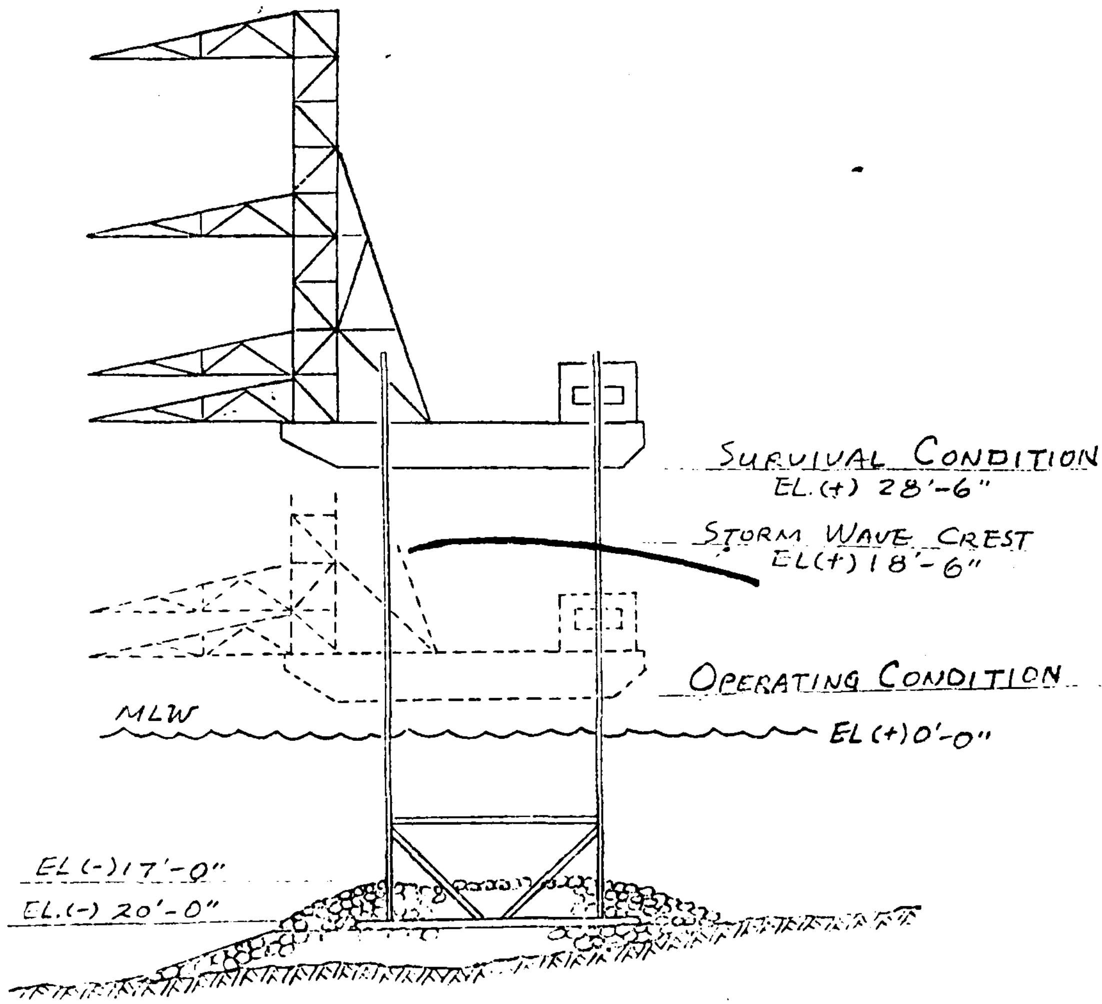

FIGURE 2-5 Ballast Stabilization System A

Ballast Stabilization System B -- If the scour around the mat is not critical, the rip rap portion of the gravel backfill may be saved. Figure 2-6 represents the modified ballast system. In order to obtain required stability, center core of the rock-fill has to be increased to 5 feet above the mat surface.

APPENDIX 7.2 provides detailed calculatious of evnironmental forces, stabilizing forces and the factor of safety for each different structural modification concept.

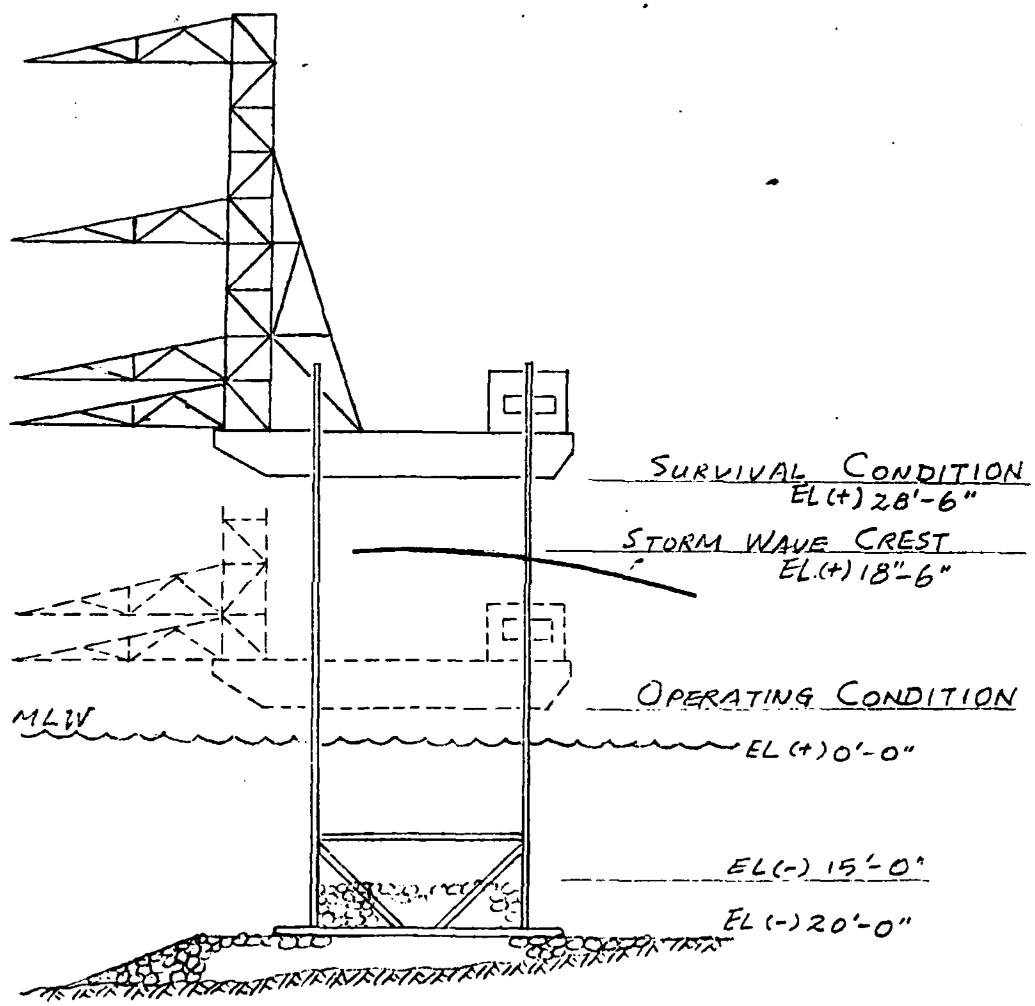

FIGURE 2-6 Ballast Stabilization System B

3. PROJECT SCHEDULE

3.1 Introduction

SIR ROBERT is currently located on land at the Naval Construction Battalion Center at Port Hueneme, California. The top 40 feet section of the barge legs has been cut at the welding joint for the convenience of shipping from Chesapeake Bay to its present location. The aluminum instrument tower with arms and the electronic instrumentation are located at NRL and are to be shipped to California.

The most desirable time frame for the installation of the barge and the erection of the instrument tower is in the Spring-Summer of 1977. The reasons for selecting this time frame are twofold: (a) taking advantage of the favorable weather conditions for construction operation and (b) complying with the sponsor's budgeting restraint in the fiscal year of 1977.

3.2 Schedule

A proposed work schedule is shown in Chart 3-1. The chart is designed to fit into each of the three possible structural stabilization systems described in the previous section. It is noted that Seabees will not be available for the Project METEOR this year. This schedule is predicated on backing into a late Summer 1977 installation and is extremely optimisitc. Realistically, an implant in Summer 1978 is more practical.

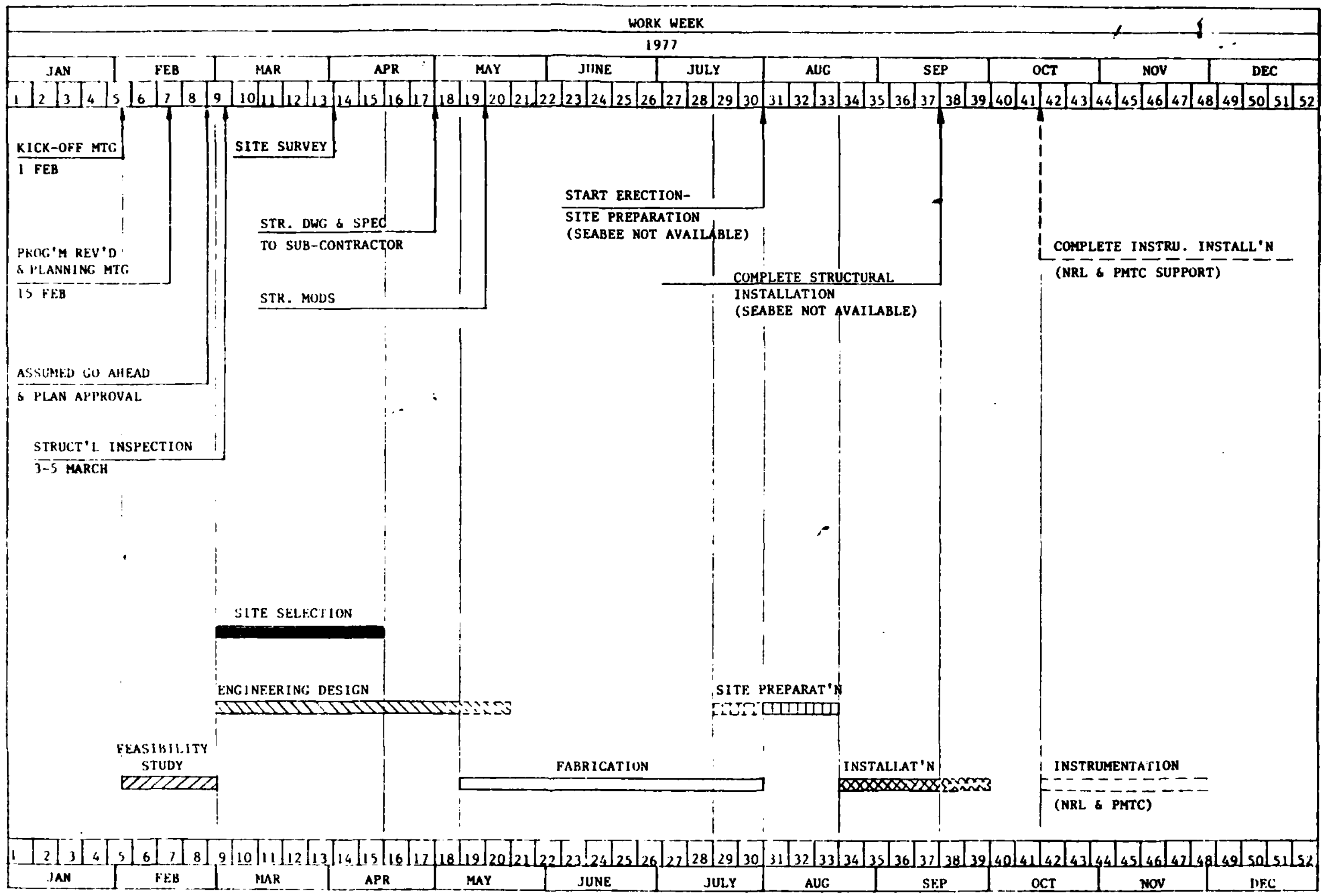

Chart 3-1 WORK SCHEDULE OF ENGINEERING SERVICES

The schedule contains the following essential steps in carrying out the engineering services:

- Feasibility Study
- Site Selection
- Engineering Design
- Fabrication (Structural Modification)
- Site Preparation
- Barge Installation
- Instrumentation

Information for setting up the schedule is attached in APPENDIX 7.3.

4. COST INFORMATION

4.1 Introduction

Cost information gathered in this section represents the summation of estimates of current market prices from possible sources for the completion of engineering services within the time frame shown in Chart 3-1 of the previous section. The sources include a market search of the Navy and commercial organizations that may be available for participation in this project. The cost items investigated include:

(1) Feasibility Study

- Concept Selection
- Scheduling
- Cost Estimate

(2) Site Selection

- Sea Floor Survey
- Site Selection
- Soil Core Sampling and Analysis

(3) Engineering Design

- Environmental Assessment
- Wave Force Analysis
- Structural Analysis/Design
- Foundation Analysis

- Corrosion Analysis/Design
- Specifications/Drawings
- Design Report

(4) Fabrication

- Structural Modifications
- Cathodic Protections
- Paint
- Miscellaneous Attachments

(5) Site Preparation

- Base Flattening
- Kelp Cleaning

(6) Installation

- Installation Plan
- Project Installation Management
- Barge Transportation and Installation
- Anchor Installation,or
- Ballast and Scour Protection

4.2 Cost Summary

Estimated costs for carrying out each of the three feasible concepts presented in Section 2 are tabulated in Tables 4-1, 4-2, and 4-3. In each table, costs for four possible cases in a specific system are shown.

Breakdown cost items for each case are shown in APPENDICES 7.4 and 7.5.

TABLE 4-1 ANCHOR STABILIZATION SYSTEM

CASE	DESCRIPTION	ESTIMATED COST
1	Man-made base, rockfill @ 2000 cu yd 8 - CEL 100K Propellant anchors Commerical transport of Sr Robert	$ 337,880
2	Man-made base, rockfill @ 2000 cu yd 8 - CEL 100K propellant anchors Navy transport of Sr. Robert	$ 316,980
3	Natural Flat Base, no scour protect. 8 - CEL 100K propellant anchors Commerical transport of Sr. Robert	$ 242,840
4	Natural Flat Base, no scour protection 8 - CEL 100K propellant anchors Navy transport of Sr. Robert	$ 212,940

Note: Estimared Cost includes:
(1) Installation of 1500 ft power cable, and
(2) 2 lights for navigation aids

TABLE 4-2 BALLAST STABILIZATION SYSTEM A

CASE	DESCRIPTION	ESTIMATED COST
A-1	Man-made base rockfill @ 2000 cu yd Scour Protection Commerical transport of Sr. Robert	$ 284,010
A-2	Man-made base, rockfill @ 2000 cu yd Scour Protection Navy transport of Sr. Robert	$ 257,610
A-3	Natural Flat Base Scour Protection Commerical transport of Sr. Robert	$ 188,970
A-4	Natural Flat Base Scour Protection Navy transport of Sr. Robert	$ 162,570

Note: Estimated Cost includes:
(1) Installation of 1500 ft power cable, and
(2) 2 lights for navigation aids

TABLE 4-3 BALLAST STABILIZATION SYSTEM B

CABLE	DESCRIPTION	ESTIMATED COST
B-1	*Man-made base, rockfill @ 2000 cu yd* Commerical transportation of Sr. Robert	$ 273,010
B-2	Man-made base, rockfill @ 2000 cu yd Navy transport of Sr. Robert	$ 246,610
B-3	Natural Flat Base Commerical transport of Sr. Robert	$ 177,970
B-4	Natural Flat Base Navy transport of Sr. Robert	$151,570

Note: Estimated Cost includes:
(1) Installation of 1500 ft power cable, and
(2) 2 lights for navigation aids

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Conclusions drawn from the feasibility study may be summarized as follows:

- Structural modifications for the coversion of SIR ROBERT to a permanent gravity platform is feasible.

- Stabilization of the barge to the seafloor may be achieved by using either CEL propellant anchors or rock backfill for ballast and scour protection purposes.

- For the same seafloor conditions, it is found that the cost is relatively cheaper by using rock backfill stabilization.

- Site preparation process is vital to the cost of the project. A natural flat firm base is most economical for the site. A man-made flat firm base in a remote offshore area is usually expensive.

- A thorough seafloor investigation is needed to support the foundation and scour protection design for the installed SIR ROBERT.

5.2 Recommendations

Recommendations for action are listed as follows:

- Site selection process shall proceed first and engineering design to follow pending results of site survey.

- A risk investment in the contract preparation for fabrication, site preparation and barge installation shall be initiated in early March. Contract procedure for the amount exceeding 100K is usually lengthy and time-consuming.

- A thorough project review of engineering services shall take place immediately after the completion of site selection process to update technical and economic considerations and confirm go/no go with respect to subsequent work effort.

6. REFERENCES

1. Plan of Action for Engineering Services -- Project METEOR Proposal FPO-1: fm 11150, 28 May 1976

2. Naval Research Laboratory Correspondence 8322-415: TVB: gc, 1 July 1976

3. Plan of Action for Engineering Services -- Project METEOR, A Proposal Submitted to Pacific Missile Test Center, Point Mugu, California, FPO-1E1: bw 3161, 19 November 1976

4. Geology of San Nicolas Island, Geological Survey Professional Paper 369, United States Government Printing Office, Washington: 1973

5. Some Geophysical Considerations For Site "C" on Northern San Nicolas Island, Atmospheric Sciences Technical Note No. 47, Geophysics Division, Range Operations Department, Pacific Missile Test Center, Point Mugu, California.

6. United States Coast Pilot 7 PACIFIC COAST: California, Oregon, Washington, and Hawaii, United States Government Printing Office: 1968

7. Climate Handbook for Point Mugu and San Nicolas Island, Part 1, Surface Data, Geophysics Division, Pacific Missile Range, Point Mugu, California, March 1974.

8. Climatological Study Southern California Operating Area, Naval Western Service Command, Fleet Weather Facility, San Diego, Califonia, March 1971

9. Naval Research Laboratory Correspondence 8322-16: TVB: be, 3 February 1977

10. Report on Engineering Study of San Nicolas Island, California, U. S. Army Engineer District, Los Angeles, Corps of Engineers, April 1962

11. Rules and Regulations for Artificial Islands and Fixed Structures on the Outer Continental Shelf, Department of Transportation, United States Coast Guard, July 1972

7. APPENDICES

Appendix 7.1

Scope of Work --- (NRL Supply)

Naval Facilities Engineering Command study for the installation of the Naval Research Laboratory's jack up barge at San Nicolas Island, California

I. Scope of Work

A. This study is to be conducted by the Naval Facilities Engineering Command (NAVFAC) for the Naval Research Laboratory (NRL) with the consultation and support of the Pacific Missile Test Center (PMTC).

B. NAVFAC is to assist NRL in identifying a number of possible sites at the PMTC San Nicolas Island (SNI) facility for the NRL jack up barge SIR ROBERT based upon oceanographic safety considerations.

C. From among the above sites, one primary and one alternate site will be selected by NRL based upon the scientific requirements of the project. NAVFAC is to conduct a diver bottom survey and take bottom core samples at the two selected locations.

D. NAVFAC is to develop a possible (more than one if practical) logistical/modification/installation scenario with an itemized projected cost breakdown and design options.

E. Based upon the final selected scenario, NAVFAC is to conduct an architectural analysis of the proposed modified structure to insure its safety and to obtain the required NAVFAC and Army Corps of Engineers certification.

F. NAVFAC is to develop a recommended maintenance (including painting and fueling) and diver inspection program with projected costs to insure the structures continued safety and operation.

G. NAVFAC is to propose possible alternatives to the modified jack up barge structure within the scientific, scheduling and funding constraints of the project.

II. Basic Configuration of the Barge System

A. The jack up barge has been properly maintained and in service since 1973. It is 40 feet long and 20 feet wide with four vertical legs which are 60 feet in length.

B. Each of the legs consists of three welded sections of 20 foot long 14 inch O.D., ½ inch wall, steel pipe with a welded steel rack. Although each leg rack and pinion mechanism is independently controlled by a separate hydraulic motor, the legs are presently attached to each by a rigid mat structure welded to the bottom of the legs.

C. From the bottom of the barge hull to the top of the deck is 5 feet. In the floating mood the barge in its present configuration has a minimum freeboard (located in the rear) of about 1½ feet.

D. Mounted on the rear of the deck is an air conditioned 10 foot by 20 foot insulated wheelhouse used to house the scientific personnel and the electronic instrumentation.

E. Delicate electronic atmospheric sensors are mounted on the forward end of five 25 foot long retractable arms which are attached to various levels of a 45 foot tall welded tubular aluminum instrument tower mounted on the forward starboard deck of the barge.

F. Although no completely detailed set of blue prints exist for the barge, there are four overall view blue prints which show the inside and outside of the structure.

G. The barge is propelled and the hydraulic systems power by two inboard marine diesel engines which can produce a maximum speed of 3 or 4 knots. The engines are cooled by a closed loop water cooling system which transfers heat to the ocean through the bottom skin of the barge. The fuel capacity of the barge is approximately 800 gals.

H. The barge has been transported by Military Sealift Command Freighter from Chesapeake Bay to its present location on a dock at the Naval Construction Battalion Center at Port Hueneme, Californi which is approximately ten miles from the main PMTC facility at Point Mugu.

I. In its present shipping configuration the tower and electronics have been removed from the barge. The top 40 foot section of the barge legs have been cut at the weldjoint and are laying on their side, welded to temporary outboard shipping brackets.

J. In its present configuration, the barge weighs approximately 130,000 lbs.

K. The aluminum instrument tower (with arms) and the electronic instrumentation are presently located at NRL and are to be shipped to California.

III. Structural and Environmental Data

The following data will be provided by NRL and PMTC to NAVFAC to assist in the final site selection and to establish the environmental design criteria for the structure:

A. American Marine and Machinery Company jack up barge blue prints (1972).

B. Washington Aluminum Company instrumentation tower and arm blue prints (1973).

C. NOAA preliminary SNI shore line depth chart* (Oct. 1976).

D. PMTC high resolution color aerial photos of the Thousand Springs Cove (Jan. 1977).

E. Miramar Naval Air Station aerial photos of SNI (Oct. 1976).

F. Army Corps of Engineers SNI reports (Apr. and Aug. 1972).

G. PMTC Geophysics Division SNI sea state, wind, and tide report (Dec. 1976).

H. Department of the Interior geology report of SNI (1963).

I. Naval Weather Service wave height data for Southern California (1971).

J. Ocean Wave Statistics by Hogen and Lumb (1967).

K. PMTC SNI climatology report (1974).

L. NRL photographs of barge system in operation (1975).

IV. Scientific Requirements

A. The accuracy of the atmospheric profile measurements require that the instrument tower platform be both horizontally and vertically stable. Thus, a floating platform can not be employed.

B. In order to conduct the required air-sea interaction studies, it is necessary that the bottom level of the instrument tower (deck height) be five feet or less from the water surface. Therefore, it is required that the instrument tower be on a platform which can be raised and lowered at least ten feet in order to adjust to sea state and tidal variations.

C. The structure with the tower and sensors mounted on the front must face directly into the Northwest (315° from true North), the predominant wind direction.

D. The location of the structure must be such that when the wind is coming from any direction in a 90 degree arc subtented by the West to North directions (270° to 360° from true North) that

*Note: It must be stressed that the NOAA chart is preliminary and may contain a large number of errors.

there be no surf upwind of the structure. This is required in order to make true open ocean aerosol measurements uncontaminated by the local surf and in order to protect the delicate and extremely expensive instrumentation from excessive corrosion and clogging.

E. The structure should be in sufficiently deep water to insure that under normal wind and seastate conditions, the waves break as far down wind from the strucutre as possible. This is required in order to minimize the back flow of surf generated aerosols transported upwind by vortices induced by the structure in the wind field.

F. The structural members at water level must be kept to a minimum in order to minimize the local aerosol contamination generated by the structure.

G. Any modification of the barge structure must be kept to a minimum. This is required in order not to distort the wind field being measured by the instrumentation and to allow access to the sensors by rotating the tower arms back into the tower.

H. Anti-bird devices (pointed or sharply rounded surfaces) will have to be included on any structure around the instrument tower in order to eliminate the problem of birds (primarily sea gulls) from perching and fouling the instrumentation with air born debris.

V. Engineering Requirements

A. The barge structure is to be permanently installed as a non-floating elevator platform with an operational life requirement of from five to ten years.

B. Due to the freeboard of the barge, the weight of the entire system will have to be an important consideration in the transport and installation phases.

VI. Site Requirements

A. The structure is to be installed in the vicinity of the small Thousand Springs cove located on the northernmost tip of SNI, just East of the optical site C. The cove is located at approximately 33° 17' 10" North Latitude, 119° 31' 50" West Longitude (or grid coordinates: N 422,600 by E 997,600). The final site for the structure in this cove is still to be selected. This general location was chosen because of its proximity to optical path, the unusual protection it affords to a structure in the water, and its uniquely hospitable and accessable sandy beach.

B. The structure must be installed within approximately one thousand feet of the shore line at site C. This is required in order that the PMTC marine power and communication cables can be installed from the island to the structure.

C. Since the preliminary NOAA chart of the bottom of the cove may contain errors a cross-check will have to be performed when the diver survey of the bottom is conducted. When the selected sites have been located, there will have to be a marker placed in the water.

D. PMTC is to install a wave measurement buoy at the primary site location. It would be appropriate if this was coordinated with the NAVFAC diver survey. Once installed, the data from the buoy will be available to NAVFAC and NRL on a monthly basis.

VII. Schedule Requirements

A. The structure must be installed with the Spring-Summer 1977 time frame. This is required in order to take advantage of the most favorable sea state and weather conditions.

B. If the barge system is not operational and atmospheric data in hand (at the very latest) by the end of this fiscal year, the entire program will be cancelled by the sponsor.

VIII. Logistical Requirements

A. The instrument tower and arms will have to be mated back to the barge.

B. The electronic racks of instrumentation will have to be installed back in the wheel house after the final installation of the barge structure in the cove. This is to insure that the electronics ($500K) will not be lost if the barge ($250K) should be lost during transport or installation.

C. The barge will have to be off loaded from the dock at Port Hueneme.

D. A boat will most probably be required to assist the barge in transport from Port Hueneme to SNI.

E. An intermediate holding point at SNI will have to be provided. This in case of bad weather and/or as a possible assembly point for the barge structure.

F. A trade off will have to be made between the ease of performing the modifications at Port Hueneme, as opposed to SNI, and the additional weight (the affect on freeboard) in the transport of the barge to the island.

G. There is an existing freight service by barge from Long Beach to SNI approximately twice a month.

H. There are no docking facilities at SNI.

I. Presently, there is a conventional twenty ton land based mobile crane available on SNI.

IX. Structural Modification Requirements

A. The barge mat can be removed and the legs operated independently.

B. For safety considerations, it is proposed that when the barge is not in operation, that it be raised to a height for enough above the water for the hull not to be struck by waves during a storm. This would minimize the cross sectional area exposed to the waves and, thus, minimize the load forces induced on the structure by the water.

C. A ladder system will have to be provided for the on and off loading of personnel from the platform.

D. A davit will have to be provided for the on and off loading of equipment (800 lbs. max.) from the platform.

E. A way will have to be devised to meet the dual requirements the adjustable platform height and the marine (power and communication) cable-platform interface.

F. The structural modifications will have to take in to consideration that SNI is in an earthquake zone 3.

G. The possibility should be explored of employing a multi-line mooring cable technique coupled with explosive bottom anchors. If mooring cables are employed, the increased loading due to large amounts of kelp collecting on the cables will have to be taken into account or periodic kelp removal be included in the maintenance program.

H. The structural modifications will have to be such as to allow room for a LARC or similar sized craft being tied up to the structure.

I. If required, the possibility should be explored of reinforcing the existing legs by inserting a smaller diameter steel pipe inside. This would have to be considered in light of the increased weight.

J. The modification will most probably have to include a more positive and massive way of locking the elevated platform to the legs than presently exists.

K. The modification will have to include a cathodic protection system for the entire structure.

X. Installation Requirements

A. In the installation phase a boat will most probably be required to assist in maneuvering the barge into position and for diver support.

B. The installation of the marine power and communication cables will have to be coordinated with the installation of the structure. This should be included as an itemized projected cost.

C. Due to funding constraints, if at all possible it is hoped that the installation of the structure can be performed without the use of extremely expensive floating cranes and support barges for pouring of marine concrete.

D. In transport and installation phases, the barge will have to be operated by an experienced qualified operator.

XI. Safety Requirements

A. It is not anticipated that there should ever be a conflict between the safety and scientific requirements of the project, since data is not required during high winds and sea state conditions. If, however, a conflict should ever occur, the safety of the personnel will always take precedence.

B. The transport, installation, and operational phases of the NAVFAC scenario should include an emergency evacuation procedure in case of an accident or an unexpected violant storm. The barge is presently equipped with an inflatable six man life raft.

XII. Consultation

A. It has been suggested by NAVFAC that both NRL and PMTC be kept abreast of the NAVFAC study as it evolves on a weekly basis.

B. It is suggested that this can be accomplished by informal long distance telephone conference calls between the three parties, orginated at NRL.

XIII. Coordination

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Appendix 7.2

A Concept Study

A CONCEPT STUDY

CONVERSION OF [illegible]R ROBERT TO A

PERMANENT GRAVITY PLATFORM

OCEAN ENGINEERING AND CONSTRUCTION PROJECT OFFICE (FPO-1)

CHESAPEAKE DIVISION

NAVAL FACILITIES ENGINEERING COMMAND

WASHINGTON NAVY YARD

WASHINGTON, D.C. 20374

FEBRUARY 197[illegible]

C. Chern
2-8-77

TABLE OF CONTENTS

INTRODUCTION

BACKGROUND

This report is prepared as a part of the support to Mr. Ted Blanc of the Naval Research Laboratory (NRL) for the installation of a jack-up barge, SIR ROBERT, as a permanent platform at San Nicolas Island, California.

SIR ROBERT is a movable barge which consists of a 40 ft x 20 ft x 5 ft hull, a 35 ft x 30 ft mat attached with four 14"Øx0.5" WT x 60 ft long legs, and a set of hydraulic motor systems to adjust the elevation of the hull. The barge is currently located on land at Port Hueneme, California.

ENGINEERING DATA

The data used for the engineering analysis are listed as follows:

LOCATION:

Approximately 1000 ft offshore Thousand Springs, San Nicolas Island, California (see Fig. 1).

ENVIRONMENTAL DATA

Mean Low Water Depth	*20 ft*
Wave Height	*13 ft*
Wave Period	*10.5 Sec.*
Tidal Range	*8.5 ft*
Wind	*60 MPH*
Drag Coefficient	$C_D = 1.05$
Inertia Coefficient	$C_M = 1.5$
Earthquake Zoning	*Zone 3*

MATERIAL

Structural Steel A36

ANALYSIS

The barge is treated as a gravity platform subjected to the actions of environmental forces. The main considerations in the stability of gravity type of platforms are:

(a) Overturning Stability

(b) Sliding Stability

(c) Structural Component Stability; and

(d) Foundation Stability

The stability of the platform is expressed in terms of the factor of safety under either the combination of earthquake and operational waves and winds or the condition under design storm waves and winds. A total of five different concepts of the platform configurations is studied.

SUMMARY

The summary of the study is tabulated in a matrix form shown as follows:

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2-7-77

CONCEPT NO.	DESCRIPTION	CONDITION	FACTOR OF SAFETY		
			Overturn'g	Sliding	Jack-Up Barge Col.
1	Structure: As i[illegible] Foundation: Flat Base	a	0.82	1.09	0.37
		b	1.38	1.09	0.83
		c	1.65	1.55	0.76
2	Structure: Enlarge mat size [illegible]0'x45' Insert 12"Dx1"WT Pipe into legs 3' Gravel Overburden Leg Braces at 1[illegible] level Foundation: Flat Base	a	5.46	3.61	1.25
		b	8.66	3.61	2.36
		c	12.55	6.30	2.34
3	Structure: Enlarge mat size [illegible]x60' Insert 12"Dx1"WT Pipe into legs Leg Braces at 1[illegible] level Foundation: Flat Base	a	[illegible].61	1.27	1.25
		b	4.14	1.27	2.36
		c	6.0	2.22	2.24
4	Structure: As is w/ minor modification 8-Cable [illegible] Foundation: Flat Base	a	[illegible].0*	14.4	2.50
		b	5.35*	2.4	0.90
		c	3.0**	–	–
4a	Structure: Same as Concept [illegible] Insert [illegible] into legs Foundation: Flat Base	a	–	–	–
		b	6.2*	2.45	1.67
		c	–	–	–

a) Earthquake + 30% (Design Wave & Wind)
b) Operating ([illegible] load included)
c) Design Wave & Wind

* 20 ton [illegible] Anchor
** 10 ton Capacity Anchor

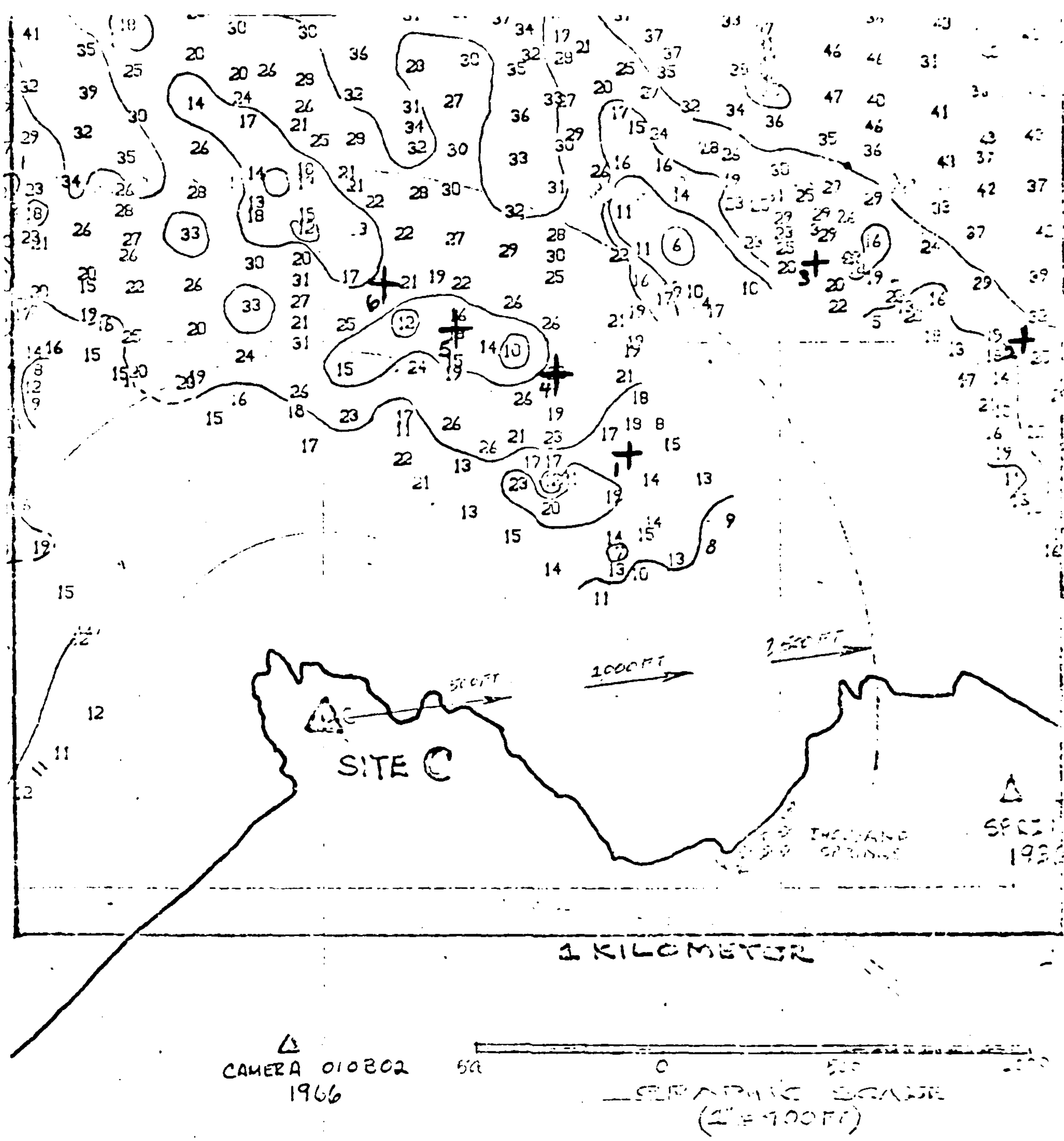

Fig. 1 Possible Offshore Sites

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2-4-77

I. WAVE FORCES

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2-2-77

WAVE FORCES

Design Wave Characteristics:

Wave Height	H =	13 ft
Wave Period	T =	10.5 sec.
Mean Low Water	=	20 ft
Tide Range	=	8.5 ft
(max.		6.7 ft above MLW)
(min.		−1.8 ft below MLW)

Design water Depth $h = 28.5$ ft

Ref. 1.

Calculate small amplitude deepwater wave length

$$L_0 = \frac{gT^2}{2\pi} = \frac{32.2 \times (10.5)^2}{2\pi} = 565 \text{ ft}$$

$$\frac{h}{L_0} = \frac{28.5}{565} = 0.05$$

$$\frac{H}{L_0} = \frac{13}{565} = 0.023$$

Case 5C

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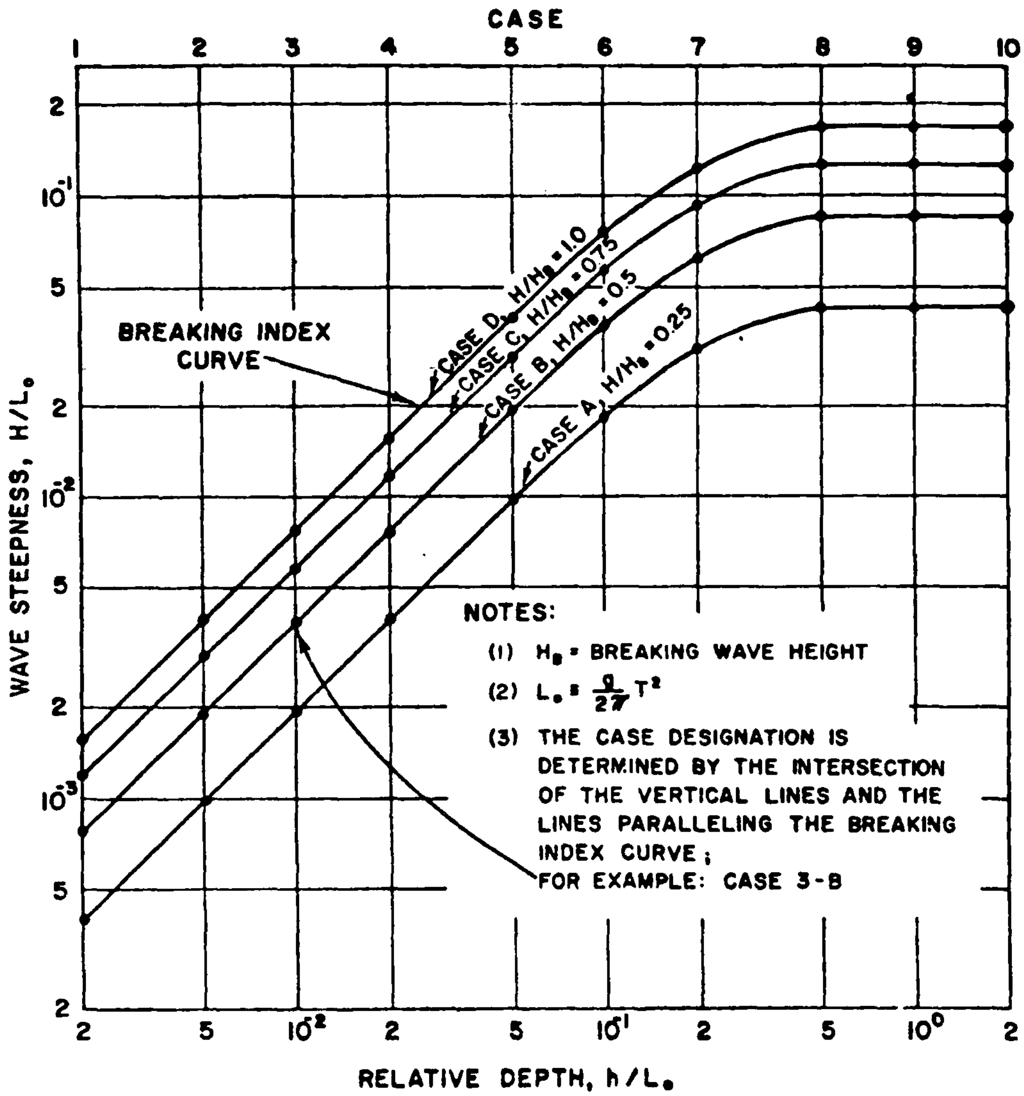

Figure 23. Wave characteristics selected for tabulation
(From Ref. 1)

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2-2-77

Hull Bottom Elevation

$$h'' = h + \eta_{max} + h'$$

Where h = design water depth

η_{max} = max. displacement of the wave above still water level

h' = freeboard

= 10 ft

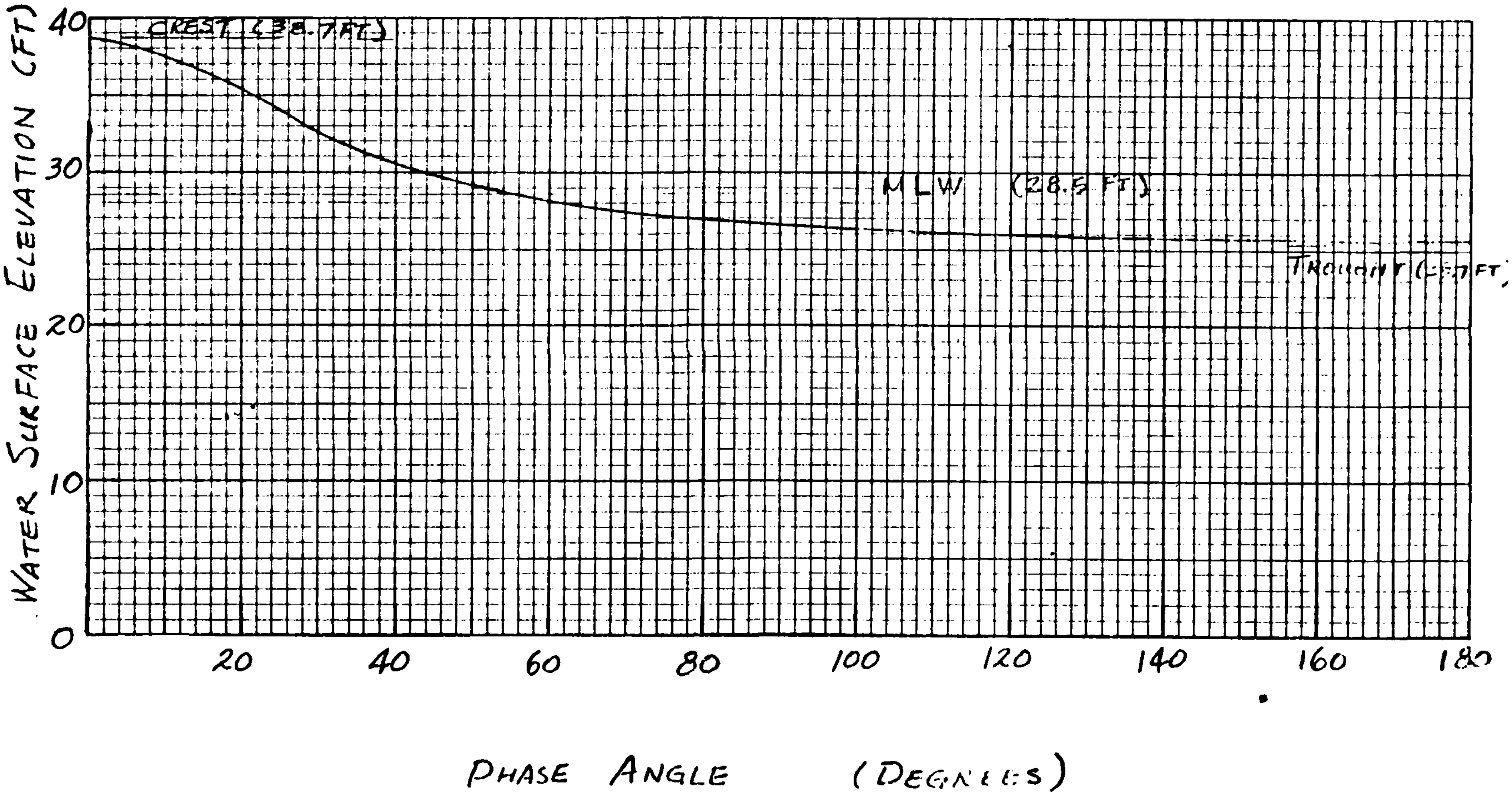
Table I

$\theta = 0°$ $\quad \frac{\eta}{H} = 0.784$

$$\eta_{max} = 0.784 \times 13 = 10.2 \text{ ft}$$

$$h'' = 28.5 + 10.2 + 10 = 48.7 \text{ ft} \leftarrow$$

θ	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	130	180
η/H	[illegible]	[illegible]	[illegible]	.318	[illegible]	-.1[illegible]	-.175	-.209	-.216
η_{max}	[illegible]	[illegible]	[illegible]	4.[illegible]	[illegible]	-1.4	-2.[illegible]	-2.7	-2.8
h'' (ft)	38.[illegible]	[illegible]	[illegible]	[illegible]	29.3	27.1	[illegible]	25.8	[illegible]


CREST (38.7FT)
MLW (28.5 FT)
TROUGH
WATER SURFACE ELEVATION (FT)
0
10
20
30
40
20
40
60
80
100
120
140
160
180
PHASE ANGLE (DEGREES)

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2-2-77

Wave Force on 14"ϕ Leg

$C_D = 1.05$ $H = 13$ ft

$C_I = 1.5$ $h = 28.5$ ft

$\rho = 1.99$ slug/ft³ $T = 10.5$ sec

$D = 14/12$ ft

$$\frac{C_D \rho D (H/T)^2 h}{2} = \frac{1.05(1.99)(14/12)(13/10.5)^2(28.5)}{2}$$

= 53.25 lbs

= 0.053 Kips

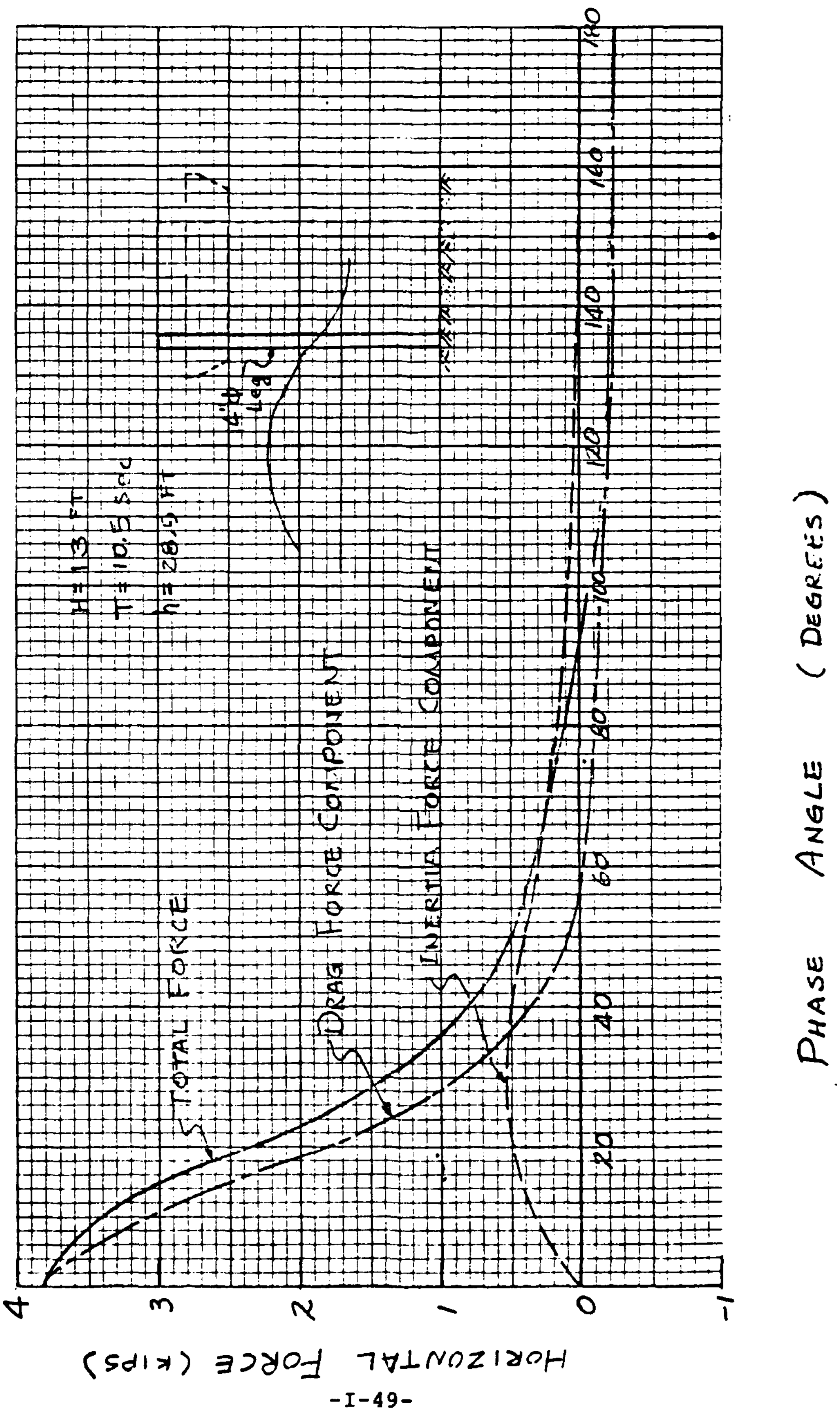
$$\frac{C_M \rho \pi D^2 (H/T^2) h}{4} = \frac{1.5(1.99)\pi(14/12)^2(13/10.5^2)(28.5)}{4}$$

= 10.72 lbs

= 0.011 Kips

Table V & VI

$\theta°$	0	10	20	30	50	75	100	130	180
F_D'	72.03	57.50	33.65	16.23	1.65	-.54	-2.54	-4.20	-4.55
F_D (KIPS)	3.82	3.05	1.78	0.86	0.09	-0.03	-0.13	-0.22	-0.24
F_I'	0	30.72	44.93	47.12	36.65	19.26	8.43	1.91	0
F_I (KIPS)	0	0.34	0.49	0.52	0.40	0.21	0.09	0.02	0
F_T (KIPS)	3.82	3.39	2.27	1.38	0.49	0.18	-0.04	-0.20	-0.24


H=13 FT
T=10.5 sec
h=28.9 FT
TOTAL FORCE
DRAG FORCE COMPONENT
INERTIA FORCE COMPONENT
4'0 Leg
PHASE ANGLE (DEGREES)
HORIZONTAL FORCE (KIPS)
4
3
2
1
0
-1
20
40
60
80
100
120
140
160
180

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2-3-77

Moments on 14"Φ Leg Due to Waves

$$\frac{C_D \rho D (H/T)^2 h^2}{2} = \frac{1.05(1.99)(14/12)(13/10.5)^2(28.5)^2}{2}$$

$$= 1517.6 \text{ ft-lbs}$$

$$= 1.52 \text{ ft-kips}$$

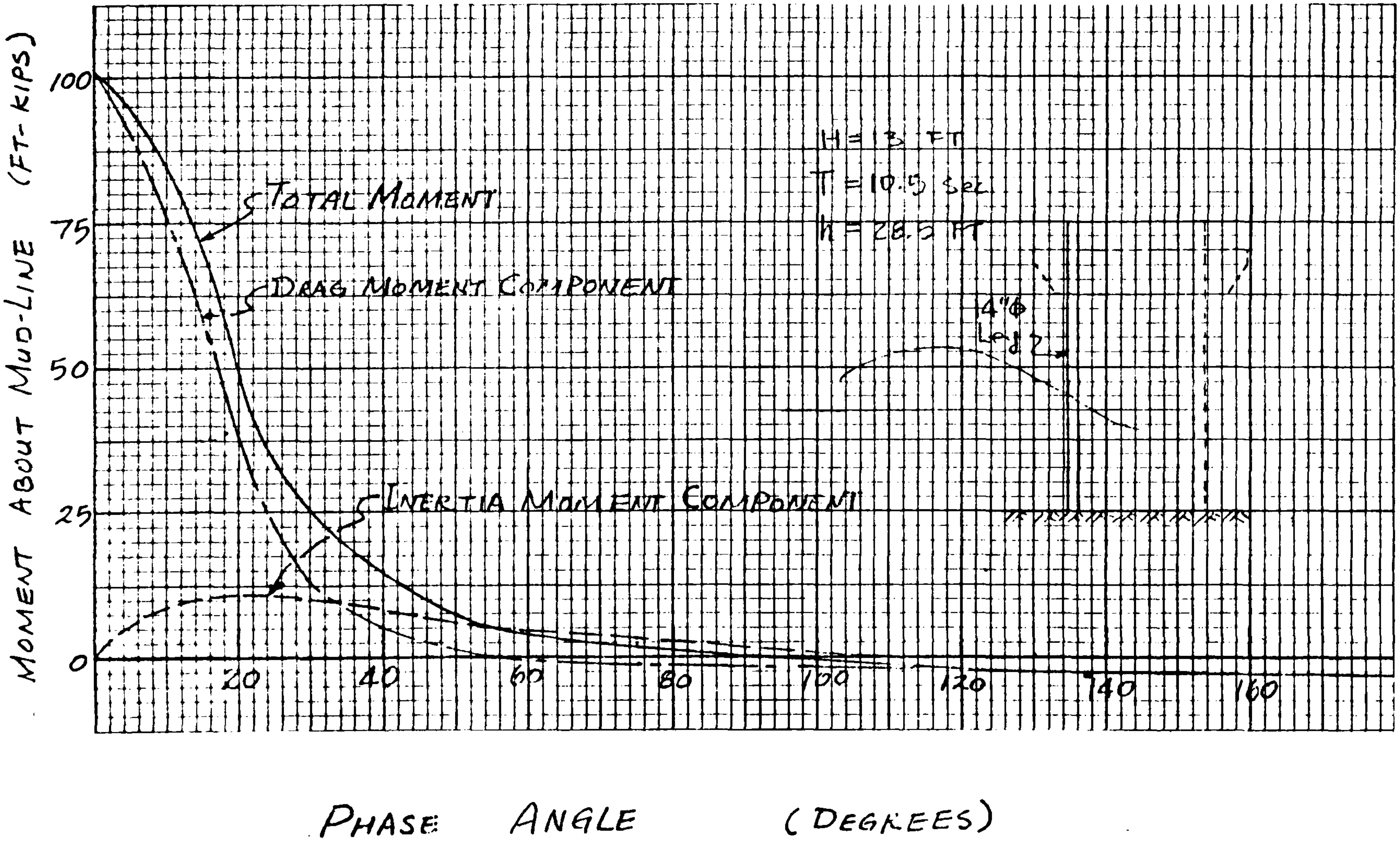
$$\frac{C_M \rho \pi D^2 (H/T^2) h^2}{4} = \frac{1.5(1.99)\pi(14/12)^2(13/10.5^2)(28.5)^2}{4}$$

$$= 305.6 \text{ ft-lbs}$$

$$= .31 \text{ ft-kips}$$

Table VII & VIII

θ°	0	10	20	30	50	75	100	130	180
M_D'	66.82	49.73	25.09	10.26	.71	-.33	-1.22	-1.87	-2.00
M_D (ft-kips)	101.57	75.59	38.14	15.60	1.08	-0.50	-1.85	-2.84	-3.04
M_I'	0	27.22	35.01	32.03	19.83	8.72	3.52	.77	0.
M_I (ft-kips)	0	8.44	10.85	9.93	6.15	2.70	1.09	0.24	0
M_T (ft-kips)	101.57	84.03	48.99	25.53	7.23	2.20	-0.76	-2.60	-3.04


TOTAL MOMENT
DRAG MOMENT COMPONENT
INERTIA MOMENT COMPONENT
H = 13 FT
T = 10.5 Sec
h = 28.5 FT
4"Φ
Leg 2
100
75
50
25
0
20
40
60
80
100
120
140
160
MOMENT ABOUT MUD-LINE (FT-KIPS)
PHASE ANGLE (DEGREES)

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Water Particle Velocity - Horizontal

$$\frac{H}{T} = \frac{13}{12.5} = 1.24 \text{ fps}$$

$$u = 1.24\, u' \text{ fps}$$

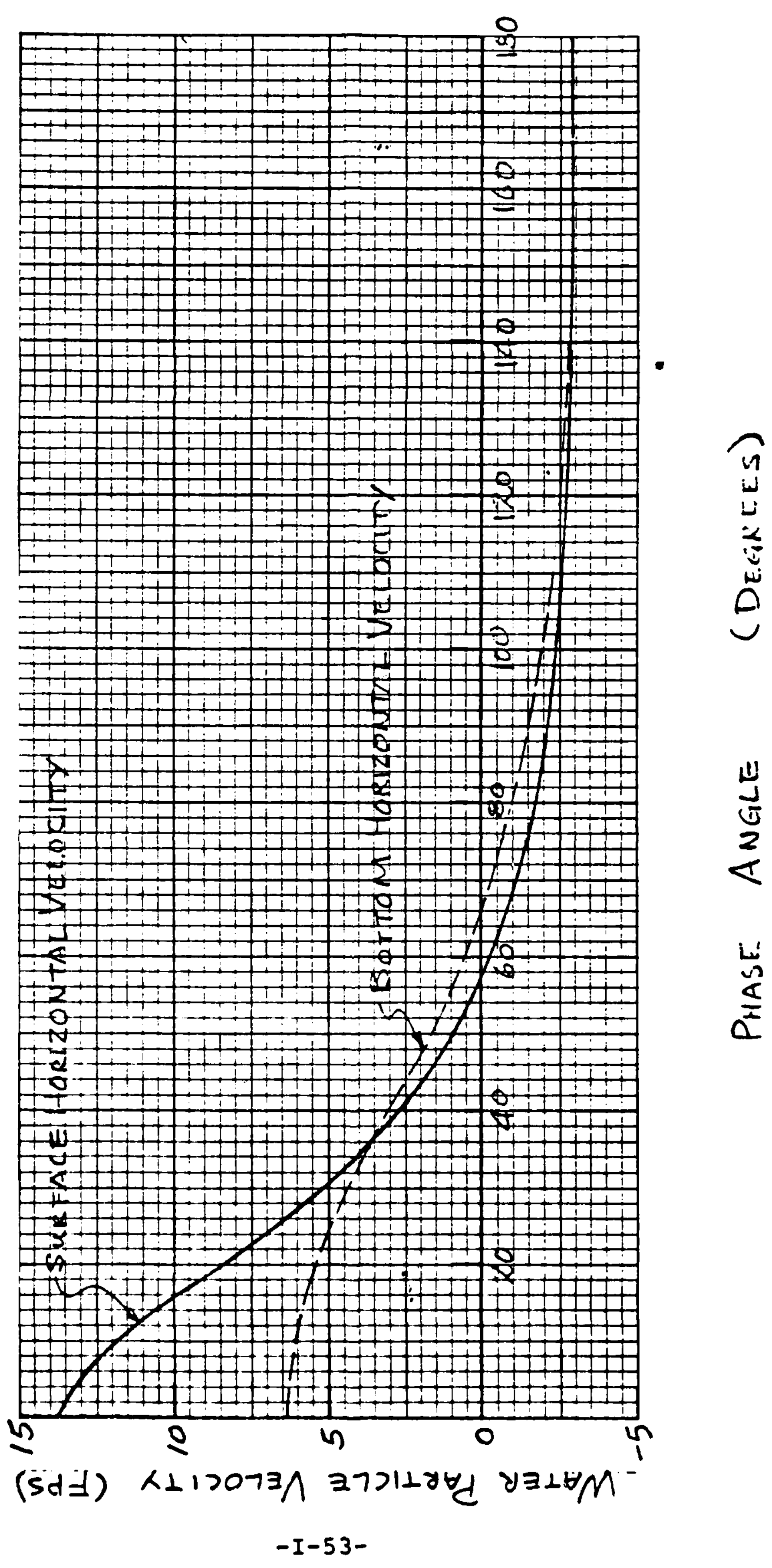
Table I

Surface Velocity

$\theta°$	0	10	20	30	50	75	100	130	180
u'	11.07	9.53	6.69	4.14	.75	-1.18	-1.90	-2.24	-2.31
u fps	13.73	11.82	8.30	5.13	.93	-1.46	-2.34	-2.78	-2.86

Bottom Velocity

$\theta°$	0	10	20	30	50	75	100	130	180
u'	5.11	4.90	[illegible]	3.44	[illegible]	[illegible]	-1.57	-2.16	[illegible]
u fps	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-.63	-1.95	-2.68	[illegible]


SURFACE HORIZONTAL VELOCITY
BOTTOM HORIZONTAL VELOCITY
PHASE ANGLE (DEGREES)
WATER PARTICLE VELOCITY (FPS)
15
10
5
0
-5
20
40
60
80
100
120
140
160
180

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2. Wind Forces

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2-3-77

WIND FORCES

Gust Wind Speed $V = 52$ knots

$= 52 \cdot \left(\frac{6080}{5280}\right)$

$= 59.88$ mph

(say 60 MPH)

Wind Pressure $p = 0.00256\, C_s V^2$

$= 0.00256\,(60)^2\, C_s$

$= 9.22\, C_s$ psf

Shape	Shape Factor C_s	Wind Pressure p psf
Cylindrical Member	1.0	9.22 (use 10 [illegible])
Flat Face	1.5	13.83 (use 15 [illegible])

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ITEM	Wind Area SQ. FT	Wind Pressure PSF	Wind Force Lbs	Moment Arm FT	Moment FT-KIPS
Barge	40×5=200	15	3000.	51.2	153.6
Wheelhouse	10×7.5=75	15	1,125.	57.4	64.6
Legs	4×(12/12)×(60-26) = 158.7	10	1,587.	43.0	68.2
Towers	112.5	10	1,125.	76.2	85.7
			6,837		[illegible]

Tower $\left(4 \times \frac{2.5}{12}\right) \times 4 = 37.5$ SQ FT for 4-columns

Braces and Extension Arms Total Estimated
on $37.5 \times 3 = 112.5$ SQ FT

Wind Force Centroids:

[illegible] 43 [illegible]

℄ barge $43.7 + 2.5 = 51.2$ ft
℄ Wheelhouse $[illegible] = [illegible]$ ft
℄ Legs $26 + (60-26)/2 = 43.0$ ft
℄ Towers $43.[illegible] + 5 + 22.5 = 76.2$ ft

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3. GRAVITY LOADS

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Dry Weight -- MAT

BILL OF MATERIAL

DESCRIPTION	MATERIAL	WEIGHT	QTY	TOTAL WT LBS
18" PIPE X .375 WALL X 35'-0" LG.	STEEL	2471	2	4942.
18" PIPE X .375 WALL X 34'-3" LG.	STEEL	2418	2	4836.
18" PIPE X .375 WALL X 14'-10 13/16 LG.	STEEL	1052	2	2,104.
18" PIPE X .375 WALL X 26'-6" LG.	STEEL	1,871	1	1,871.
18" PIPE X .375 WALL X 12'-6" LG.	STEEL	882	2	1,764.
18" PIPE X .375 WALL X 17'-2" LG	STEEL	1210	2	2,420.
18" PIPE X .375 WALL X 7'-0" LG.	STEEL	494	2	988.
18" PIPE X .375 WALL X 5'-6" LG.	STEEL	288	8	2,304.
8" PIPE X .322 WALL X 4'-6" LG	STEEL	124	2	248.
8" PIPE X .322 WALL X 3'-6" LG.	STEEL	79	1	79.
8" PIPE X .322 WALL X 7'-6" LG.	STEEL	169	2	338.
8" PIPE X .322 WALL X 10'-0" LG	STEEL	226	2	452.
3/16 PL 3'-6" X 5'-6"	STEEL	295	8	2,360.
3/16 PL 4'-0" X 2'-0"	STEEL	61	2	122.
3/16 PL 4'-0" X 7'-7 11/16	STEEL	215	2	430.
3/16 PL 4'-0" X 7'-4 11/16	STEEL	226	4	904.
3/16 PL 4'-0" X 3'-0	STEEL	92	2	184.
3/16 PL 9'-5" X 7'-1" 13/16	STEEL	268	4	1,072.
3/16 PL 8'-2" X 6'-9"	STEEL	211	4	844.
1/2 PL 14" X 42 3/8	STEEL	84	8	672.
1/2 PL 26" X 42 3/8	STEEL	135	4	540.
1/2 PL 26" X 42 3/8	STEEL	99	4	396.
3/8 PL 18 DIA.	STEEL	27	1	27.
2" STD. COUPLING	STEEL	1	5	5
2" STD. PIPE PLUG.	STEEL	1	5	5
				29 957

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BILL OF MATERIAL				
DESCRIPTION	MATERIAL	WEIGHT	QTY	TOTAL WT LBS
MAT	SEE DWG.	30,707	1	30,707
OUT-BOARD RUB RAIL		2782	4	2,782
JACK UP LEG		4820	4	19,280
RACK & PINION & FAB.		6440	1	6,440
HULL		65,240		65,240*
PROPULSION ASS'Y & RUDDER DETAILS				
CABIN ASS'Y	SEE DWG.	5459	1	5,459
CABIN HATCH COVER	SEE DWG	92	1	92

Total Dry Wt : 130,000**

** Value given in Scope of Work
* Calculated Value from (Total Weight – know Values)

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<u>Buoyed WEIGHT – MAT</u>

Assuming that all 18"ϕ members will be flooded.

flooded unit weight

$$\mu' = 70.59 - 64.\times\left(\frac{20.76}{144}\right) = 61.36\ \#/ft$$

8"ϕ Members will be air tight

$$\mu' = 28.55 - 64\cdot\frac{\pi}{4}\left(\frac{8.625}{12}\right)^2 = 2.58\ \#/ft$$

18"ϕ members Flooded Wt:

$$61.36\times(35\times2 + 34.25\times2 + 15\times2 + 26.5\times1 + 26.5\times2 + 17.2\times2 + 7.0\times2 + 5.5\times8)$$

= [illegible]

= [illegible] #

[illegible]

[illegible] $+ 10.0\times2)$

= [illegible]

= [illegible]

Miscellaneous [illegible] Mat) -- 15% [illegible]

[illegible] = 6.[illegible] #

MAT WEIGHT = [illegible] + [illegible] + 6.[illegible] = [illegible].437 #

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Buoyed WEIGHT – LEG

Assuming that storm water level at EL.(+) 38.7 FT

14"Φ x .5" WT Buoyed unit weight

$$u' = 72.09 - 64\left(\frac{\pi}{4}\right)\left(\frac{14}{12}\right)^2 = \text{[illegible]}\ \#/\text{ft}$$

$$\text{[illegible]} = \{\text{[illegible]} \times 38.\text{[illegible]} + 72.0\text{[illegible]} \times (60 - \text{[illegible]})\} \times 4$$

$$= 6{,}710\ \#$$

TOTAL BUOYED WEIGHT

DESCRIPTION	DRY WEIGHT	BUOYED WEIGHT
[illegible]	[illegible] 707#	[illegible]#
OVERALL SUPPORT [illegible]	[illegible] 732	[illegible]
[illegible]	19,280	[illegible]
RACK & PINION @ FAC	6,440	[illegible] 440
HULL	65,[illegible]40	[illegible]
PRODUCTION AREA		
CABIN ASSY	?,459	[illegible]
CABIN HATCH COVER	92	92
TOTAL WEIGHT (LBS)	130,000	114,160

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4. EARTHQUAKE LOADS

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EARTHQUAKE LOADS

ANSI Spec.
§8.2 Min. Earthquake Forces for Structures

Lateral Force $V = ZKCW$

$Z = 1.0$ for zone 3
$K = 3.0$ Table 22
$C = 0.10$ for single story
$(0.12 \le K \le 0.25)$

$V = 1.0 \times 0.25 W$
$= 0.25 W$

Structural Element Weight w/o Mat
$W = (130 - 30.7)$
$= 99.3$ kips

Lateral Force $V = 0.25 \times 99.3$
$= 24.8$ kips

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SURVIVAL CONDITION:

Overturning Moment $= V \cdot h$

$= 24.8 \times 54^{*}$

$= 1339.2$ ft-kips

* Estimated Center of Gravity at Survival Elevation

OPERATING CONDITION:

Overturning Moment $= 24.8 \times 28^{**}$

$= 694.4$ ft-kips

** Estimated Center of Gravity at Operating [illegible]

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5. LOADING COMBINATIONS

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SURVIVAL CONDITION

(1) Design Wave Forces + Wind Forces :

Horizontal Force @ Mud-Line = 4 × 3.82 + 6.84 = 22.12 Kip.

Overturning Moment @ Mud-Line = 4 × 141.87 + 391.1 = 958.58 ft-kips

(2) Earthquake Load + 30% (Design Wave + Wind Forces)

Horizontal Force @ Mud-Line = 24.8 + 0.3 × 22.12 = 31.44 Kip ←

Overturning Moment @ Mud-Line = 1339.2 + 0.3 × 958.4 = [illegible] ftkips ←

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OPERATING CONDITION

(1) Earthquake Load + 30% (Design Wave + Winds)

Horizontal Force @ Mud-Line $= 24.8 + 0.3 \times 22.12 = 31.44$ kips.

Overturning Moment @ Mud-Line $= 624.7 + 0.3 \times 1008.4 = 927.9$ ft-kip

3-4-77

6. CONCEPTS AND SOLUTIONS

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CONCEPT No. 1

Statement: Use the existing Sr. Robert as a gravity platform.

Loadings:

Environmental Forces:

	Survival	Operating
Horiz. Force:	31.44 kips	31.44 kips
Overturning Mom:	1,572.7 ft-kips	927.9 ft-kips

Gravity Forces:

Barge Dry Weight = 130 kips
Buoyed Weight = 114 kips

Supporting Mat Size

35' x 30'

Leg Center-Line Distance

22'-6"

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Solution

(a) Survival Condition:

Overturning Stability:

$$\text{Factor of Safety (F.S.)} = \frac{\text{Resisting Moment}}{\text{Overturning Moment}}$$

M_o = Overturning Moment = 1,572.7 ft-kip

M_r = Resisting Moment $= 114 \times \frac{22.5}{2} = 1282$ ft-kips

$$F.S. = \frac{1282}{1572.7} = 0.82 \leftarrow$$

Sliding Stability:

$$F.S. = \frac{\text{Resisting Shear @ Base}}{\text{Applied Shear @ Base}}$$

H_a = Applied Shear @ Base = 31.44 kips

H_r = Resisting shear @ Base

$= 0.3^{*} \times 114 = 34.2$ kips

$$F.S. = \frac{34.2}{31.44} = 1.09 \leftarrow$$

* Estimated friction coefficient at mat base

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<u>Column Strength</u>

14" Ø × .5' WT Pipe

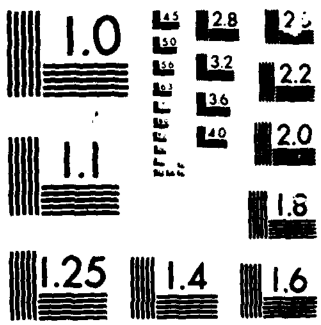
Section Modulus $S = 69.13\ in^3$
Estimated Allowable $\sigma = 15$ ksi
Stress @ Deck-Pile
junction

$$M_r = 4 \times (15 \times 69.13/12) = 345.6 \text{ ft-kips}$$

$$F.S. = 1.67 \times \frac{345.6}{1592.7} = 0.3[illegible] \blacktriangleleft$$

AD-A165 768 PROJECT METEOR FEASIBILITY STUDIES ON THE CONVERSION OF THE SIR ROBERT TO..(U) NAVAL FACILITIES ENGINEERING COMMAND WASHINGTON DC CHESAPEAKE.. C CHERN JUN 77 2/4

UNCLASSIFIED CHES/NAVFAC-FPO-1-7717-VOL-2 F/G 13/10 NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A

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2-4-77

(b) Operating Condition:

Overturning Stability:

$$F.S. = \frac{1283}{927.9} = 1.38 \leftarrow$$

Sliding Stability:

$$F.S. = \frac{34.2}{31.44} = 1.09 \leftarrow$$

Column Strength

$$M_r = 4\{20^* \times 69.13/12\} = 461 \text{ ft-kips}$$

* Increased allowable stress for short column

$$F.S. = 1.67 \times \frac{461}{927.9} = 0.83 \leftarrow$$

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(c) Survival Condition under Design Wave & Wind

Horiz. Force : 22.12 kips
Overturning Mom : 778.38 ft-kips

Overturning Stability :

$M_o = 778.38$ ft-kips

$M_r = 114 \times \frac{22.5}{2} = 1282$ ft-kips

$F.S. = \frac{1282}{778.4} = 1.65$ ←

Sliding Stability :

$H_a = 22.12$ kips

$H_r = 34.2$ kips

$F.S. = \frac{34.2}{22.12} = 1.55$ ←

Column Strength

$M_c = 778.38$ ft-kips

$M_r = 354.6$ ft-kips

$F.S. = 1.67 \times \frac{354.6}{778.4} = 0.76$ ←

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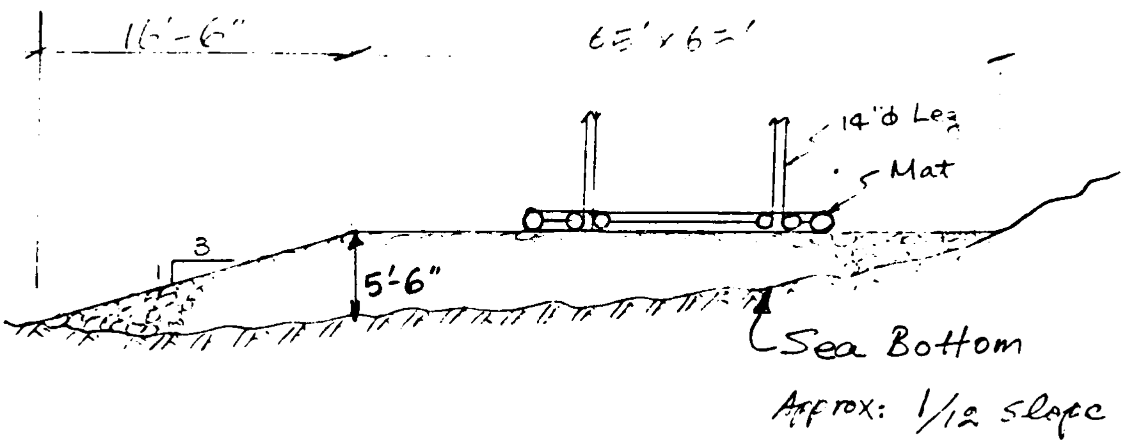
Foundation -- Gravel Back-fill to obtain flat base.



Approximate Calculation of Back-fill volume

$A = \frac{1}{2} \times 5.5 \times (16.5 + 65)$

$= 224$ SQ.FT

$V = 224 \times (65 + 16.5)$

$= 18,256$ cu. ft

$= 676$ cu. yd.

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CONCEPT NO. 2

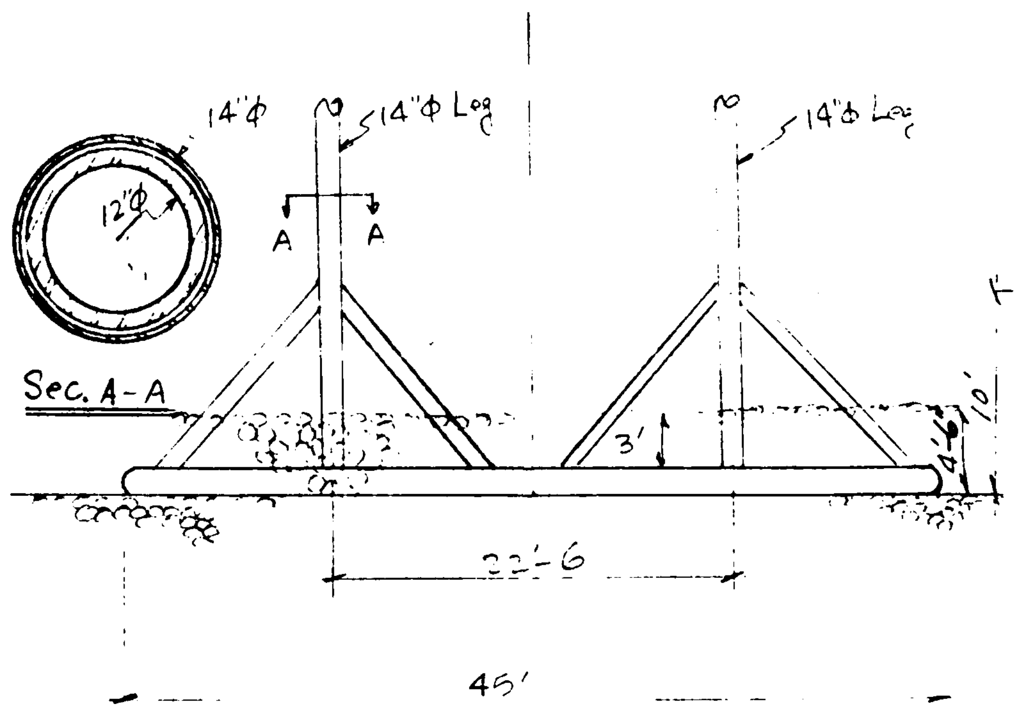
Modification on the Jack-up Barge (Concept #1):

(1) Enlarge mat size to 50' x 45'

(2) Insert 12"Φ x 1" WT Pipe into 14"Φ x .5" WT Leg and grout the gap

(3) 3 ft Gravel back-fill on top of the mat

(4) Leg braces at 10 ft level.



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Loadings:

12"φ x 1" WT Pipe unit weight = 117.5 #/ft

$W' = 4 \times (117.5 \times 60)/1000 = 28.2$ kips

Increased Earthquake Load

$V' = 0.25 \times 28.2 = 7.1$ kips

$M' = 7.1 \times 30 = 213$ ft-kips

18"φ x .375" members @ flood state, additional gravity weight at mat is

$W'' = 61.36 \times 2 \times (50+45)/1000 = 11.7$ kips

Environmental Forces:

Horiz. Force :	38.54 kips	38.54 kips
Overturning Mom :	1,785 ft-kips	1126.6 ft-kips
	(Survival)	(Operating)

Gravity Force:

Buoyed Weight (Barge) = $114 + 28.2 + 11.7 = 153.9$ kips

Gravel $= (3 \times 45 \times 50) \times \frac{110-64}{1000} = 310.5$ kips

461.4 kips

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SOLUTION

(a) Survival Condition:

Overturning Stability:

$$M_o = 1{,}785 \text{ ft-kips}$$

$$M_r = 464.4 \times \left(\frac{42.0}{2}\right) = 9{,}752.4 \text{ ft-kips}$$

$$F.S. = \frac{9{,}752.4}{1{,}785} = 5.46 \leftarrow$$

Sliding Stability:

$$H_o = 38.54 \text{ kips}$$

$$H_r = 0.3 \times 464.4 = 139.32 \text{ kips}$$

$$F.S. = \frac{139.32}{38.57} = 3.61 \leftarrow$$

Column Strength

Grouting will force two pipes to bend at the same curvature. that is, $M = M_1 + M_2$

$$\text{Section Capacity} = 4 \times \left\{ 20 \times (69.13 + 87.83)/12 \right\}$$

$$= 1046.4 \text{ ft-kips}$$

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Applied Moment @ 10' Level

$$= 1785 - 38.54 \times 10$$

$$= 1400 \text{ ft-kips}$$

$$F.S. = 1.67 \times \frac{1046.4}{1400} = 1.25 \longleftarrow$$

(b) Operating Condition:

Overturning Stability:

$$F.S. = \frac{9,752.4}{1126.6} = 8.66 \longleftarrow$$

Sliding Stability:

$$F.S. = \frac{139.32}{38.54} = 3.61 \longleftarrow$$

Column Strength

$$M_a = 1126.6 - 38.54 \times 10 = 741.2 \text{ ft-kips}$$

$$F.S. = 1.67 \times \frac{1046.4}{741.2} = 2.36 \longleftarrow$$

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2-7-77

(C) Survival Condition under Design Wave & Wind

Horiz. Force : 22.12 kips
Overturning Mom : 778.38 ft-kip

Overturning Stability:

$M_o = 778.4$ ft-kips

$M_r = 9,752.4$ ft-kips

$$F.S. = \frac{9,752.4}{778.4} = 12.53 \longleftarrow$$

Sliding Stability:

$H_a = 22.12$ kips

$H_r = 139.32$ kips

$$F.S. = \frac{139.32}{22.12} \doteq 6.30 \longleftarrow$$

Column Strength

$M_o = 778.4$ ft-kips

$M_r = 1046.4$ ft-kips

$$F.S. = \frac{1046.4}{778.4} \times 1.67 = 2.24 \longleftarrow$$

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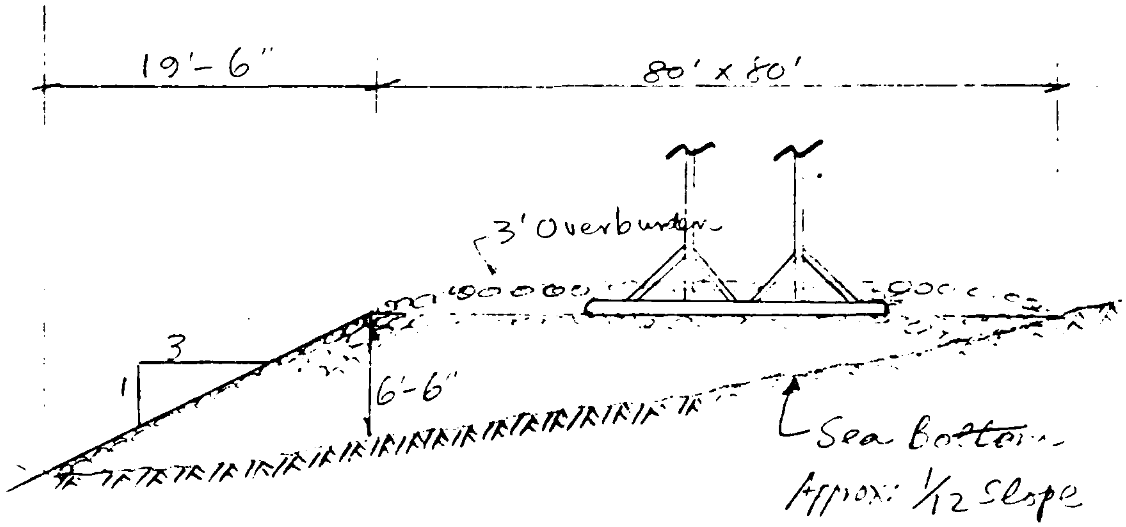
Foundation -- Gravel Backfill to obtain flat base and overburden



Approximate Calculation of Backfill volume

$$A = \frac{1}{2} \times 6.5 \times (19.5 + 80) + 3 \times 80$$

$$= 564 \text{ sq ft}$$

$$V = 564 \times (80 + 19.5)$$

$$= 56,118 \text{ cu. ft}$$

$$= 2,078 \text{ cu. yd.}$$

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2-4-77

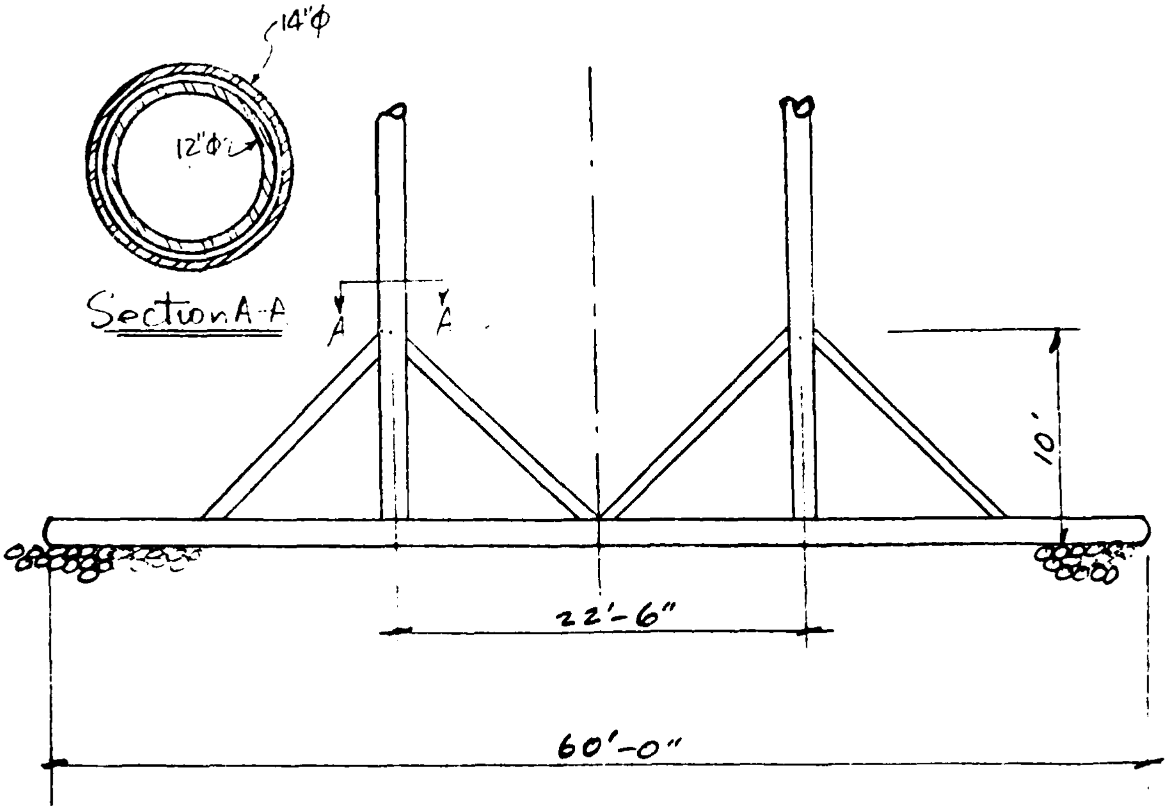
CONCEPT No. 3

Modification on the Jack-up Barge (Concept #1):

(1) Enlarge mat size to 60'x60'

(2) Insert 12"Φx1" WT Pipe into 14"Φx.5" WT Leg and grout the gap.

(3) Leg braces at 10ft level.



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Loadings:

3'φ x 1" WT Pipe unit weight = 117.5 #/ft

$w' = 4 \times 117.5 \times 60 / 1000 = 28.2$ kips

Increased Earthquake Loads

$V' = 0.25 \times 28.2 = 7.1$ kips

$M' = 7.1 \times 30 = 213$ ft-kips

18"φ x .375" WT member @ flooded state, additional gravity weight @ mat level is

$w'' = 61.36 \times 2 \times (60 + 60 + 2 \times 15 + 2 \times 12.5) / 1000$

$= 21.48$ kips

Environmental Forces:

Horiz. Force :	38.54 kips	33.[illegible] kips
Overturning Mom :	1,785 ft-kips	1126.[illegible] ft-kips
	(Survival)	(Operating)

Gravity Force:

Buoyed Barge Weight = 114 + 28.2 + 21.48 = 163.7 kips

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SOLUTION

(a) Survival Condition:

Overturning Stability:

$M_o = 1.785$ ft-kip

$M_r = 163.7 \times \left(\frac{60-3}{2}\right) = 4.669.5$ ft-kips

$F.S. = \frac{4.669.5}{1.785} = 2.61 \longleftarrow$

Sliding Stability:

$H_a = 38.54$ kip

$H_r = 0.3 \times 163.7 = 49.11$ kips

$F.S. = \frac{49.11}{38.54} = 1.27 \longleftarrow$

Column Strength

See Concept #2 Solution

$F.S. = 1.20 \longleftarrow$

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(b) Operating Condition:

Overturning Stability:

$$F.S. = \frac{4,665.5}{1126.6} = 4.14 \leftarrow$$

Sliding Stability:

$$F.S. = \frac{49.11}{38.54} = 1.27 \leftarrow$$

Column Strength

See Concept #2 Solution

$$F.S. = 2.36 \leftarrow$$

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(c) Survival Condition under Design Wave & Wind

Horiz. Force : 22.12 kips
Overturning Mom : 778.4 ft-kips

Overturning Stability:

$M_o = 778.4$ ft-kips

$M_r = 4,665.5$ ft-kips

$$F.S. = \frac{4,665.5}{778.4} = 6.0 \longleftarrow$$

Sliding Stability:

$H_a = 22.12$ kips

$H_r = 49.11$ kips

$$F.S. = \frac{49.11}{22.12} = 2.22 \longleftarrow$$

Column Strength

See Concept No. 2

$$F.S. = 2.24 \longleftarrow$$

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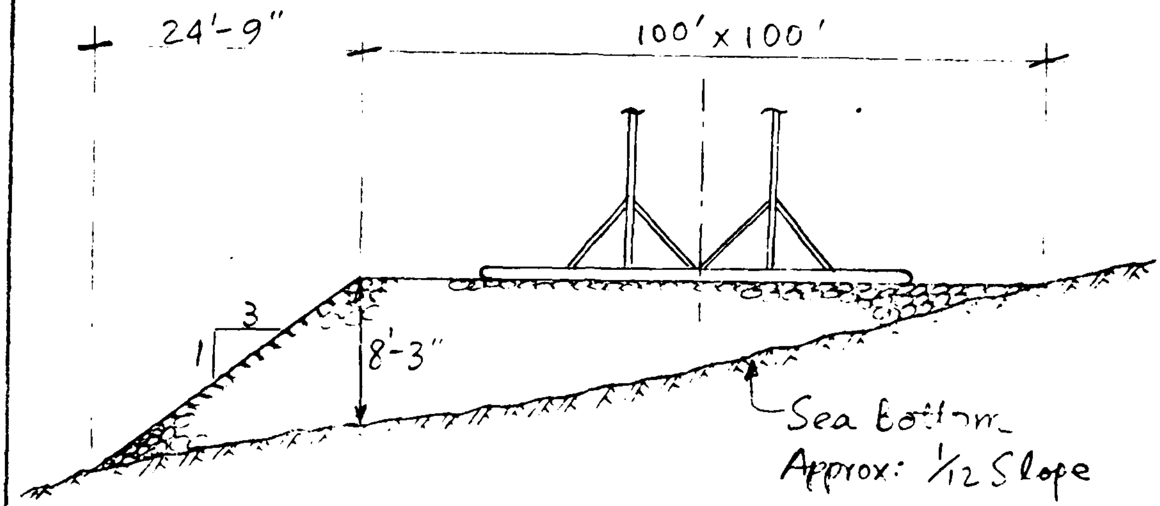
Foundation -- Gravel Backfill to obtain flat base



Approximate Calculation of Backfill Volume:

$A = \frac{1}{2} \times (8.25) \times (24.75 + 100)$

$= 514.6$ SQ. FT

$V = 514.6 \times (100 + 24.75)$

$= 64{,}196$ cu. ft

$= 2{,}378$ cu. yd.

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2-5-77

CONCEPT No. 4

Statement: Use existing St Robert as a gravity platform and reinforced with 8-Cables.

Loadings:

Environmental Forces:

Horiz. Force:	31.44 kip	31.44 kips
Overturning Mom:	1,572.7 ft-kip	927.7 ft-kip
	(Survival)	(Operating)

Gravity Force:

Barge Buoyed Weight = 114 kip

Supporting Mat Size

35' x 30'

Leg Center-Line Distance

22'-6"

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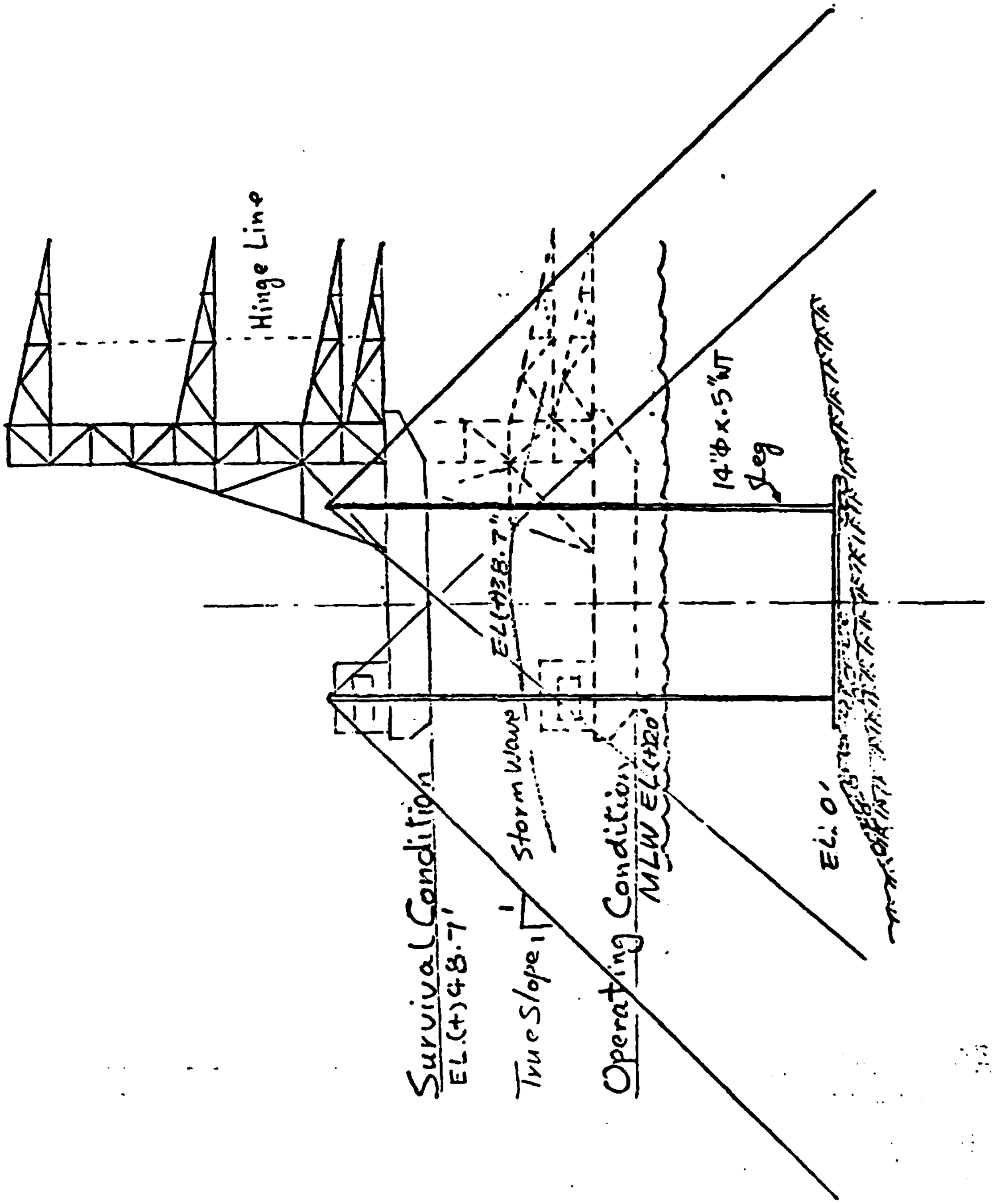
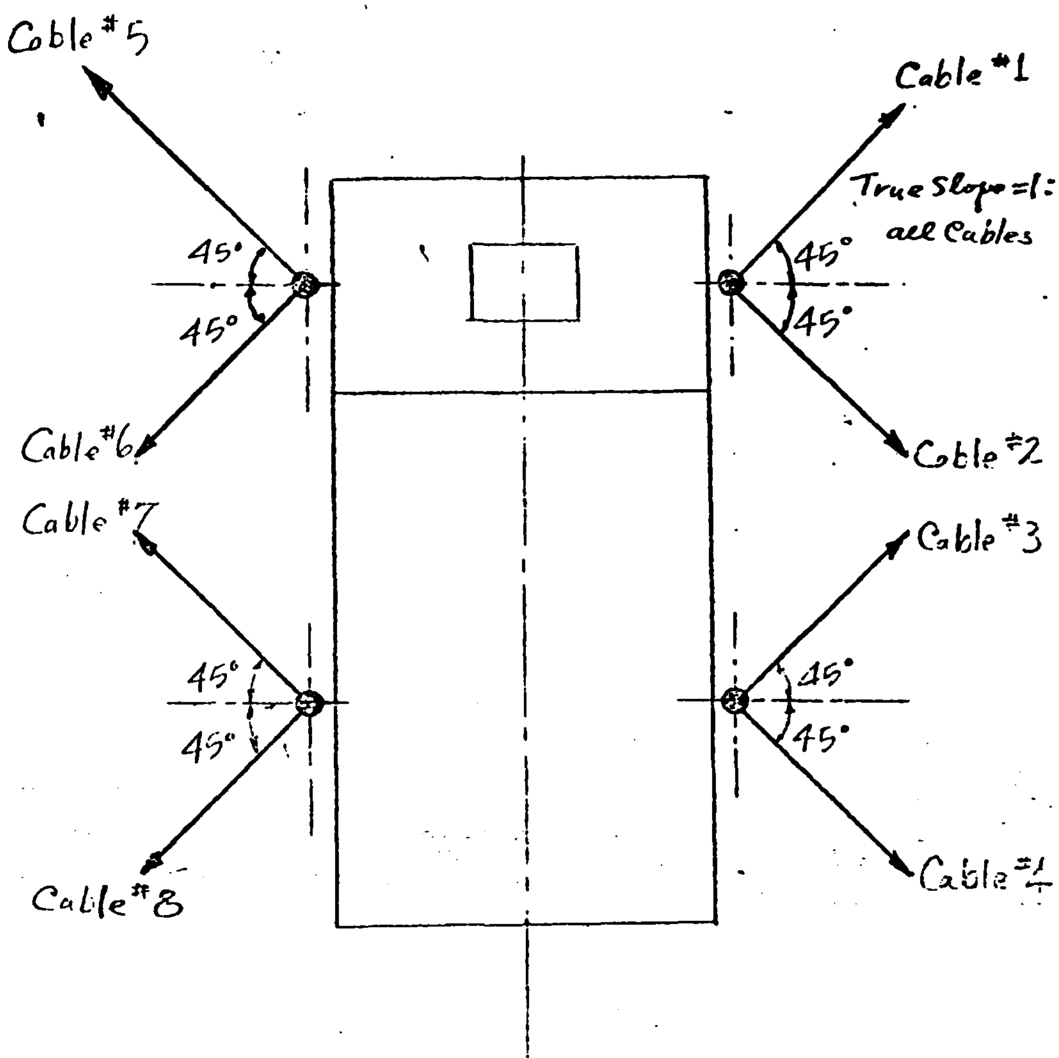

Hinge Line
Survival Condition
EL.(+)48.7'
True Slope
Storm Wave
EL.(+)38.7'
Operating Condition
MLW EL(+)20'
14'Φ x .5" WT Leg
EL. 0'


Cable #5
Cable #1
True Slope = 1:1
all Cables
45°
45°
45°
45°
Cable #6
Cable #2
Cable #7
Cable #3
45°
45°
45°
45°
Cable #8
Cable #4

2-5-77

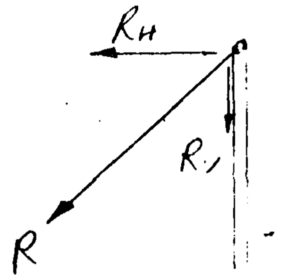
SOLUTION

(a) Survival Condition:

Overturning Stability:

Assuming that F.S. = 3 is desired.

Since cable cannot carry the compression load, the stability is achieved by the tension of two cables at one side of the barge.



Resisting Moment $M_r = \left(4 \times \frac{R_H}{\sqrt{2}}\right) \times 60$ ft-kip

Overturning Mom. $M_o = 1,572.7$ ft-kip

$$F.S. = \frac{\left(4 \times \frac{R_H}{\sqrt{2}}\right) \times 60}{1,572.7} = 3.0$$

$R_H = 27.8$ kips

$R = R_H \sqrt{2} = 39.3$ kips

Say $R = 40$ kips
$= 20$ tons

*** Anchor Capacity = 20 tons pulling resistance.

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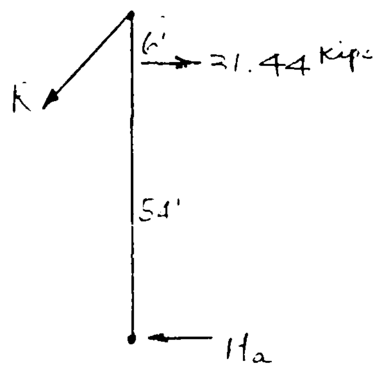
Sliding Stability :

Resisting Shear = 0.3 (Gravity + Reaction from Cable)

$$R_v' = \frac{4\frac{R}{\sqrt{2}}}{F.S.} = \frac{4 \times \frac{39.3}{\sqrt{2}}}{3} = 37.1 \text{ kips}$$

$$H_r = 0.3 \times (114 + 37.1)$$
$$= 45.33 \text{ kips}$$



$$H_a = \frac{31.44 \times 6}{60} = 3.14 \text{ kips}$$

$$F.S. = \frac{45.33}{3.14} = 14.4 \longleftarrow$$

[illegible]

M_a = Max Mom @ 6' from Log top = $\frac{3.14 \times 54}{2}$

$M_a = 84.8$ ft-kips

$M_r = 22 \times 69.13 / 12 = 126.7$ ft-kips

$$F.S. = \frac{126.7}{84.8} \times 1.67 = 2.50 \longleftarrow$$

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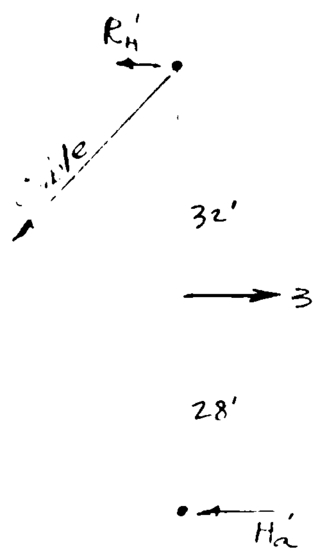
(2) Operating Condition:

Overturning Stability:



$$R'_H = \frac{(31.44/2)\times 28}{60}$$

$$= 7.34 \text{ kip}$$

$$2\left(R/\sqrt{2}\right)/\sqrt{2} = R'_H$$

$$R = R'_H = 7.34 \text{ kips}$$

$$F.S. = \frac{39.3}{7.34} = 5.35$$ ←

Sliding Stability:

H'_a = [illegible]

$$H_r = 0.3\times\left(114 + \frac{4\times 7.34}{\sqrt{2}}\right) = 40.4 \text{ kip}$$

$$F.S. = \frac{40.4}{2\times 8.38} = 2.4$$ ←

Column Strength:

$$M_a = 8.38\times 28 = 234.6 \text{ ft-kip}$$

F.S. = [illegible] ←

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(c) <u>Survival Condition Under Design Wave & Wind</u>

Horiz. Force: 32.12 kip

Overturning Mom: 778.4 ft-kip

[illegible]:

[illegible] is required.

$$M_r = \left(4 \times \frac{K}{\sqrt{2}} \cdot \frac{1}{\sqrt{2}}\right) \times [illegible] \text{ ft-kip}$$

[illegible] 4 ft-kips

$$F.S. = \frac{120K}{778.4} = 3.0$$ ←

$$K = 19.46 \text{ kips}$$

[illegible] kip

[illegible] Tons

** [illegible] capacity = [illegible] Tons [illegible]

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Foundation : Same as Concept No. 1

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CONCEPT NO. 4a

Statement: Same as Concept No. 4 with 12'Φx1"W. Pipe reinforcement in the 14'Φ leg

Loadings:

Environmental Forces:

See Concept No. 3

Horiz. Force:	38.54 kips	38.54 kips
Overturning Mom:	1.785 ft-kips	1.126 ft-kips
	(Survival)	(Operating)

Gravity Force:

Enlarged Barge Weight + Reinforcing Pipe: $114 + 28.2 = 142.2$ kips

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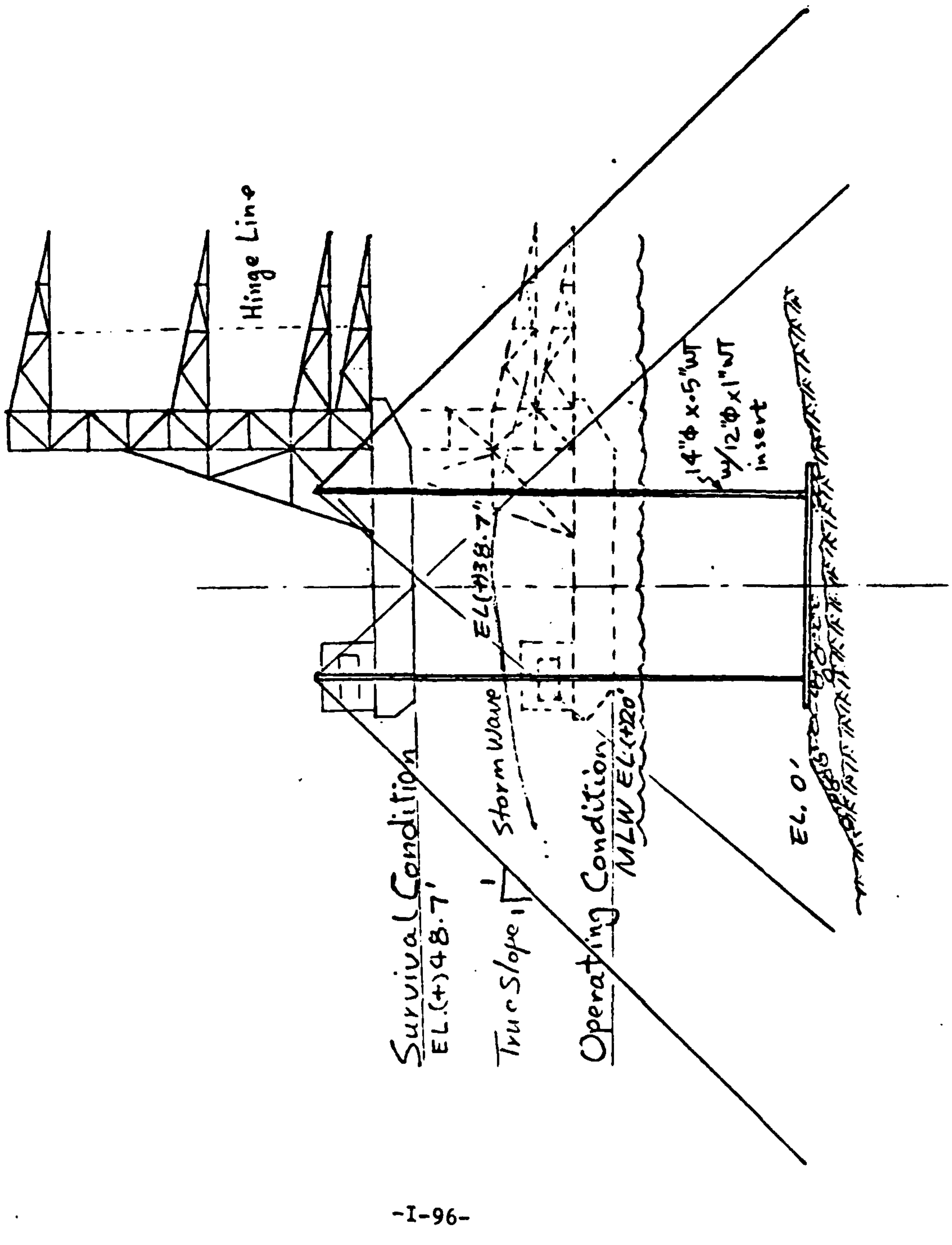

Hinge Line
14"Φ x .5" WT w/12"Φ x 1" WT insert
EL(+)38.7'
Storm Wave
EL. 0'
Survival Condition
EL.(+)48.7'
True Slope 1 1
Operating Condition
MLW EL(+)20'

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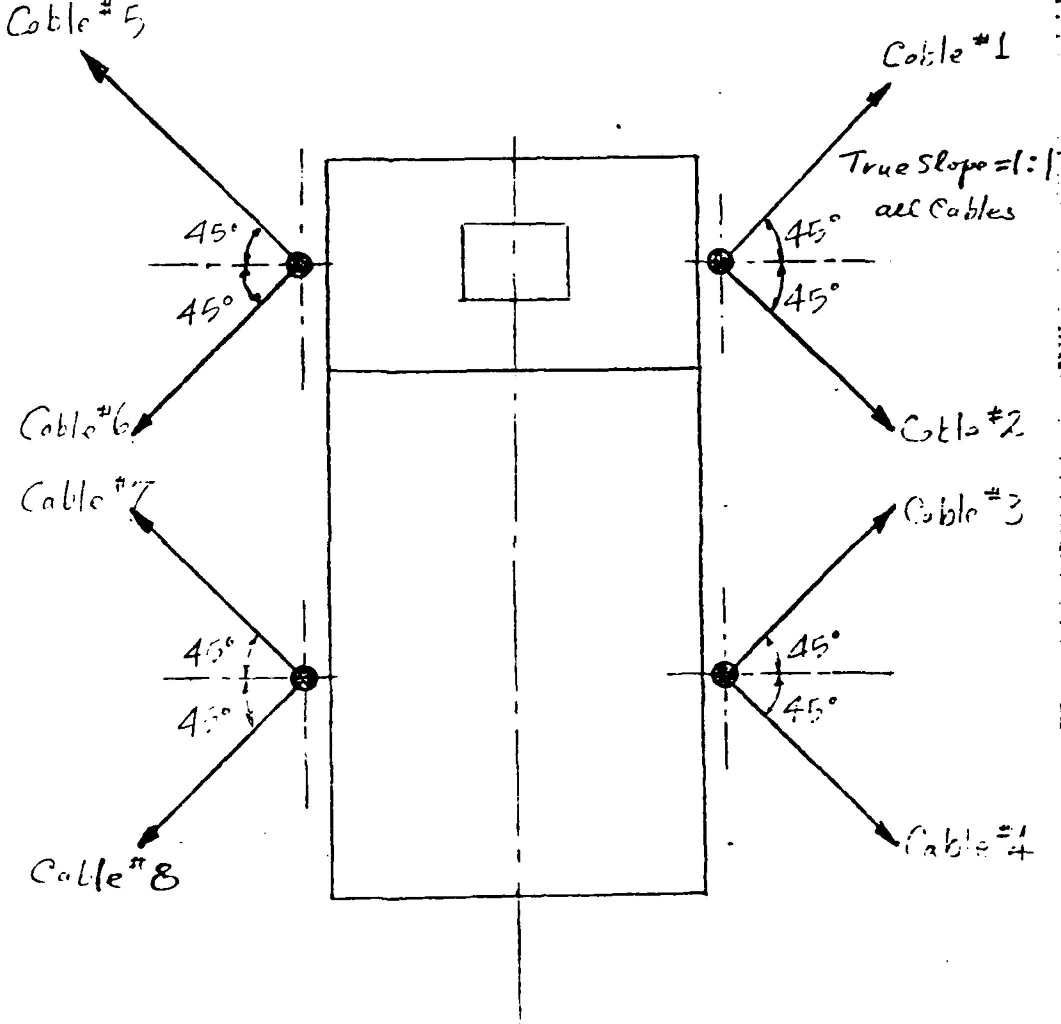
7-7-77


Cable #5
Cable #1
True Slope = 1:1
all Cables
45°
45°
45°
45°
Cable #6
Cable #2
Cable #7
Cable #3
45°
45°
45°
45°
Cable #8
Cable #4

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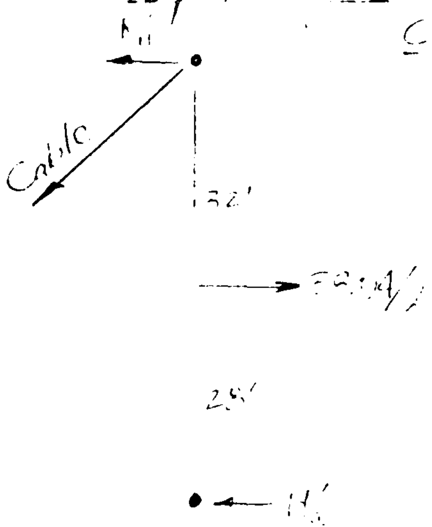
Solution

(a) Survival Condition:

See Concept No. 4

(b) Operation Condition:



$$R_H' = \frac{[illegible]}{60} = 8.[illegible] \text{ kips}$$

$$F.S. = \frac{39.3}{\frac{8.00}{2} \times \sqrt{2}} = 6.2 \longleftarrow$$

$$H_o = \frac{[illegible] \times 32}{[illegible]} = 10.28 \text{ [illegible]}$$

$$H_v = [illegible] = 2 \times (8.99 \times \sqrt{2}) = 50.29 \text{ kip.}$$

$$F.S. = \frac{50.29}{2 \times 10.28} = 2.45 \longleftarrow$$

Column Strength

$$M_o = 10.28 \times 28 = 287.84 \text{ ft-kip}$$

$$F.S. = \frac{[illegible]}{287.84} \times .67 = 1.67 \longleftarrow$$

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$$M_r = M_1 + M_2$$
$$= 22(69.13 + 80.89)/12$$
$$= 287.76 \text{ ft-kips}$$

By assuming that grouting will force two pipes to bend at the same curvature.

<u>Foundation</u>

Same as Concept No. 1

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REFERENCES

1. Dean, R.G.
EVALUATION AND DEVELOPMENT OF WATER WAVE THEORIES FOR ENGINEERING APPLICATION
[illegible] Army Corps of Engineers, [illegible]

2. Fors[illegible]thal, J. and Helvey, R.
SOME GEOPHYSICAL CONSIDERATIONS FOR [illegible] NORTHERN SAN NICOLAS [illegible],
Pacific Missile Test Center, Atmospheric Sciences Technical Note No. [illegible], December 1976

3. Ved[illegible]
GEOLOGY OF [illegible] NICOLAS ISLAND, [illegible]. Geological Survey Professional [illegible] 369, 1969

Appendix 7.3

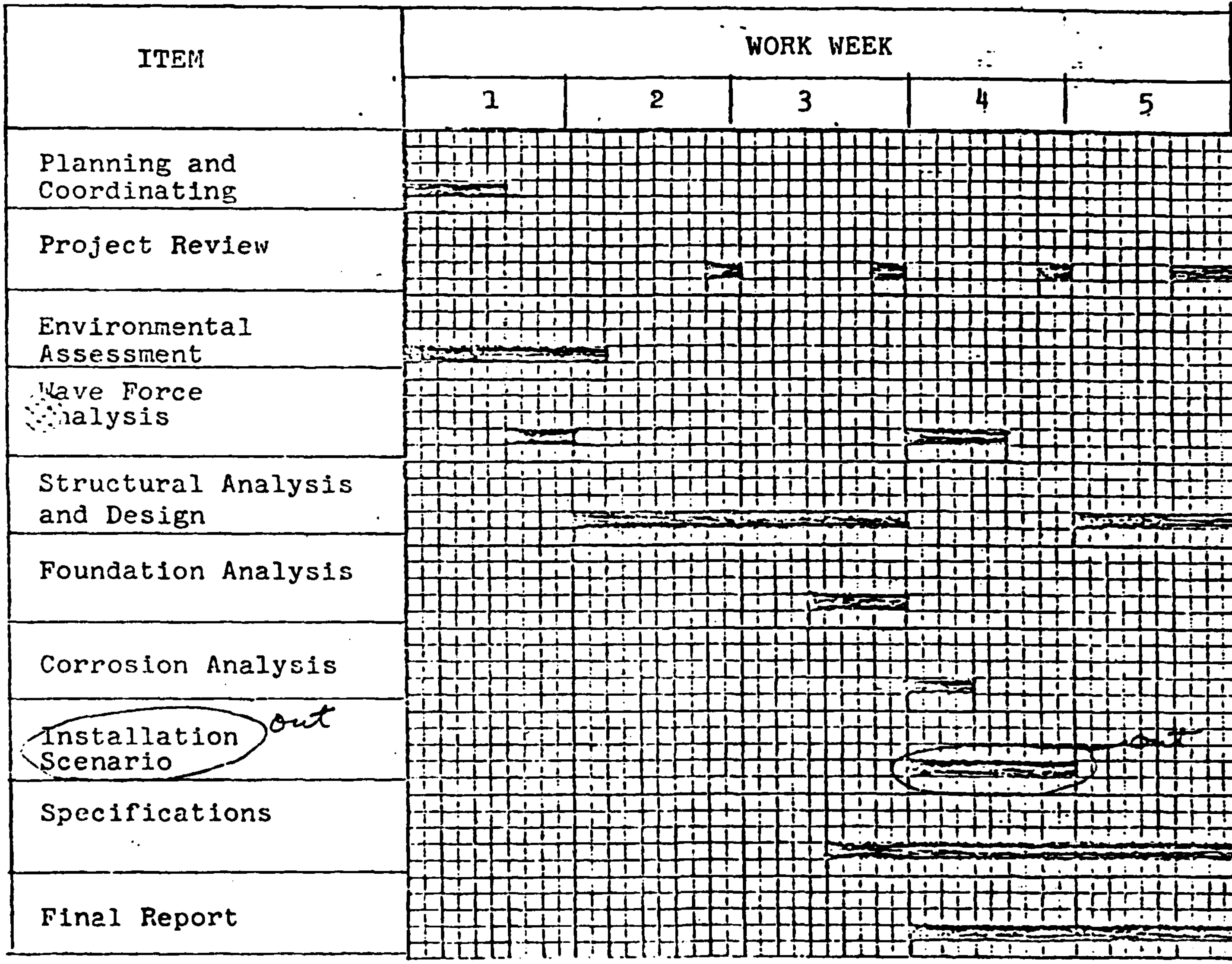
Schedule Information

Contract Procedure

Item	Estimated Time Req'd
Scope of Work	1 ~ 4 wks
Advertisement	2 ~ 3 wks
Response	1 wk
Slate Board Selection Board }	1 wk
Negotiation Board	1 wk
Notification of Award	–
	6 ~ 10 wks

TIME SCHEDULE -- Engineering Design

The following bar chart calendar shows a schedule of event completions. The calendar begins from time of project award.



Appendix 7.4

A Cost Estimate Report

A COST ESTIMATE REPORT

CONVERSION OF SIR ROBERT TO A

PERMANENT GRAVITY PLATFORM

BY

C. CHERN

OCEAN ENGINEERING AND CONSTRUCTION PROJECT OFFICE (FPO-1)
CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON NAVY YARD
WASHINGTON, D.C. 20374

FEBRUARY 1977

(This report initially provided to Mr. Ted Blanc during a 15 February 1977 meeting at CHESNAVFACENGCOM. It incorporates agreed changes in estimated cost items).

C. CHERN
2-15-77

TABLE OF CONTENTS

INTRODUCTION

Background

This report is prepared as a part of the support to Mr. Ted Blanc of Naval Research Laboratory (NRL) for the Project METOR Program Review and Planning Meeting held on 15 February 1977 at Ocean Engineering and Construction Project Office (FPO-1), Chespaeake Divsion, Naval Facilities Engineering Command. The planned work schedule and estimated total cost shown in this report are preliminary in nature. The main reasons are that the offshore site for the jackup barge is not yet defined and the sea floor soil properties at the barge site is still unknown. The preparation of offshore site is usually very costly.

Cost Items

The cost items considered in this report are as follows:

Feasibility Study

- Concept Selection
- Scheduling
- Cost Estimate

Site Selection

- Sea Floor Survey
- Site Selection
- Soil Core Sampling and Analysis

Engineering Design

- Environmental Assessment
- Wave Force Analysis
- Structural Analysis/Design
- Foundation Analysis
- Corrosion Protection Analysis/Design
- Specifications/Drawings
- Design Report

Fabrication

- Structural Modification
- Cathodic Protection
- Paint
- Miscellaneous Attachment

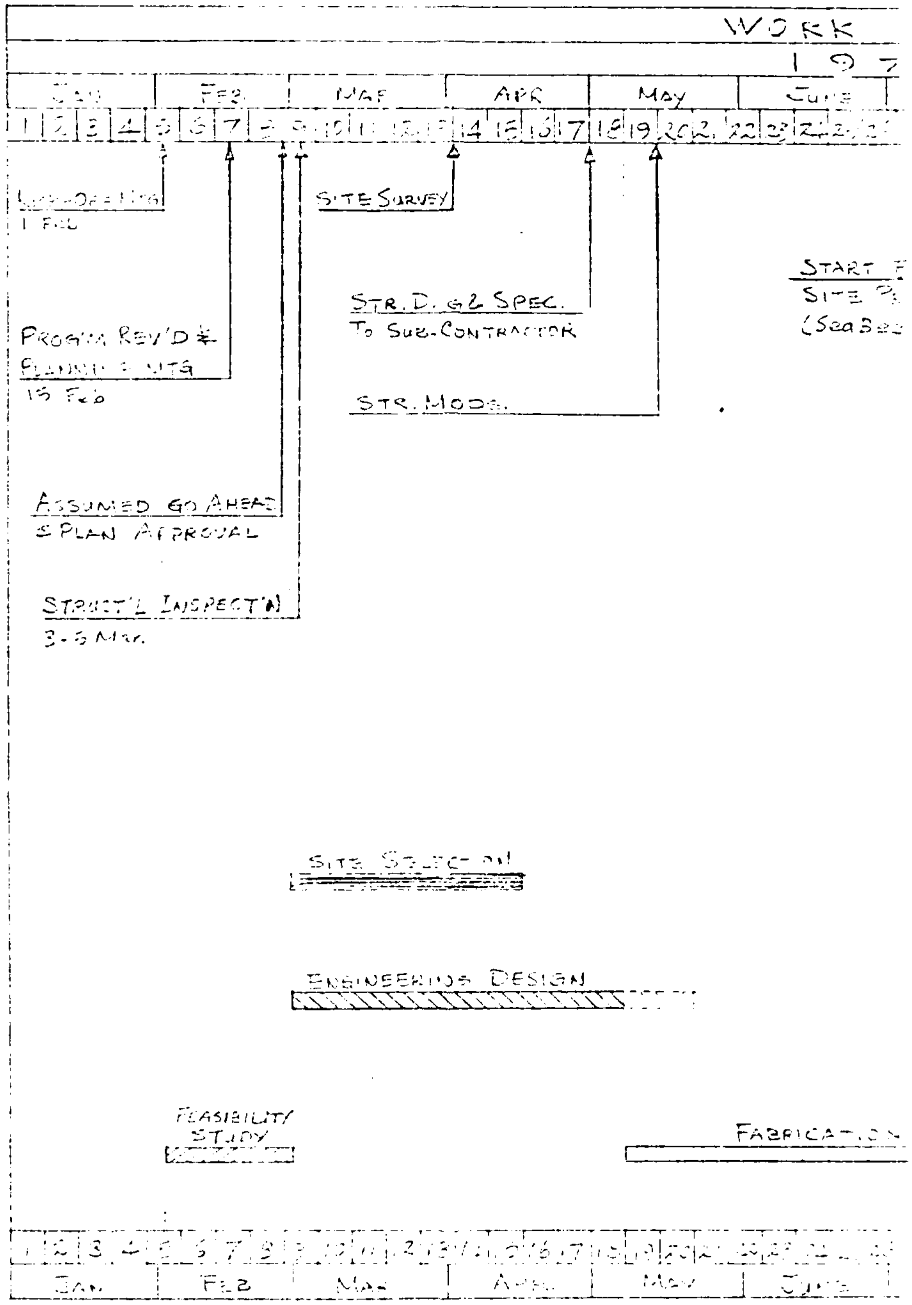
Site Preparation

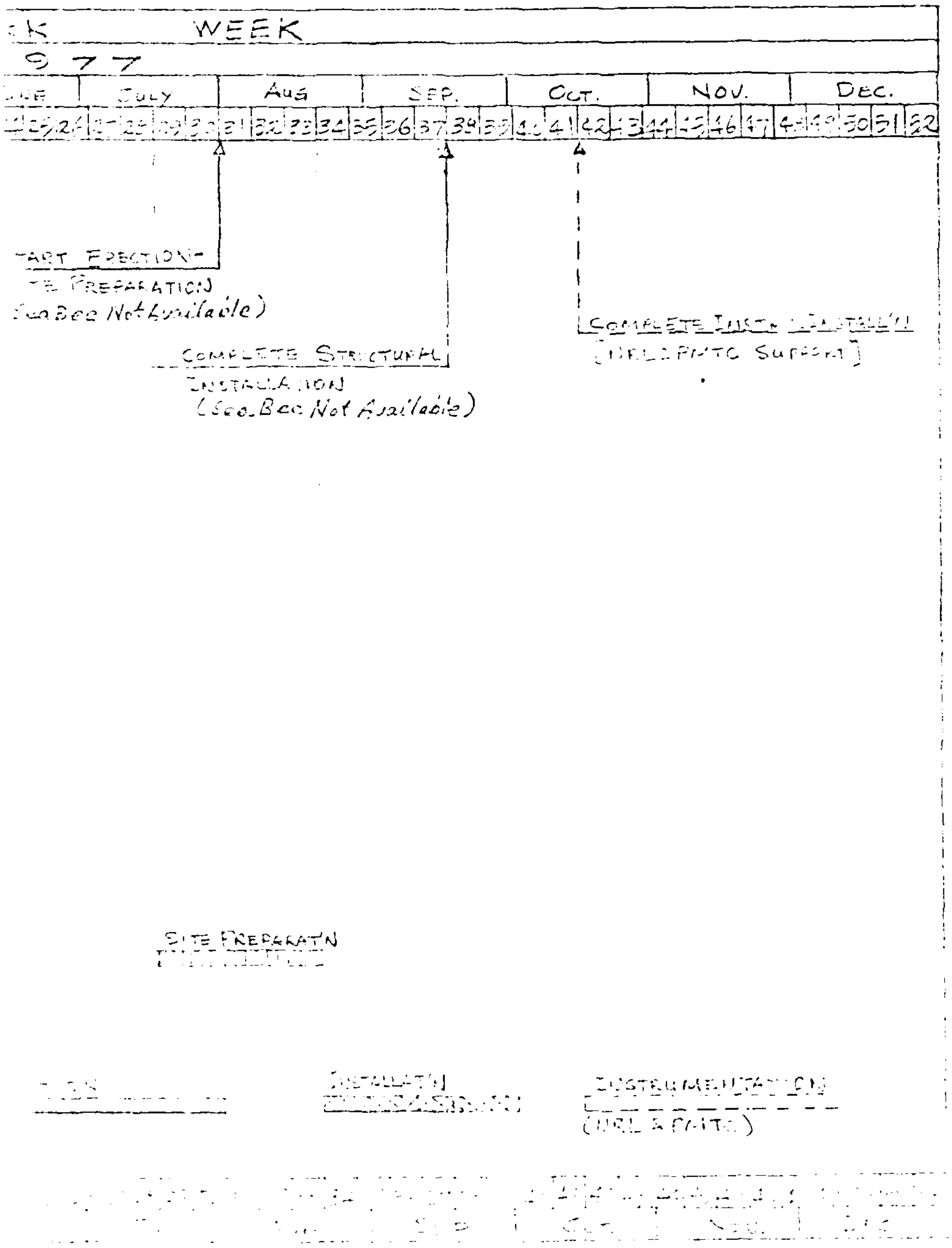
- Base Flattening
- Kelp Cleaning

Installation

- Installation Plan
- Project Installation Management
- Barge Transportation and Installation
- Propellant Anchor Installation
- Ballast and Scour Protection

I. WORK SCHEDULE


WORK
FEB
MAY
SITE SURVEY
STR. D. G & SPEC.
To SUB-CONTRACTOR
STR. MODS.
ASSUMED GO AHEAD
& PLAN APPROVAL
15 Feb
3-5 Mar.
ENGINEERING DESIGN
FEASIBILITY/
STUDY


WEEK
July
Aug
Sep.
Oct.
Nov.
Dec.
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
(SeaBee Not Available)
COMPLETE STRUCTURAL
INSTALLATION
(SeaBee Not Available)
SITE PREPARATN
INSTALLATN
(NRL & PMTC)

2. ANCHOR STABILIZATION SYSTEM

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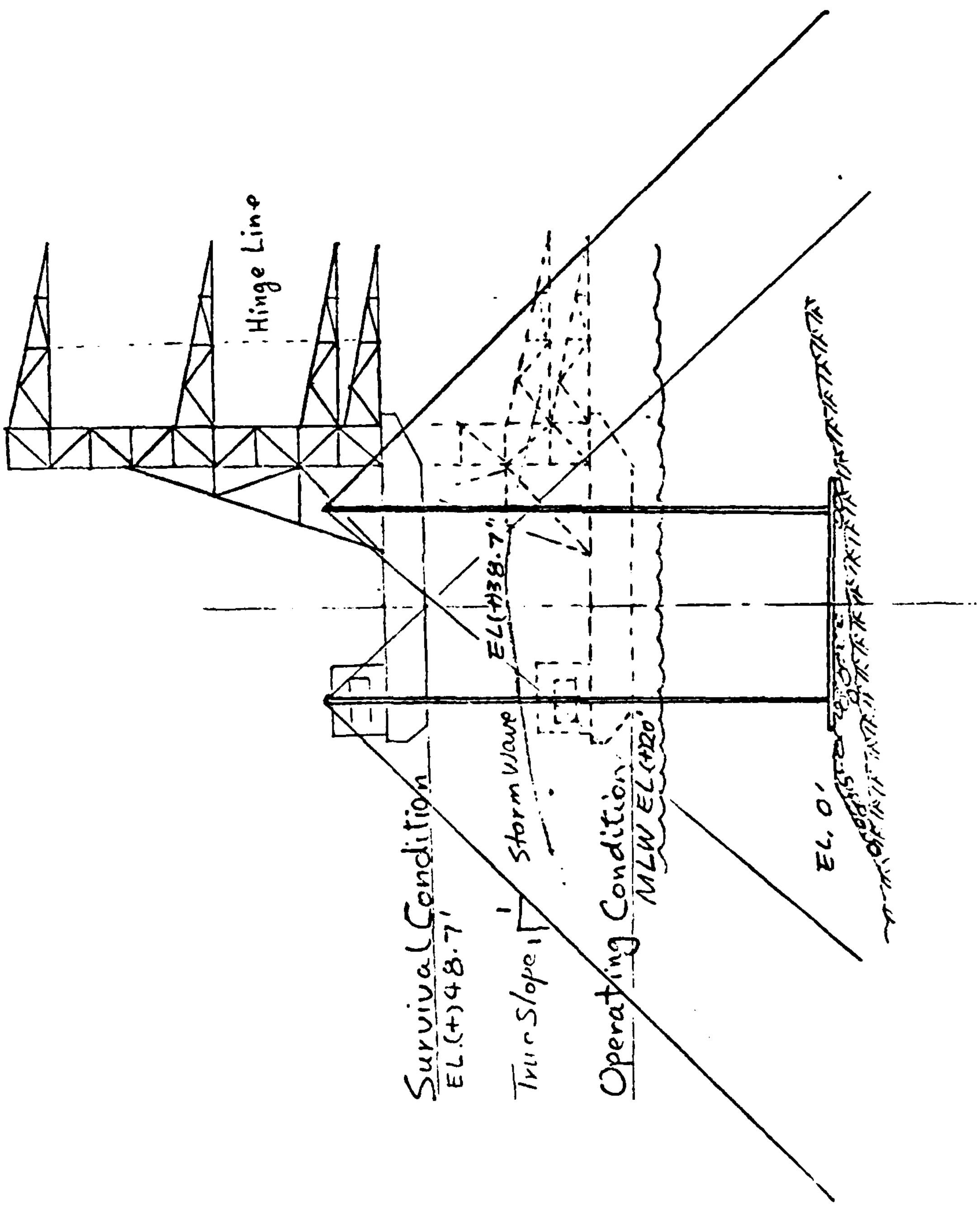
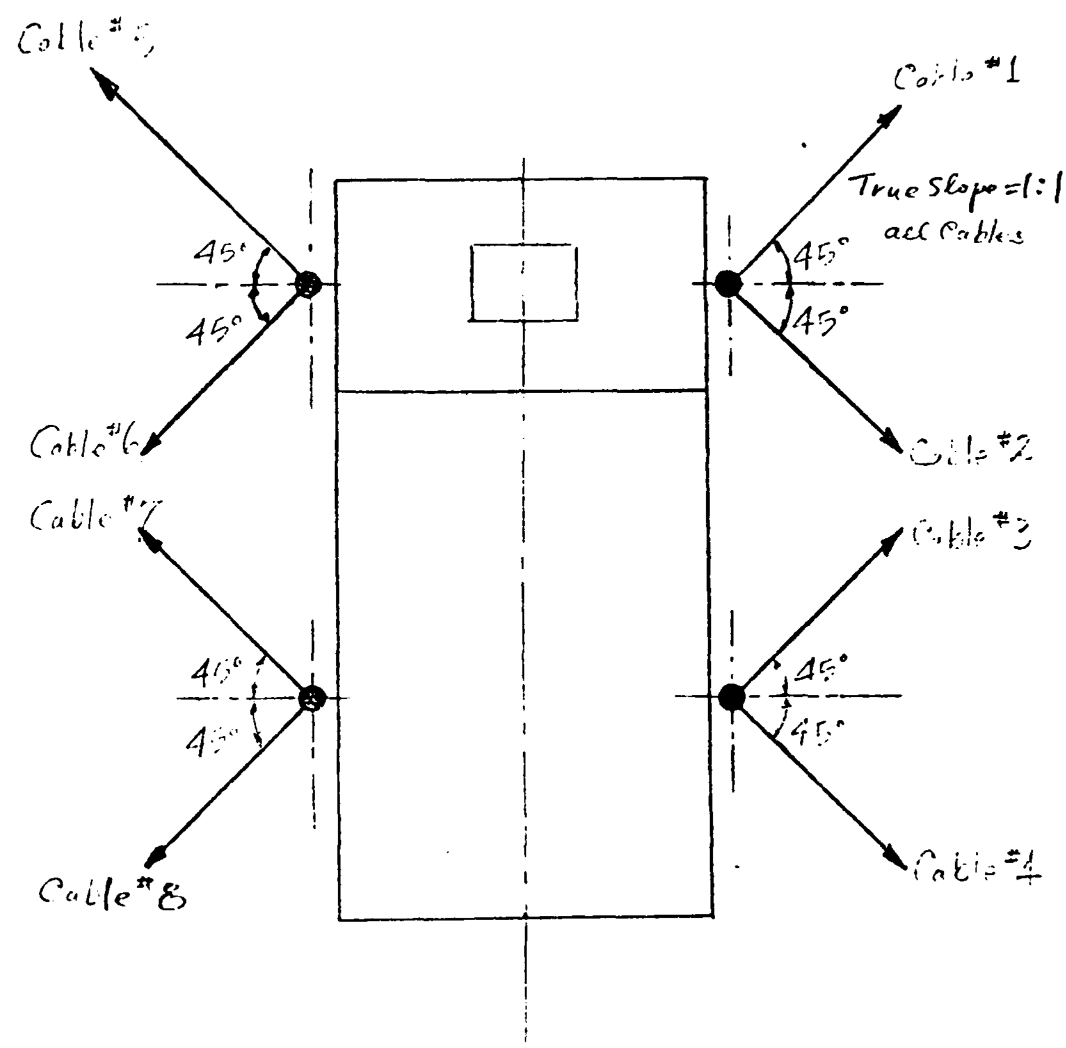
2-5-77


Hinge Line
Survival Condition
EL.(+)48.7'
True Slope 1 1
Storm Wave
EL(+)38.7'
Operating Condition
MLW EL(+)20'
EL. 0'


Cable #1
True Slope = 1:1
all Cables
45°
45°
Cable #2
Cable #3
45°
45°
Cable #4
45°
45°
Cable #6
Cable #7
45°
45°
Cable #8

ANCHOR STABILIZATION SYSTEM

2-15-77
C. Chern

ROUTE	DESCRIPTION	ESTIMATED COST	PROJECTED COMPL' DATE
(1)	Man-made base, rockfill @ 2000 cu.yd 8-CEL 100K Propellant anchors Commercial transport of Sr. Robert	$313,880	Sept,'77
(2)	Man-made base, rockfill @ 2000 cu.yd 8-CEL 100K Propellant anchors SeaBee transport of Sr. Robert	$292,980	N.A. '77
(3)	Natural Flat Base, no scour protect. 8-CEL 100K Propellant anchors Commercial transport of Sr. Robert	$218,840	Sept,'77
(4)	Natural Flat Base, no scour protection 8-CEL 100K Propellant anchors SeaBee transport of Sr Robert	$197,940	N.A. '77

(1) Instrumentation Installation Cost is not included in Estimated Cost.

(2) Power and Communication Cables installation is not included.

CASE 1 ANCHOR STABILIZATION SYSTEM

2-15-77
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SUBJECT	TASK	COST: NAVY	COST: COMMERCIAL
FEASIBILITY STUDY	Concept Selection Scheduling Cost Estimate	$4,000	
SITE SELECTION	Sea Floor Survey Site Selection Soil Core Sampling	$15,000	
ENGINEERING DESIGN	Environmental Assessment Wave Force Analysis Structural Analysis/Design Foundation Analysis Corrosion Analysis/Design Specification/Drawings Design Report	$15,650	
FABRICATION	Structural Modification Cathodic Protection Paint Miscelloneous Attachment	$29,900	
SITE PREPARATION	Base Flattening Kelp Cleaning (2000 cu. yd @ 43^{20}/cu. yd)		$86,400
INSTALLATION PLAN		$6,720	
PROJ. INSTALLATION MANAGEMENT		$18,700	
BARGE TRANSPORT'N & INSTALLATION	w/CEL Warping Tug Ass't		$39,000
ANCHOR INSTALLATION	CEL [illegible] anchors & rig'd	$69,970	
ALL APPROVALS	NRL & PMTC Support	-	
CONTINGENCY	10% of Above Cost	$16,000	$12,540
TOTAL		$175,940	$137,940

CASE 2 ANCHOR STABILIZATION SYSTEM

2-15-77
C. Chern

SUBJECT	TASK	COST	
		NAVY	COMMERCIAL
FEASIBILITY STUDY	Concept Selection Scheduling Cost Estimate	$4,000	
SITE SELECTION	Sea Floor Survey Site Selection Soil Core Sampling	$15,000	
ENGINEERING DESIGN	Environmental Assessment Wave Force Analysis Structural Analysis/Design Foundation Analysis Corrosion Analysis/Design Specification/Drawings Design Report	$15,650	
FABRICATION	Structural Modification Cathodic Protection Paint Miscellaneous Attachment	$29,900	
SITE PREPARATION	Base Flattening Kelp Cleaning (2000 cu. yd @ 43^{20}/cu. yd)		$86,400
INSTALLATION PLAN		$6,720	
PROJ. INSTALLATION MANAGEMENT		$18,700	
BARGE TRANSPORT'N & INSTALLATION	w/CEL Warping Tug Ass't Navy Transport & Installation	$20,000	~~$39,000~~
ANCHOR INSTALLATION	CEL 100K Propellant anchors 8 req'd	$69,970	
ALL APPROVALS	NRL & PMTC Support	-	
CONTINGENCY	10% of Above Cost	$18,000	$8,640
TOTAL		$197,940	$95,040

CASE 3 ANCHOR STABILIZATION SYSTEM

2-15-77
C. Chern

SUBJECT	TASK	COST	
		NAVY	COMMERCIAL
FEASIBILITY STUDY	Concept Selection Scheduling Cost Estimate	$4,000	
SITE SELECTION	Sea Floor Survey Site Selection Soil Core Sampling	$15,000	
ENGINEERING DESIGN	Environmental Assessment Wave Force Analysis Structural Analysis/Design Foundation Analysis Corrosion Analysis/Design Specification/Drawings Design Report	$15,650	
FABRICATION	Structural Modification Cathodic Protection Paint Miscellaneous Attachment	$29,900	
SITE PREPARATION	~~Base Flattening~~ NATURAL ~~Kelp Cleaning~~ FIRM ~~(2000 cu.yd @ 43.20/cu.yd)~~	FLAT BASE	~~$86,400~~
INSTALLATION PLAN		$6,720	
PROJ. INSTALLATION MANAGEMENT		$18,700	
BARGE TRANSPORT'N & INSTALLATION	w/CEL Warping Tug Ass't		$39,000
ANCHOR INSTALLATION	CEL 100K Propellant anchors 8 req'd	$69,970	
ALL APPROVALS	NRL & PMTC Support	-	
CONTINGENCY	10% of Above Cost	$16,000	$3,900
TOTAL		$175,940	$42,900

Case 4 ANCHOR STABILIZATION SYSTEM

2-15-77
C. Chern

SUBJECT	TASK	COST	
		NAVY	COMMERCIAL
FEASIBILITY STUDY	Concept Selection Scheduling Cost Estimate	$4,000	
SITE SELECTION	Sea Floor Survey Site Selection Soil Core Sampling	$15,000	
ENGINEERING DESIGN	Environmental Assessment Wave Force Analysis Structural Analysis/Design Foundation Analysis Corrosion Analysis/Design Specification/Drawings Design Report	$15,650	
FABRICATION	Structural Modification Cathodic Protection Paint Miscellaneous Attachment	$29,900	
SITE PREPARATION	~~Base Flattening~~ NATURAL FLAT ~~Kelp Cleaning~~ FIRM BASE ~~(2000 cu. yd @ 43.20/cu. yd)~~		~~$86,400~~
INSTALLATION PLAN		$6,720	
PROJ. INSTALLATION MANAGEMENT		$18,700	
BARGE TRANSPORT'N & INSTALLATION	w/CEL Warping Tug Ass't NAVY TRANSPORT & INSTALLATION	$20,000	~~$39,000~~
ANCHOR INSTALLATION	CEL 100K Propellant anchors 8 req'd	$69,970	
ALL APPROVALS	NRL & PMTC Support	-	
CONTINGENCY	10% of Above Cost	$18,000	0
TOTAL		$197,940	0

3. BALLASTING STABILIZATION SYSTEM A

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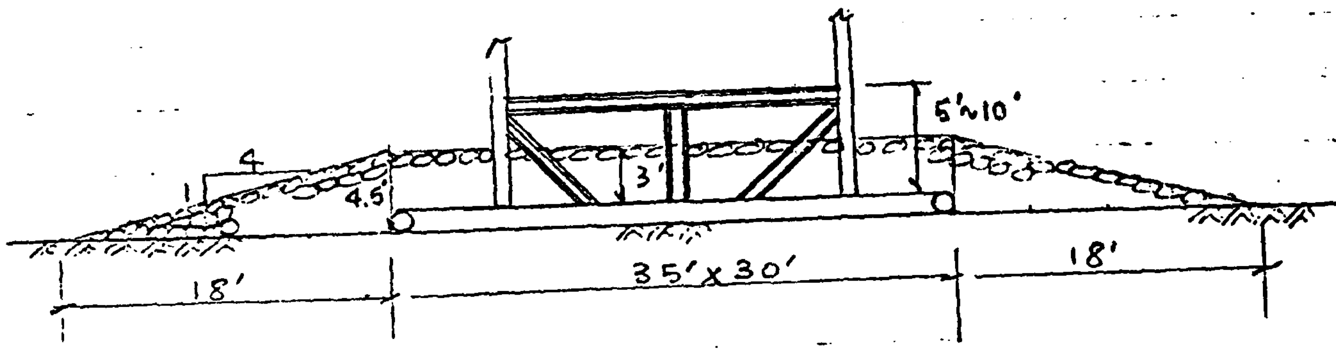
C. Chern
2-15-77

BALLASTING AND SCOUR PROTECTION PROFILE



BALLASTING STABILIZATION SYSTEM A

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2-15-77

ROUTE	DESCRIPTION	ESTIMATED COST	PROJECTED COMP. DATE
A1	Man-made base, rockfill @ 2000 cu.yd Scour Protection Commercial Transport of Sr. Robert	$260,010	Sept, '77
A2	Man-made base, rockfill @ 2000 cu.yd Scour Protection SeeBee transport of Sr. Robert	$233,610	N.A. '77
A3	Natural Flat Base Scour Protection Commercial transport of Sr. Robert	$164,970	Sept, '77
A4	Natural Flat Base Scour Protection SeeBee transport of Sr. Robert	$138,570	N.A. '77

(A1) BALLASTING STABILIZATION SYSTEM (A)

2-15-77
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SUBJECT	TASK	COST	
		NAVY	COMMERCIAL
FEASIBILITY STUDY	Concept Selection Scheduling Cost Estimate	$4,000.	
SITE SELECTION	Sea Floor Survey Site Selection Soil Core Sampling	$15,000	
ENGINEERING DESIGN	Environmental Assessment Wave Force Analysis Structural Analysis/Design Foundation Analysis Corrosion Analysis/Design Specification/Drawings Design Report	$15,650	
FABRICATION	Structural Modification Cathodic Protection Paint Miscellaneous Attachments	$29,900	
SITE PREPARATION	Base Flattening Kelp Clearing (2000 cu. yd @ $43.20/cu yd)		$86,400
INSTALLATION PLAN		$6,720	
PROJ. INSTALLATION MANAGEMENT		$18,700	
BARGE TRASPORT'N & INSTALLATION			$44,000
BALLASTING & SCOUR PROTECTION			$16,000
ALL APPROVALS	NRL & PMTC Support	-	
CONTINGENCY	10% of Above Cost	$9,000	$14,640
TOTAL		$98,970	$161,040

(A2) BALLASTING STABILIZATION SYSTEM (A)

2-15-77
C. Cheru

SUBJECT	TASK	COST	
		NAVY	COMMERCIAL
FEASIBILITY STUDY	Concept Selection Scheduling Cost Estimating	$4,000.	
SITE SELECTION	Sea Floor Survey Site Selection Soil Core Sampling	$15,000	
ENGINEERING DESIGN	Environmental Assessment Wave Force Analysis Structural Analysis/Design Foundation Analysis Corrosion Analysis/Design Specification/Drawings Design Report	$15,650	
FABRICATION	Structural Modification Cathodic Protection Paint Miscellaneous Attachments	$29,900	
SITE PREPARATION	Base Flattening Kelp Clearing (2000 cu. yd @ $43.20/cu. yd)		$86,400
INSTALLATION PLAN		$6,720	
PROJ. INSTALLATION MANAGEMENT		$13,700	
BARGE TRANSPORT'N & INSTALLATION	Navy Transport & Installation	$25,000	~~$44,000~~
BALLASTING & SCOUR PROTECTION			$16,000
ALL BREAKDOWNS	NRL & PMTC Support	–	
CONTINGENCY	10% of Above Cost	$11,000	$10,240
TOTAL		$120,970	$112,640

2-15-77
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(A3) BALLASTING STABILIZATION SYSTEM (A)

SUBJECT	TASK	COST	
		NAVY	COMMERCIAL
FEASIBILITY STUDY	Concept Selection Scheduling Cost Estimate	$4,000.	
SITE SELECTION	Sea Floor Survey Site Selection Soil Core Sampling	$15,000	
ENGINEERING DESIGN	Environmental Assessment Wave Force Analysis Structural Analysis/Design Foundation Analysis Corrosion Analysis/Design Specification/Drawings Design Report	$15,650	
FABRICATION	Structural Modification Cathodic Protection Paint Miscellaneous Attachments	$29,900	
SITE PREPARATION	~~Base Flattening~~ NATURAL FLAT ~~Kelp [illegible]~~ FIRM BASE ~~(2000 cu yd @ $43.20/cu yd)~~		~~$86,400~~
INSTALLATION PLAN		$6,720	
PROJ. INSTALLATION MANAGEMENT		$13,700	
BARGE TRASPORT'N & INSTALLATION			$44,000
BALLASTING & SCOUR PROTECTION			$10,000
ALL APPROVALS	NRL & PMTC Support	-	
CONTINGENCY	10% of Above Cost	$9,000	$6,000
TOTAL		$98,970	$66,000

(A4) BALLASTING STABILIZATION SYSTEM (A)

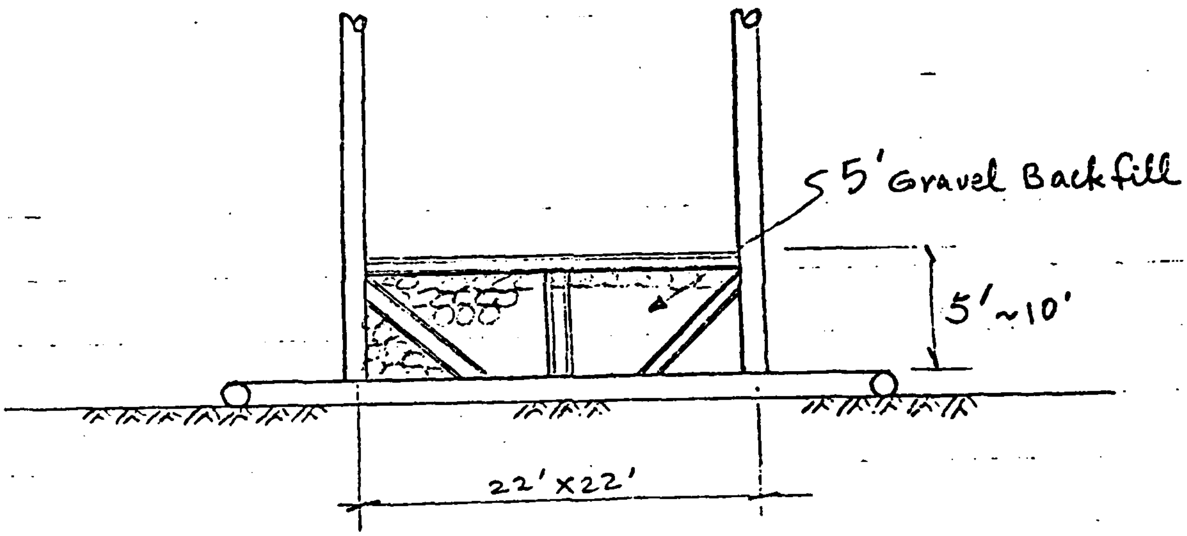
2-15-77
C. Chern

SUBJECT	TASK	COST	
		NAVY	COMMERCIAL
FEASIBILITY STUDY	Concept Selection Scheduling Cost Estimate	$4,000.	
SITE SELECTION	Sea Floor Survey Site Selection Soil Core Sampling	$15,000	
ENGINEERING DESIGN	Environmental Assessment Wave Force Analysis Structural Analysis/Design Foundation Analysis Corrosion Analysis/Design Specification/Drawings Design Report	$15,650	
FABRICATION	Structural Modification Cathodic Protection Paint Miscellaneous Attachments	$29,900	
SITE PREPARATION	~~Base Flattening~~ NATURAL FLAT ~~Kelp Clearing~~ FIRM BASE ~~(2000 cu yd @ $43[illegible]/cu yd)~~		~~$36,400~~
INSTALLATION PLAN		$6,720	
PROJ. INSTALLATION MANAGEMENT		$18,700	
BARGE TRASPORT'N & INSTALLATION	Navy Transport & Installation	$20,000	~~$44,000~~
BALLASTING & SCOUR PROTECTION			$10,000
ALL APPROVALS	NRL & PMTC Support	-	
CONTINGENCY	10% of Above Cost	$11,000	$1,600
TOTAL		$120,970	$17,600

4. BALLASTING STABILIZATION SYSTEM B

C. Chern
2-15-77

BALLASTING GRAVELFILL PROFILE



BALLASTING STABILIZATION SYSTEM B C. Chern 2-15-77

ROUTE	DESCRIPTION	ESTIMATED COST	PROJECTED COMP. DATE
B1	Man-made base, rockfill@2000 cu.yd. Commercial Transport of Sr. Robert	$249,010	Sept., '77
B2	Man-made base, rockfill@2000 cu.yd. Seebea transport of Sr. Robert	$222,610	N.A. '77
B3	Natural Flat Base Commercial transport of Sr. Robert	$153,970	Sept., '77
B4	Natural Flat Base Seebea transport of Sr. Robert	$127,570	N.A. '77

(1) Cost of instrumentation is not included

(2) Power and Communication Cables installation is not included

(B1) BALLASTING STABILIZATION SYSTEM (B)

2-15-77
C. Chern

SUBJECT	TASK	COST	
		NAVY	COMMERCIAL
FEASIBILITY STUDY	Concept Selection Scheduling Cost Estimate	$4,000.	
SITE SELECTION	Sea Floor Survey Site Selection Soil Core Sampling	$15,000	
ENGINEERING DESIGN	Environmental Assessment Wave Force Analysis Structural Analysis/Design Foundation Analysis Corrosion Analysis/Design Specification/Drawings Design Report	$15,650	
FABRICATION	Structural Modification Cathodic Protection Paint Miscelloneous Attachments	$29,900	
SITE PREPARATION	Base Flattening Kelp Cleaning (2000 cu. yd @ $43.20/cu. yd)		$86,400
INSTALLATION PLAN		$6,720	
PROJ. INSTALLATION MANAGEMENT		$18,700	
BARGE TRASPORT'N & INSTALLATION			$44,000
BALLASTING			$6,000
ALL APPROVALS	NRL & PMTC Support	–	
CONTINGENCY	10% of Above Cost	$9,000	$13,640
TOTAL		$98,970	$150,040

(B2) BALLASTING STABILIZATION SYSTEM (B)

2-15-77
C. Chern

SUBJECT	TASK	COST	
		NAVY	COMMERCIAL
FEASIBILITY STUDY	Concept Selection Scheduling Cost Estimate	$4,000.	
SITE SELECTION	Sea Floor Survey Site Selection Soil Core Sampling	$15,000	
ENGINEERING DESIGN	Environmental Assessment Wave Force Analysis Structural Analysis/Design Foundation Analysis Corrosion Analysis/Design Specification/Drawings Design Report	$15,650	
FABRICATION	Structural Modification Cathodic Protection Paint Miscellaneous Attachments	$29,900	
SITE PREPARATION	Base Flattening Kelp Clean... (2000 cu. yd @ $43.20/cu yd)		$86,400
INSTALLATION PLAN		$6,720	
PROJ. INSTALLATION MANAGEMENT		$18,700	
BARGE TRASPORT'N & INSTALLATION	Navy Transport & Installation	$20,000	~~$44,000~~
BALLASTING			$6,000
ALL APPROVALS	NRL & PMTC Support	-	
CONTINGENCY	10% of Above Cost	$11,000	$9,240
TOTAL		$120,970	$101,640

(B3) BALLASTING STABILIZATION SYSTEM (B)

2-15-77
C. Chern

SUBJECT	TASK	COST: NAVY	COST: COMMERCIAL
FEASIBILITY STUDY	Concept Selection Scheduling Cost Estimate	$4,000.	
SITE SELECTION	Sea Floor Survey Site Selection Soil Core Sampling	$15,000	
ENGINEERING DESIGN	Environmental Assessment Wave Force Analysis Structural Analysis/Design Foundation Analysis Corrosion Analysis/Design Specification/Drawings Design Report	$15,650	
FABRICATION	Structural Modification Cathodic Protection Paint Miscellaneous Attachments	$29,900	
SITE PREPARATION	~~Base Flattening~~ NATURAL FLAT ~~Kelp Cleaning~~ FIRM BASE ~~(2000 cu yd @ $43⁰⁰/cu yd)~~		~~$66,400~~
INSTALLATION PLAN		$6,720	
PROJ. INSTALLATION MANAGEMENT		$18,700	
BARGE TRASPORT'N & INSTALLATION			$44,000
BALLASTING			$6,000
ALL APPROVALS	NRL & PIATC Support	-	
CONTINGENCY	10% of Above Cost	$9,000	$5,000
TOTAL		$98,970	$55,000

(B4) BALLASTING STABILIZATION SYSTEM (B)

C. Chern

SUBJECT	TASK	COST	
		NAVY	COMMERCIAL
FEASIBILITY STUDY	Concept Selection Scheduling Cost Estimate	$4,000.	
SITE SELECTION	Sea Floor Survey Site Selection Soil Core Sampling	$15,000	
ENGINEERING DESIGN	Environmental Assessment Wave Force Analysis Structural Analysis/Design Foundation Analysis Corrosion Analysis/Design Specification/Drawings Design Report	$15,650	
FABRICATION	Structural Modification Cathodic Protection Paint Miscellaneous Attachment	$29,900	
SITE PREPARATION	~~Base Flattening~~ NATURAL FLAT ~~Kelp Clean~~ FIRM BASE ~~(2000 cu yd @ $43[20]/cu yd)~~		~~$86,400~~
INSTALLATION PLAN		$6,720	
PROJ. INSTALLATION MANAGEMENT		$18,700	
BARGE TRASPORT'N & INSTALLATION	Navy Transport & Installation	$20,000	~~$44,000~~
BALLASTING			$6,000
ALL APPROVALS	NRL & PMTC Support	–	
CONTINGENCY	10% of Above Cost	$11,000	$600
TOTAL		$120,970	$6,600

CONCLUSIONS

The results of the study on cost estimate of the Project METOR engineering services are summarized as follows:

- The use of Navy Seabee to assist in the construction phase of this project in the current fiscal year is rather difficult to obtain.

- A natural flat firm base for the barge site in economical. From the available literature in hands, chance of finding such a site in the desired optical measuring path is remote, however.

- Sea floor survey and soil properties determination are essential to the progress of the services. A thorough examination of the engineering services shall take place immediately after the sea floor survey.

Appendix 7.5

Cost Calculations

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2-8-77

ENGINEERING DESIGN

COST:	\$16,300.00	
	- 650.00	40 hrs of Installation Scenario
	\$15,650.00	

COST ITEM	MAN-HOUR	RATE*	TOTAL
Managerial Support:			
a. Planning & Coordinating	24		
b. Project Review	40		
Engineering Support:			
a. Environmental Assessment	48		
b. Wave Force Analysis	40		
c. Structural Analysis/Design	120		
d. Foundation Analysis	24		
e. Corrosion Analysis/Design	16		
~~f. Installation Scenario~~	~~40~~	To Installation Plan	
g. Specifications	100		
h. Final Report	80		
i. Traveling	40		
	572	16.49	$9,432.28
Drafting Support:			
a. Engineering Drawings	160	7.15	1,144.00
Administrative Support:			
a. Adm. & Clerical Support**			2,115.61
DIRECT COST			$12,691.89
Contingency:			
10% of Direct Cost			1,269.19
TOTAL DIRECT COST			$13,961.08
Computer Usage			1,000.00
Traveling Expenses			
a. Transportation (3 trips at $400/trip)			1,200.00
b. Per Diem (5 days at $33/day)			165.00
TOTAL PROJECT COST			$16,326.08

*RATE = (Project Hourly Rate) x 1.29

$$**\text{Adm. Support} = \frac{\text{Proj. MH}}{1730} \times \$5{,}000$$

ESTIMATE OF STRUCTURAL MODIFICATION COSTS

Cost ₵ 29.900.

MATERIALS -- steel

ITEM	MEMBER LENGTH (FT)	QUANTITY	TOTAL LENGTH (FT)	UNIT WT LBS/FT	TOTAL WT LBS
12"Φ x 1" WT	60	4	240	117.5	28,200
W16x16			253.*	16.	4,048
Miscellaneous					500
TOTAL					32,74[illegible]
Estimated Fabricated Cost @ $.75/lb including material, labor and welding					x 0.[illegible]
COST					$24,56[illegible]

$^{*}(25+25)\times 2 + (10\times\sqrt{2}\times 4)\times 2 + 4\times 10 = 253$ ft

MATERIALS -- Grouting

ITEM	VOLUMN cu.yd	UNIT COST $/cu.yd	TOTAL COST
Cement Grout	(1)		$500. (2)
Total			$ 500.

Notes: (1) $\pi\left(\frac{12.5}{12}\right) \times \frac{0.5}{12} \times 60 \times 4/27 = 1.212$ cu. yd $= 32.724$ cu. ft

(2) Estimated cost

Steel (materials and Fabrication)	$24,561.
Grouting (materials and Labor)	$500.
Paint (paint and Labor)	$1000.
Cathodic Protection (20@50#)	$1000.
Jib Crane	$800.
Safety Chains and Hooks	$200.
Rope Ladder (40ft)	$100.
	$28,161
Two Trips to Fab Site	$1,685
	$29,846.

40 hrs x 16.49 = $660
P.D. $33 x 5 = $165
Airfare 2x $400 = $800
Local Transport 5x15 $60
$1,685

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INSTALLATION OF 8 CEL 100K PROPELLANT ANCHORS

COST: $ 69,970.

Transportation of Personnel ?
Military transportation -- no charge

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(a) EQUIPMENT *

DESCRIPTION	DAY RATE $/Day	DAY REQ'D	TOTAL $
Transporting from Port Hueneme to site	3,000.	2	6,000.
Operation at site	3,000.	4	12,000.
Transporting from site to Port Hueneme	3,000	2	6,000.
TOTAL		8	24,000

* One warping barge with propellant anchor installation equipment

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2-9-77

(b) MATERIALS

DESCRIPTION	UNIT COST	QUANTITY	TOTAL
CEL 100K Propellant Anchor	\$5,125 (1)	8	\$41,000.
1"φ Steel Cable (2)	\$120/100 ft	1600 ft	1,920.
Miscellaneous Fittings (3)			500.
TOTAL			\$43,420.

(1) Unit price \$4,100 Listed in December 1974
Estimated 10% annual cost inflation. $2\frac{1}{2}$ years at June 1977 \$4,100 × 1.25 = \$5,125.

(2) 1"φ wire rope breaking strength @ 44.9 Tons

(3) Cable end fittings, splicings, etc.

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2-9-77

(C) PERSONNEL

DESCRIPTION	DAY RATE \$/Day	Per Diem \$/Day	DAY COST \$/DAY	MAN-DAY	TOTAL COST \$
DIVER	-	20.	20.	24 (1)	480.
Propellant Anchor Technician	125. (4)	35.	160.	6 (2)	960.
Engineer	150. (4)	35.	185.	6 (3)	1,110.
TOTAL					2,550.

(1) 4 divers at 4 days installation and 2 days transportation
$4 \times (4+2) = 24$ man-day

(2) 1 CEL100K propellant anchor installation technician
4 days installation and 2 days transportation

(3) 1 Engineer supervising anchor installation
4 days installation and 2 days transportation

(4) Supplied from NAVY Organization

INSTALLATION PLAN

(PROJECT EXECUTION PLAN)

from Hal Dorin — "C" Division

Personnel	:	1 Engineer	
Time	:	1 man month	
Cost	:	1 Engr/man-month	$3200.00
		Subcontractor	$2500.00
			$5700.00
		Contingency 10%	$570.00
		Total	$6,270.00

PROJECT INSTALLATION MANAGEMENT

from Hal Dorin — "C" Division

Personnel : 1 Engr & 1 - PDC

Time Preparation — 2 man months

Installation — 3 man months

Cost :		
	Travel & Per Diem	$5,000.00
	Labor	$12,000.00
		$17,000.00
	Contingency 10%	$1,700.00
	Total	$18,700.00

BARGE TRANSPORTATION AND INSTALLATION

W/O CBs COST : $44,000. (Gravel Fill)

$39,000 (Anchor Stabilization)

BARGE AND PROPULSION (GRAVEL BACKFILL)

10 day @ \$3,000 /day = \$30,000.

Crane Operator	1
Diver	4
Jack-up Barge Operator	2
Other Help	3
	10

Ave. Hourly Rate @ \$17.50 @ 8 hr day

(10 x 8 x 17.5) x 10 \$14,000.

\$44,000.

Anchor Stabilization Concept
w/ CEL Warping tug assistance

10 day @ \$2500/day = \$25,000
Crews \$14,000
\$39,000

BALLASTING AND SCOUR PROTECTION

w/Scour Protection Cost = $16,000

w/o Scour Protection Cost = $6,000

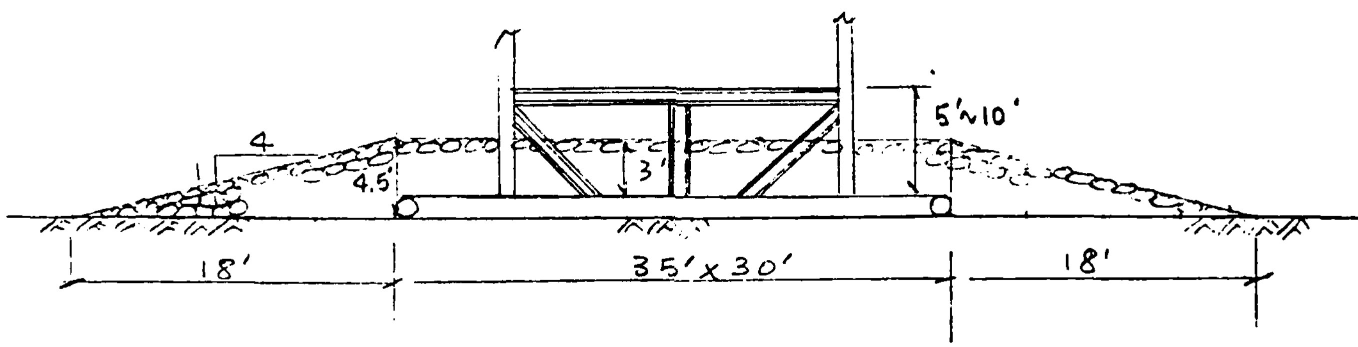
Basing on 1000 Cu. yd volume

Material @ \$6/cu.yd x 1000 cu.yd	= \$6,000
2-barge w/crane @ 500 cu.yd capacity @ \$3000/day	
3000 x 2 x 3 (days)	= \$18,000
(1 day Loading ½ day to and ½ day back 1 day work on site)	
	\$24,000
Profit, Supervision and Overhead @ 50%	\$12,000
	\$36,000
One Tug boat stand-by for emergency @ \$2400/day x 3 day	\$7,200
	\$43,200.

$$\text{Cost per cu. yd} = \frac{\$43{,}200}{1{,}000}$$

$$= \$43.2/\text{cu. yd}$$

BALLASTING AND SCOUR PROTECTION PROFILE



Ballasting Gravelfill Volume = 35x30x3/27 = 117 cu. yd

Scour Protection Gravelfill Volume

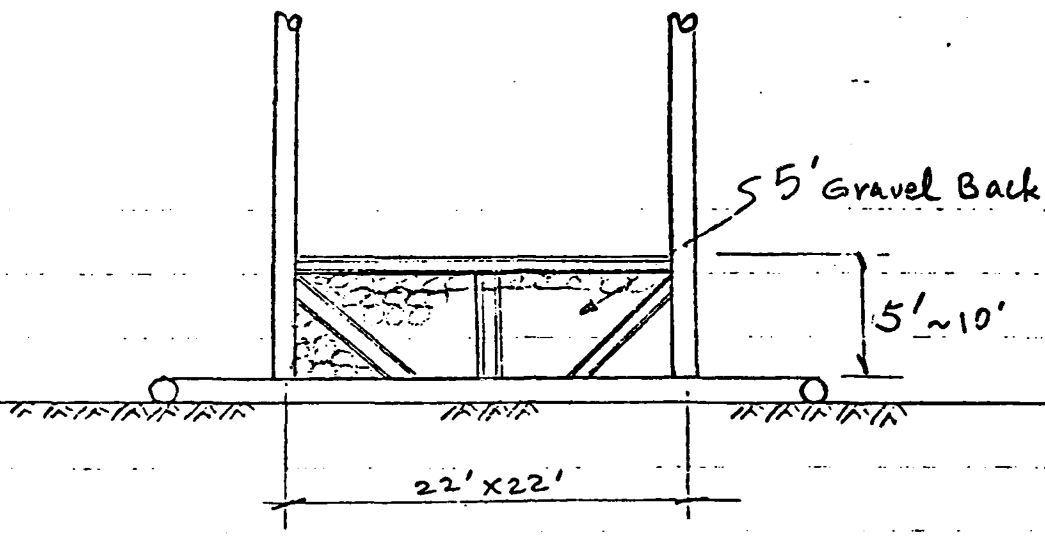
= ½x4.5x18x(35+30+18)x2/27 = 249 cu. yd

366 cu. yd

366 yd x $43.2/yd = $15,811.

$16,000.

BALLASTING GRAVELFILL PROFILE



Ballasting Gravelfill Volume = 5x22x22/27 = 90 cu. yd

Smaller barge @ $1750/day for 2 days
2 x $1750 = $3,500
Material $6/cu.yd 6x90 = $540
$4,040

Profit, Supervision and O.H. @ 50% $2,020
$6,060

Say $6,000.

COST ESTIMATE

Meteor Cable Landing

1. One 1500-foot cable
2. Sand beach
3. Rock/gravel scour protection at the barge
4. 150 feet of split pipe at the beach
5. 100 feet of split pipe under the barge
6. 100 rockbolts
7. Small beach anchor
8. No extensive beach work (such as cable vault or lengthy cable run along the shore)
9. Other personnel perform the shore and barge cable terminations
10. For planning purposes, consider that a "pigtail" must be threaded from the deck of the Sir Robert up the outside of the leg, down the inside of the same leg and out through a prefabricated penetration. The cable leading to shore must then be spliced to this "pigtail" after the cable landing.

Cost Estimate

Cable	No charge
Split pipe 250 feet @ $30/ft	$ 7,500
Rockbolts	500
Consumables (balloons, line, fuel)	2,000
Beach anchor	1,000
Gear transportation	1,000
Per diem 10 men - 10 days $10/day/man	1,000
5 men - 5 days in Pt Hueneme	No charge
Travel 5 round trip air flights	150
	$13,150
Contingency	850
	$14,000

PART II

FEASIBILITY STUDY FOR CONVERSION OF SIR ROBERT TO AN AMPHIBIOUS JACKUP PLATFORM

April 1977

By C. Chern

Approved By: S.C. Ling Manager
Engineering Analysis
Branch

Approved By: C.E. Bodey, Director
Engineering and
Design Division

Ocean Engineering and Construction Project Office
Chesapeake Division
Naval Facilities Engineering Command
Washington, D.C. 20374

ABSTRACT

A sincere attempt to modify the existing SIR ROBERT for use in Project METEOR is the main theme of this study. A rubber tire wheeled system attached to the barge hull to convert SIR ROBERT to an amphibious jackup platform is shown to be structurally feasible. However, an external power source has to be provided to ensure the sea-land maneuverability of the new system.

Modification of SIR ROBERT will involve mainly the following three aspects:

- Manufacture and installation of a rubber tire wheeled system,
- Fabrication of supporting structural frames, and
- Installation of a cable launching-pulling mechanism.

An estimated project cost of $275,600 is needed to accomplish the above work.

Further study on the propulsion capacity and the floatation stability of the modified SIR ROBERT are critical to the safe operation of the system. These two problems have to be considered thoroughly before the final decision is made.

A recommendation has been made to regard the wheeled amphibious concept only as one of the possible alternatives to use SIR ROBERT. This concept is feasible; however, the operation procedures are not practical.

TABLE OF CONTENTS

FIGURES

CHARTS

TABLES

1. INTRODUCTION

1.1 Introduction

This feasibility study is provided in response to the request by Mr. Ted Blanc of the Naval Research Laboratory (NRL), Washington, D.C., for engineering services. A sincere concern that possible hostile environment may severely endanger the safe operation of SIR ROBERT as a fixed gravity platform in the vicinity of Thousand Springs Cove, San Nicolas Island, California, shown in Fig. 1-1, was discussed in a meeting between Mr. Blanc and CHESNAVFACENGCOM (FPO-1) personnel on 24 March 1977. The alternative concept of converting SIR ROBERT to a wheeled amphibious jackup platform was evolved during the meeting. This study assessed the feasibility of a wheeled system which is permanently attached to the existing SIR ROBERT hull structure such that the modified new SIR ROBERT may be rolled up on to the shore to avoid storm wave attack.

Figures 1-2, 1-3 and 1-4 show, respectively, the top view, .iew and the supporting mat of the basic unmodified SIR ROBERT. It is noted that the dimensions of the hull are 20 feet (width) by 40 feet (length) by 5 feet (depth) and the supporting mat are 30 feet (width) by 35 feet (length). A review of the available SIR ROBERT fabrication drawings* of the American Marine & Machinery Company (AMMCO), Nashville, Tennessee, reveals that the hull skin consisted of 3/16 inch steel plat reinforced with 3 x 2 x ¼ angles and supported by 5C9 channel shape frames. Further search for the engineering data

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*AMMCO DWG NOS. 10089-E/B, SK-45-539 D, S-45-537D

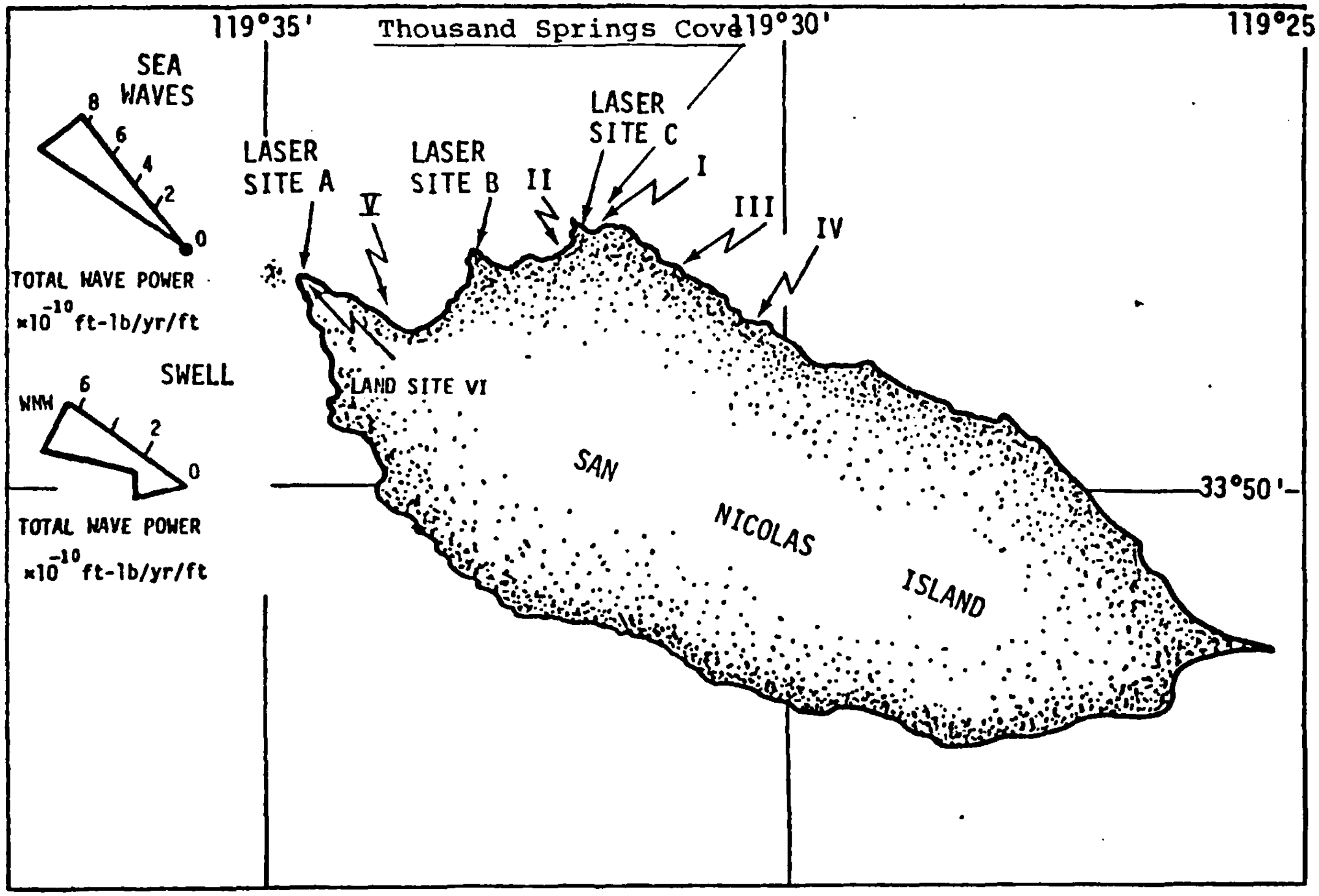

Fig. I-1 Six Prospective Sites for SIR ROBERT

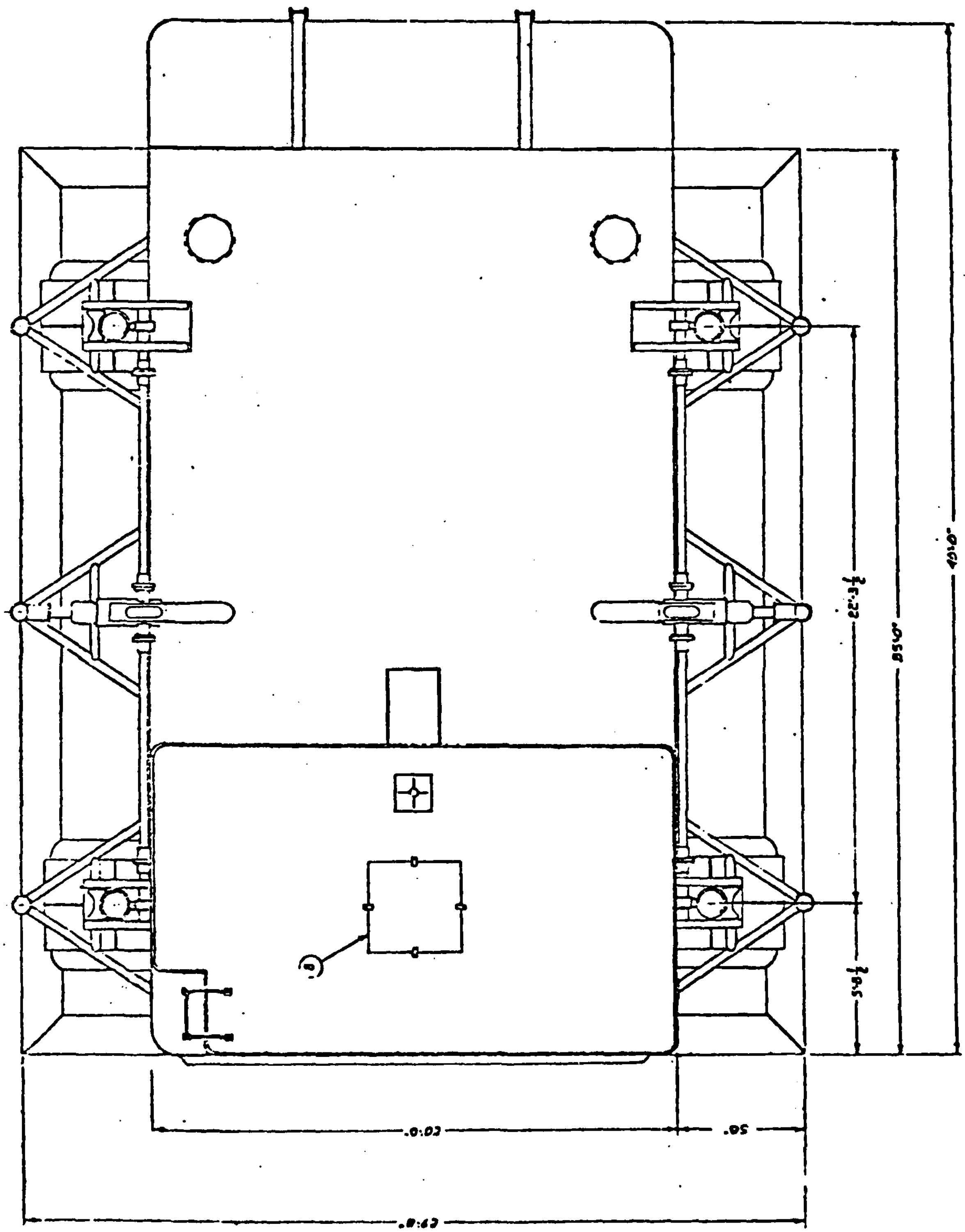

Fig. 1-2 Top View of SIR ROBERT

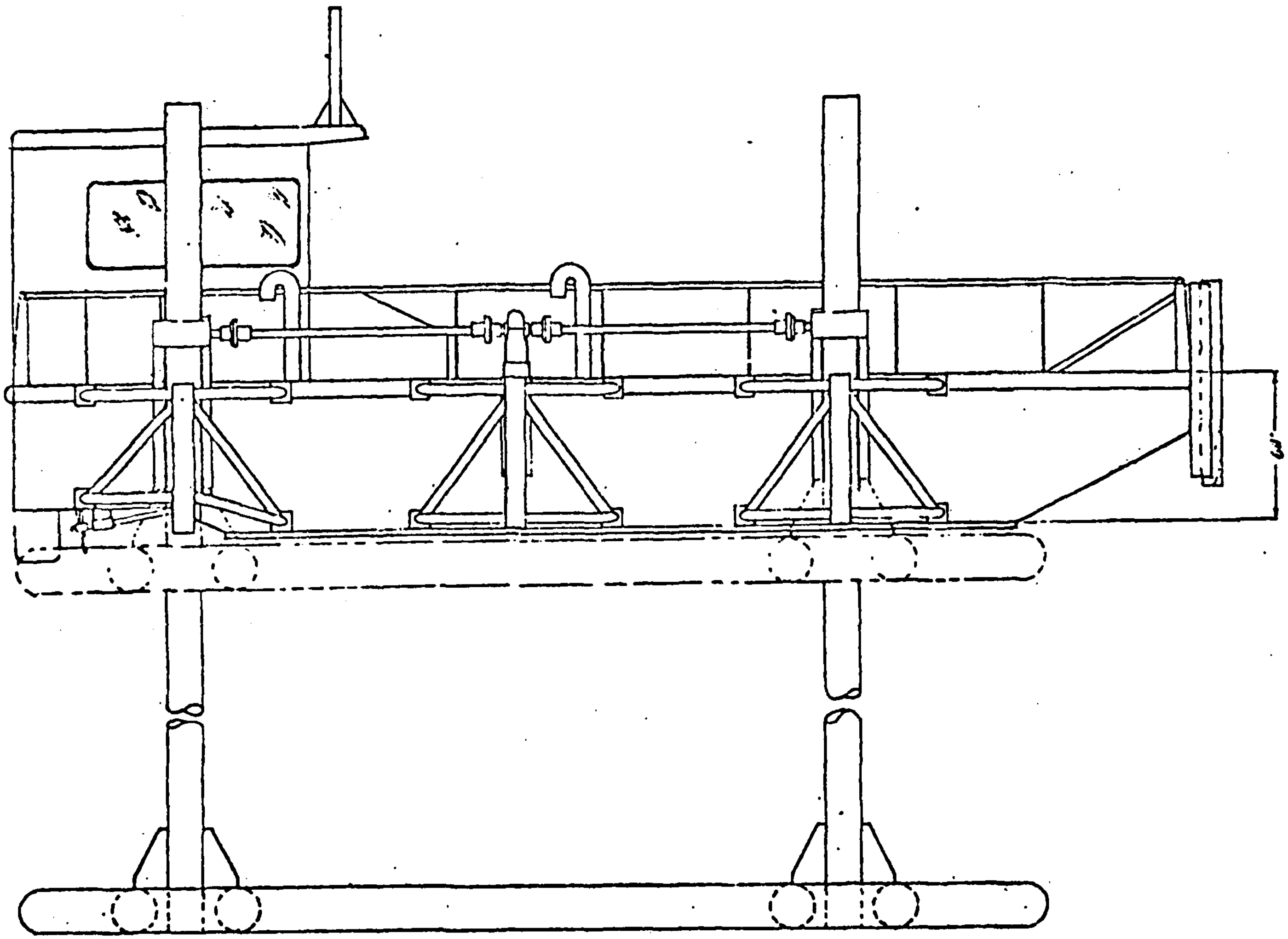

Fig. 1-3 SIDE VIEW OF SIR ROBERT

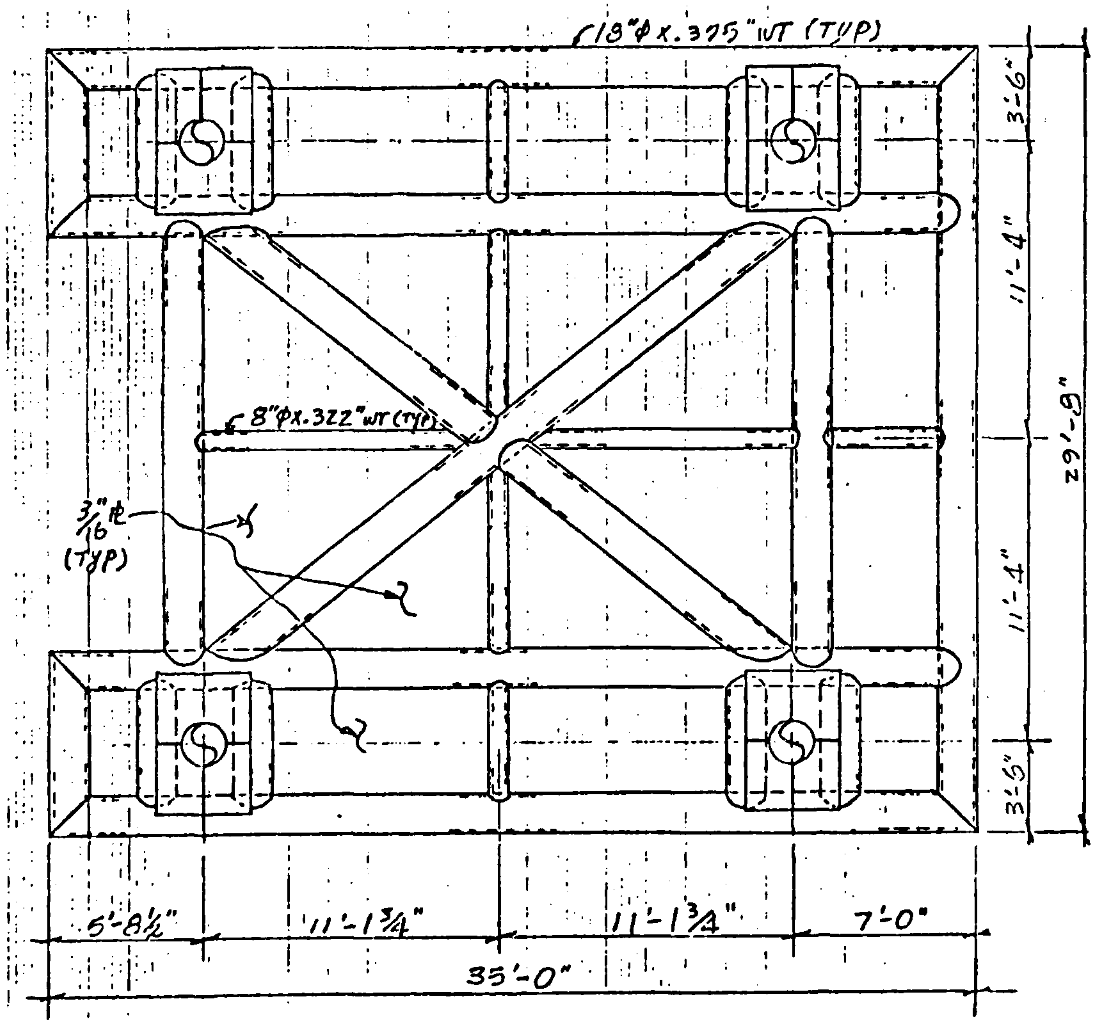

Fig. 1-4 SUPPORTING MAT OF SIR ROBERT

AD-A165 768 PROJECT METEOR FEASIBILITY STUDIES ON THE CONVERSION OF 3/4
THE SIR ROBERT TO..(U) NAVAL FACILITIES ENGINEERING
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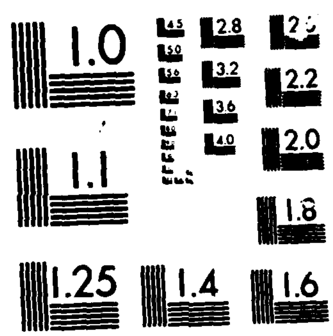

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

regarding the strength of the steel and the maximum capacity of the existing hydraulic jacking system through telephone conversation with Mr. David Binkley of AMMCO was not successful because the original design data was not found.

Mr. Stu Mendelsohn of FPO-1 sought information on the availability from U.S. Government surplus tires for use in the wheeled system. Five tires were successfully located. The results of tire information search are given in Part III accompanying this report. Rims, bearings and axles to fit the desired tire size are not available through the conventional commercial market and require special orders for this particular application.

1.2 Scope of Work

This feasibility study investigated the following aspects of the wheeled amphibious jack-up SIR ROBERT concept:

- Wheeled System
- Launching-Pulling System
- Structural Frame System
- Cost Estimate
- Problem areas and possible solutions.

2. WHEELED SYSTEM

2.1 Introduction

This section developes a feasible wheeled system which could facilitate launching and pulling operation of SIR ROBERT. The system will take into consideration the following aspects:

- Optimum utilization of government surplus,
- Project completion schedule,
- Project cost constraint, and
- Operation and maintenance procedures.

Figure 2-1 shows top view of the wheeled system. Four (4) sets of wheels with a total of eight (8) tires are needed to support SIR ROBERT on sandy beach to prevent excess tire penetration into the ground (See Part III accompanying with this volume). The wheel sets are to be mounted to the structural frame which in turn will provide port to the barge hull of SIR ROBERT during launching and pulling operation. Figures 2-2 and 2-3 illustrate the system under tow. The hull rests on the top of the structural frame and then the supporting mat is pulled up against the lower chords of the frame. When the system is in the desired offshore location, the supporting mat is lowered first and then the barge hull is jacked up above the sea surface, as shown in the front view and side view, respectively, in figures 2-4 and 2-5. The wheeled system together with the structural frame will possess some negative buoyancy so that it will remain at seafloor when the barge is jacked up for research measurement. This set-up will also provide minimum added weight to the barge when it is under tow.

C. Chern
4-14-77

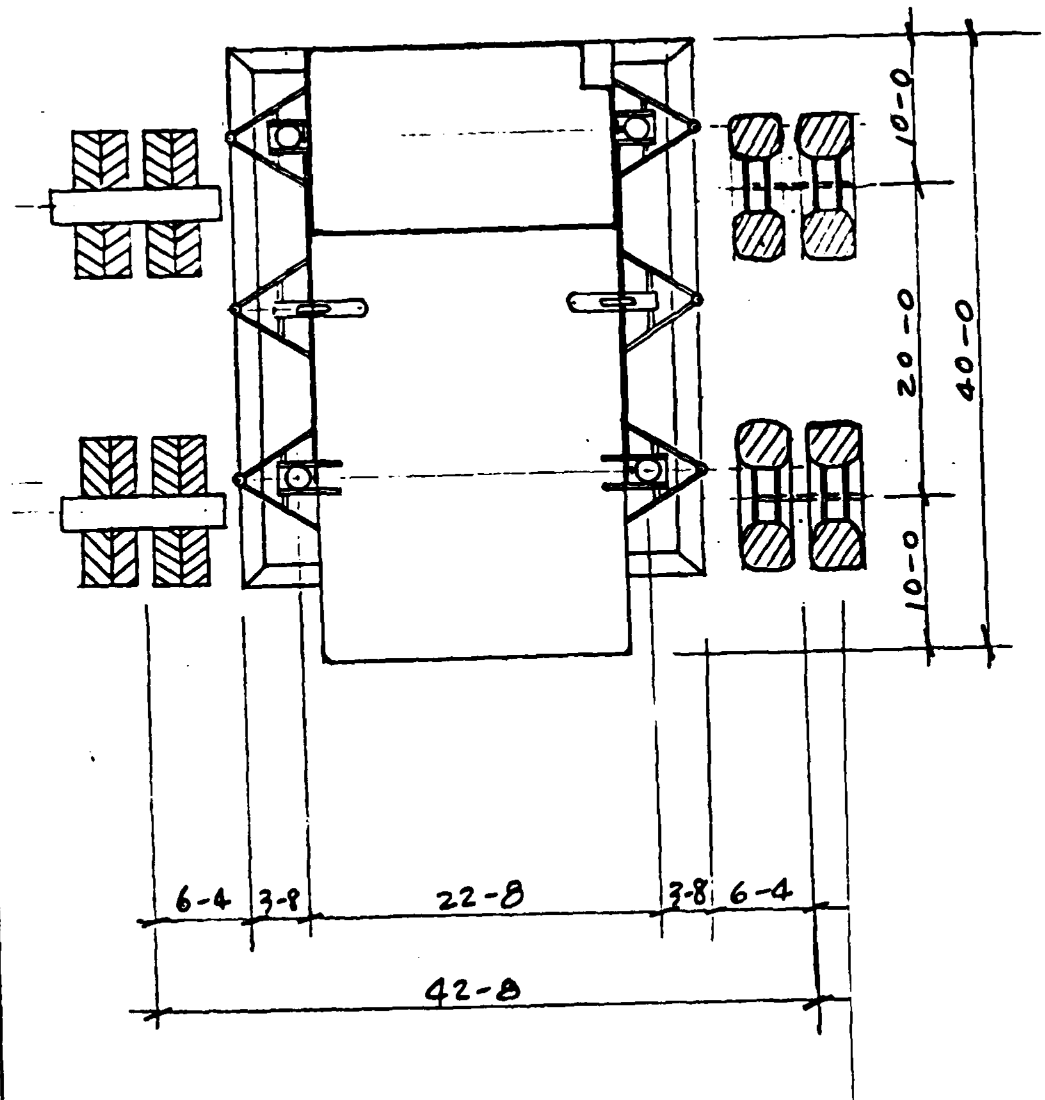

Fig. 2-1 TOP VIEW (FRAMES OMITTED FOR CLEARITY
- WHEELED SYSTEM -

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4-14-77

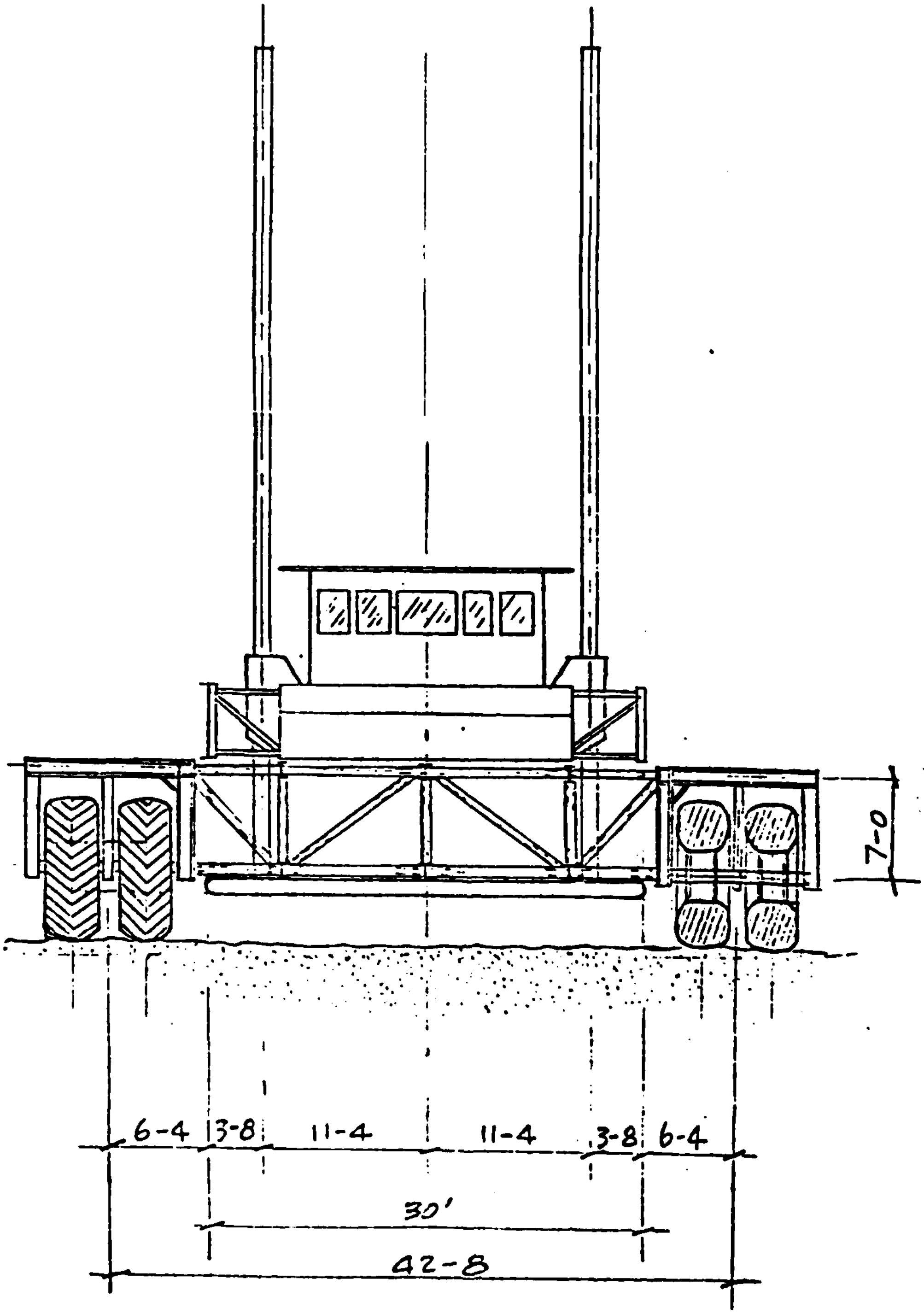

Fig. 2-2 FRONT VIEW (TOWING MODE)
- WHEELED SYSTEM -

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4-14-77

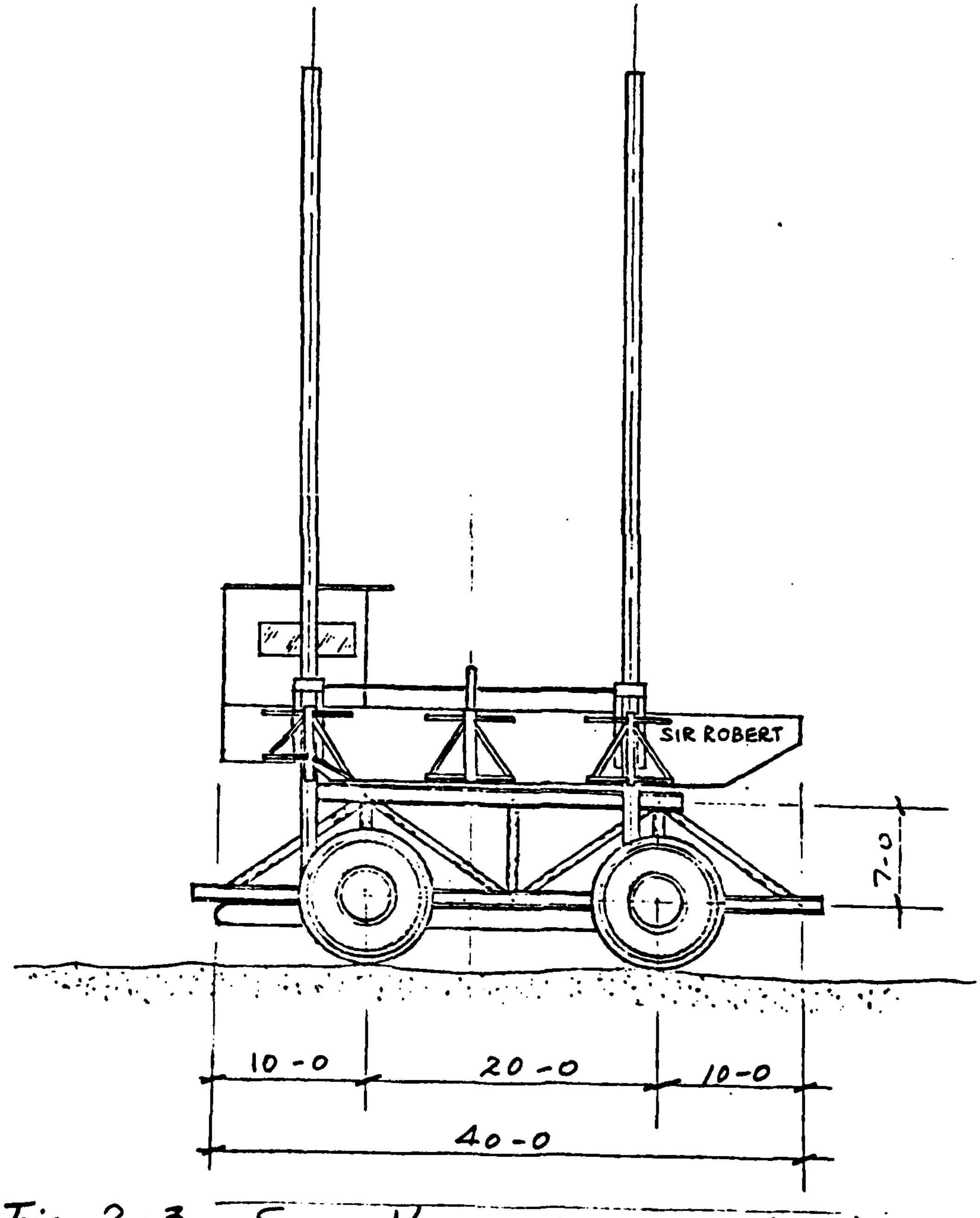

Fig. 2-3 SIDE VIEW (TOWING MODE)
- WHEELED SYSTEM -

C. Chern
4-8-77

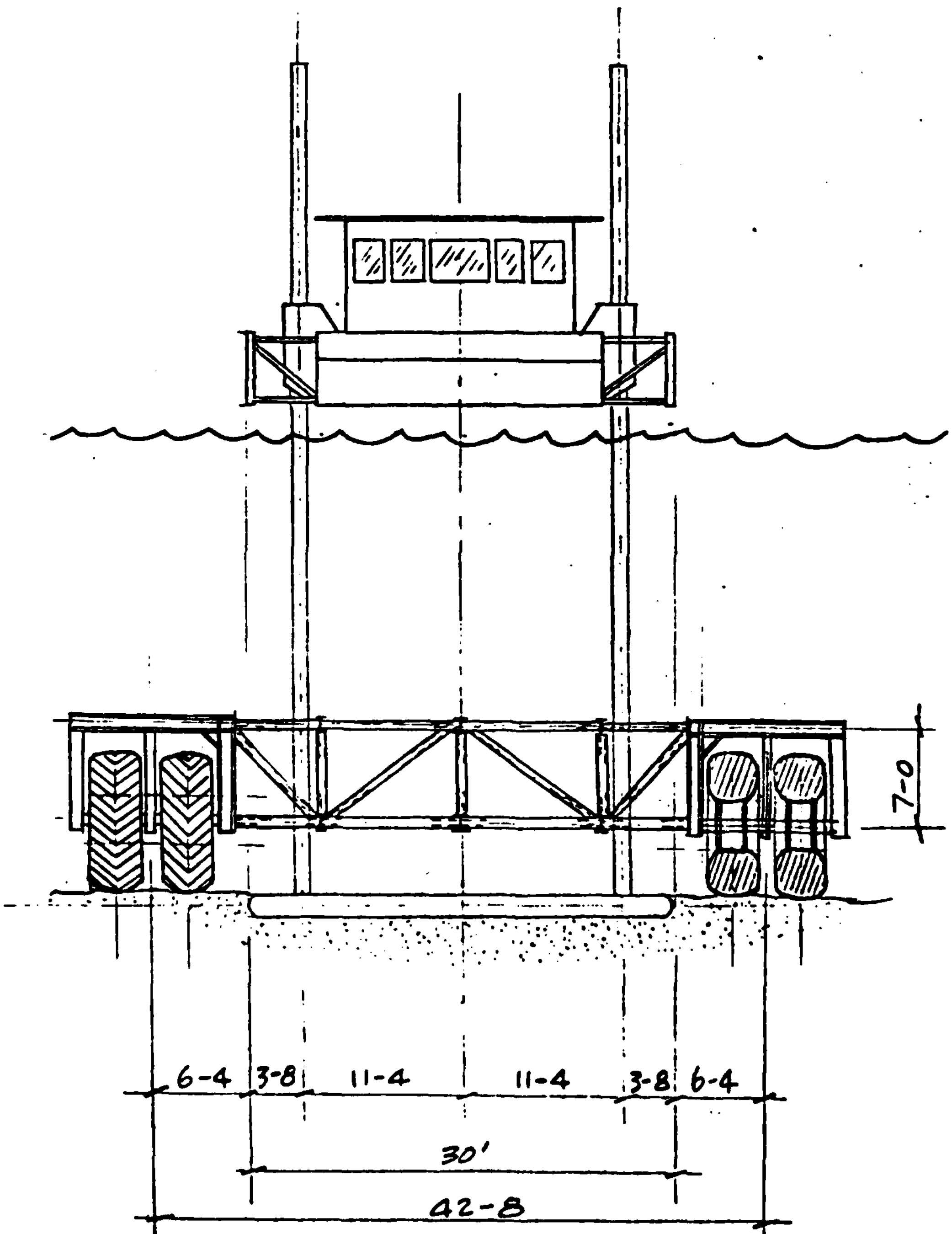

Fig. 2-4 FRONT VIEW (JACKUP MODE)
- WHEELED SYSTEM -

C. Chern
4-14-77

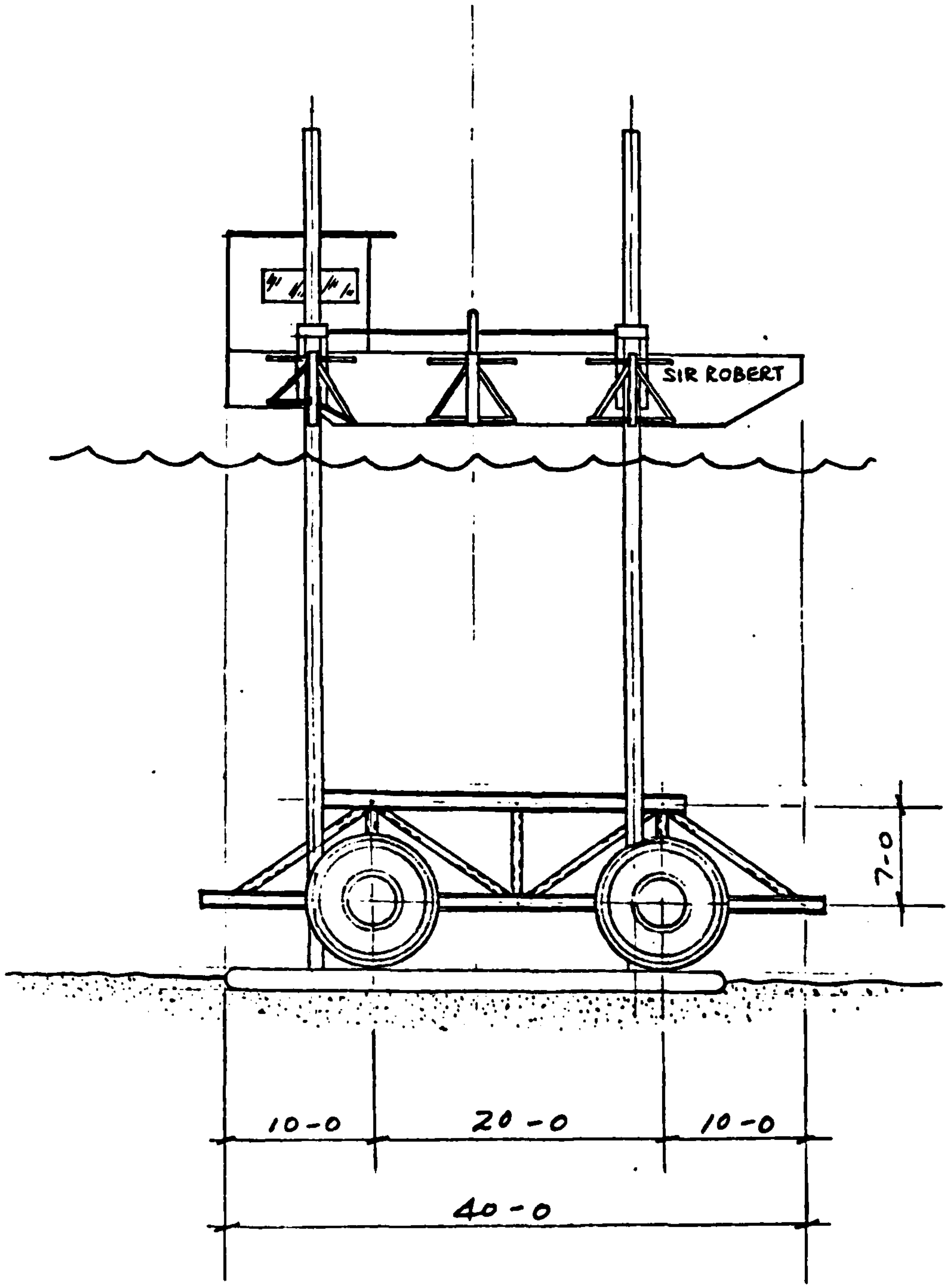

Fig. 2-5 SIDE VIEW (JACKUP MODE)
-WHEELED SYSTEM-

2.2 Tires

Rubber tires selected for the wheeled system will perform two services: (1) support the load and (2) provide low rolling resistance for the moving of SIR ROBERT. The general operational site is anticipated to be a beach with loose sand and gravel.

According to the study in Part III of the project report, the candidate rubber tires shall have the characterics as follows:

- Type: high floatation pneumatic all non-skid tire
- Tire Size: 36 x 41 48 ply
- Rim Size: 26 inches
- Gross Contact Area: 1746 square inch @ 20 psi
- Section Width: 38.9 inches unloaded

  43.0 inches loaded
- Outside Diameter: 114 inches
- Static Loaded Radius: 50 inches
- Weight: 3,362 lbs
- Rated load Capacity: 128,800 lbs @ 5 MPH
- Loads at Various Pressures @ 5 MPH

  55,250 lbs @ 20 psi

  62,950 lbs @ 25 psi

  70,040 lbs @ 30 psi

  76,650 lbs @ 35 psi

Notations for tire dimensions are shown in Figure 2-6.

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4-8-77

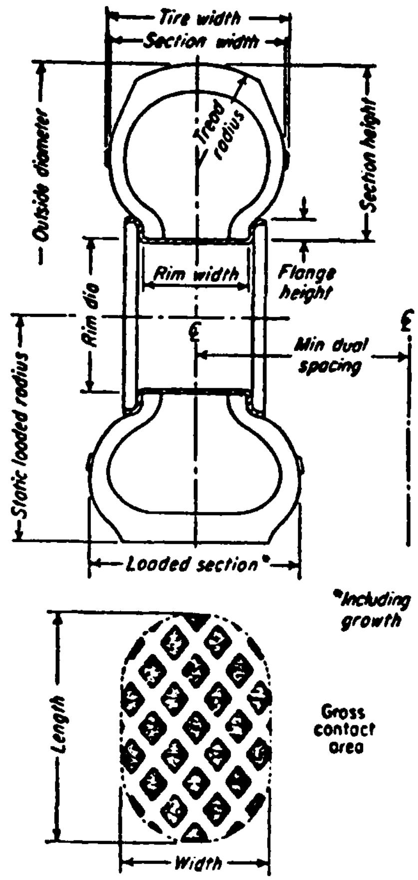

Fig. 2-6 TIRE DIMENSIONS
(Ref. 2)

As of 19 April 1977, the candidate tires may be obtained through two sources:

- Five tires are available through the Defense Property Disposal Service of the Defense Supply Agency, Stockton, California

- Three tires shall be specially ordered from Goodyear Tire and Rubber Company, Akron, Ohio

2.3 Rims, Bearings and Axles

The specified rim size, seawater proofed bearings, and axles to fit in the design wheel sets are not available through the conventional commercial market. However, Dixie wheel Company, Richmond, Virginia, expresses interest in manufacturing rims, bearings and axles to the design specification.

3. LAUNCHING-PULLING MECHANISM

3.1 Introduction

Although a working wheeled system may be developed to assist the land-sea movability of SIR ROBERT, it is still basically an unpowered "amphibious vehicle". Launching and pulling operation of the converted SIR ROBERT has to rely on external power sources.

A proposed launching-pulling mechanism is shown in Fig. 3-1. A schematic diagram showing the profile of the line between Deadman Nos. 1 and 3 is depicted in Fig. 3-2. The proposed mechanism consists of three elements:

- Deadman Anchors
  (One installed offshore and two onshore)
- Cable
- Crawler Tractor

The operational procedures for launching and pulling of the converted SIR ROBERT are achieved by moving tractors between Deadman Nos. 1 and 2. As shown in Fig. 3-1, tractors move from Deadman No. 1 toward Deadman No. 2 for pulling SIR ROBERT up to the beach. For launching, tractors will move from Deadman No. 2 toward Deadman No. 1. In this mechanism, tractors will operate only on shore to avoid seawater corrosion on tractor bearings.

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4-18-77

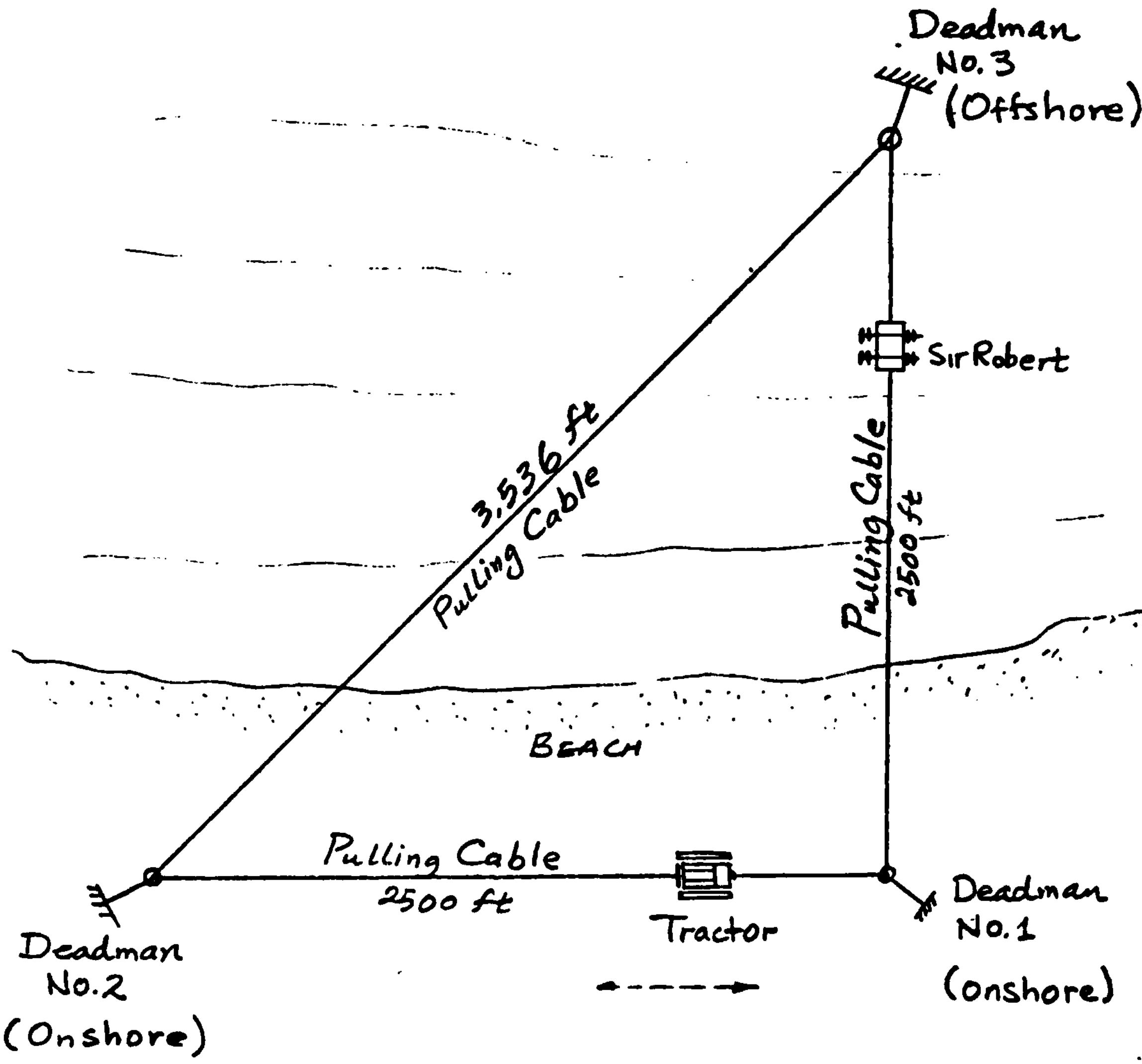


Fig.3-1 PROPOSED LAUNCHING-PULLING MECHANISM

C. Chern

4-19-77

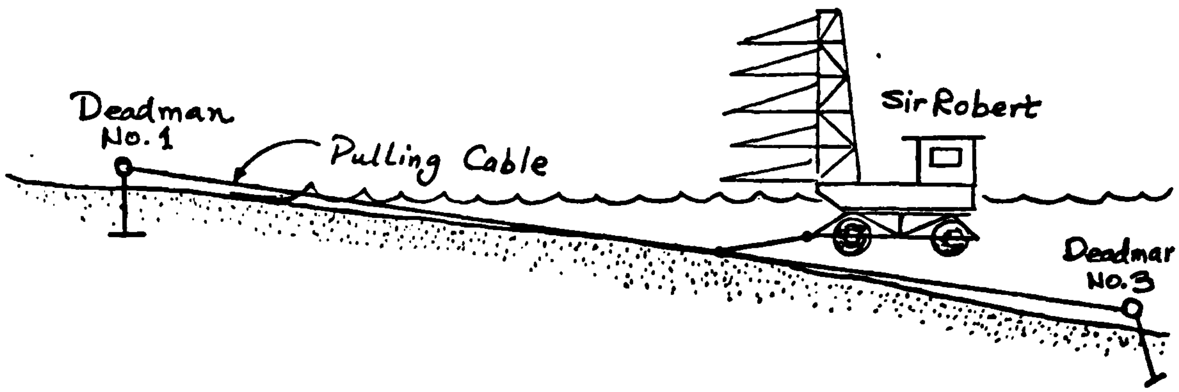


Fig 3-2 PROFILE OF PULLING MECHANISM

3.2 Rolling Resistance of SIR ROBERT

Chart 3-1 provides the preliminary information for estimating rolling resistance of a moving vehicle. In the table, rolling resistance is expressed in pounds of tractive pull required to move each gross ton over a level surface of the specified type or condition.

The converted SIR ROBERT will have a gross weight of approximately 100 tons. The wheeling system is to be rubber tires with plain bearings. The rolling surface is anticipated to be natural beach with loose sand and gravel. The tractive effort required to keep SIR ROBERT moving at a uniform speed will be

100 tons x 300 lbs/ton = 30,000 lbs

if the slope of the towing path for SIR ROBERT is assumed to be 1 percent, the necessary correction to the tractive effort provided in Chart 3-2 will be

100 tons x 20 lbs/ton = 2,000 lbs.

Total tractive effort required to move SIR ROBERT is then the sum of the above two forces, that is,

30,000 lbs + 2,000 lbs = 32,000 lbs

Chart 3-1 Rolling Resistances on Sand and Gravel Surface

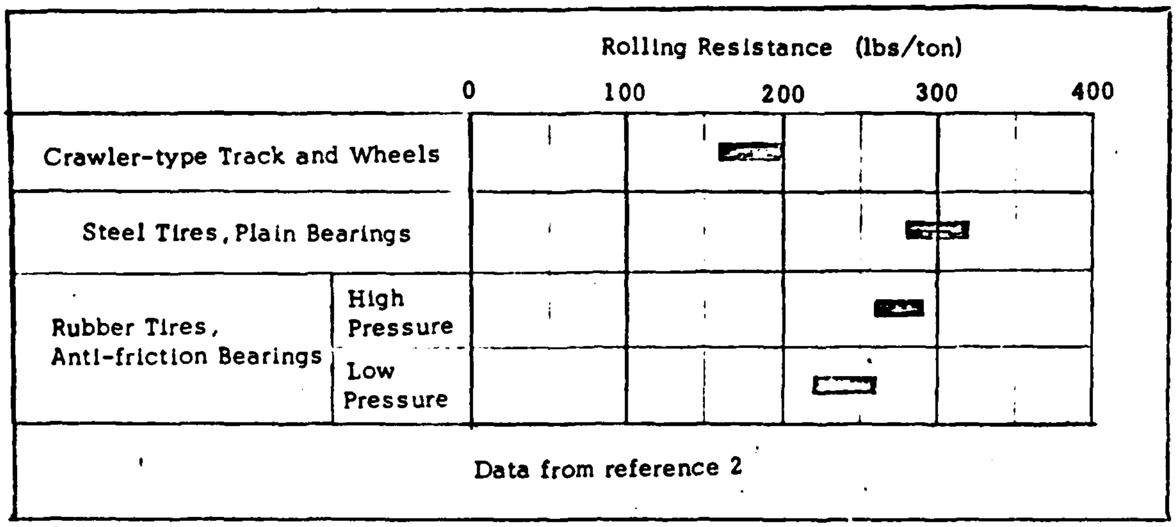
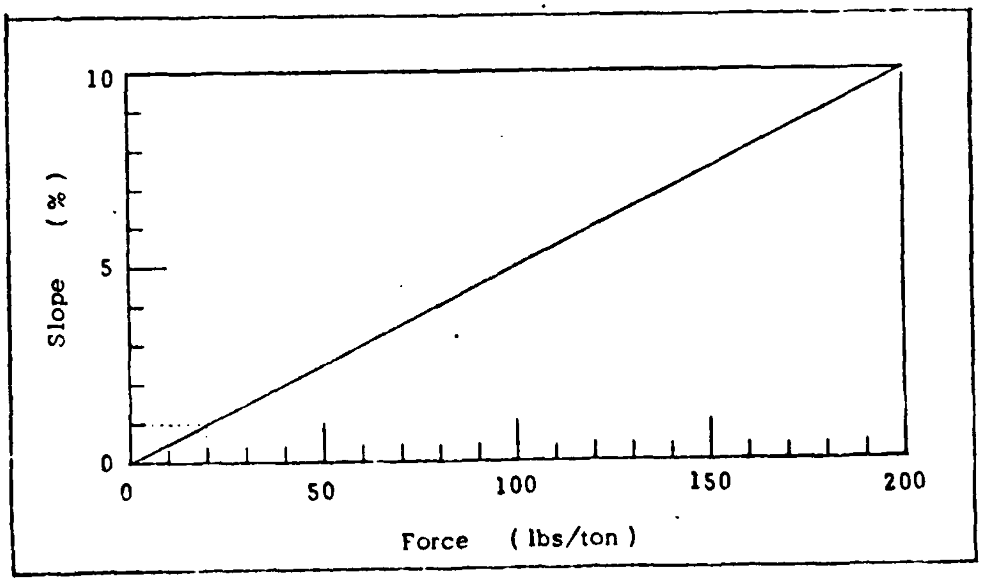


Chart 3-2 Effect of Grade on the Tractive Effort of Vehicles



3.3 Requirement of Crawler Tractors

The crawler tractor will be used as the power source to operate the proposed launching-pulling mechanism. The pull developed at the drawbar depends upon the size of tractor engine, the weight, and the coefficient of traction for a particular road surface. Chart 3-3 provides representative specifications for crawler tractors at various operating conditions.

The operating weight of CAT-D8 class tractor is approximately 40,000 lbs. The maximum drawbar pull is, from Chart 3-3, 33,714 lbs. The coefficient of traction is approximately 0.3 for loose dry sand and wet sand and gravel as given in Chart 3-4. Thus, an effective drawbar pull of a CAT-D8 class tractor operating on sand beach is

$$0.3 \times 33,714 \text{ lbs} = 10,114 \text{ lbs}$$

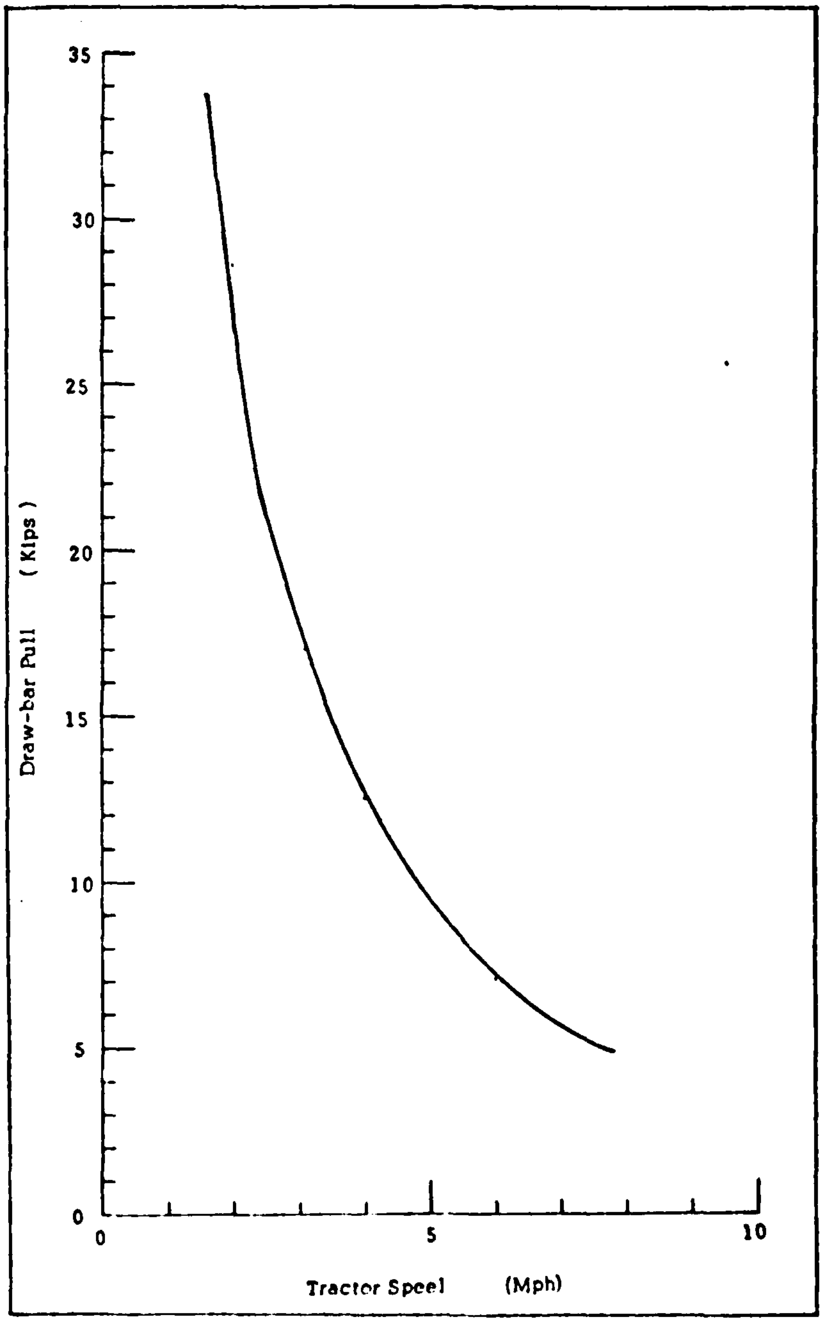
The number of CAT-D8 class tractors required to pull the converted SIR ROBERT up to the beach is obtained by dividing the total tractive effort by the effective drawbar pull per unit tractor:

$$\frac{32,000}{10,114} = 3.16$$

Therefore, an equivalent of four (4) CAT-D8 class tractors would be required to supply the power in the proposed mechanism.

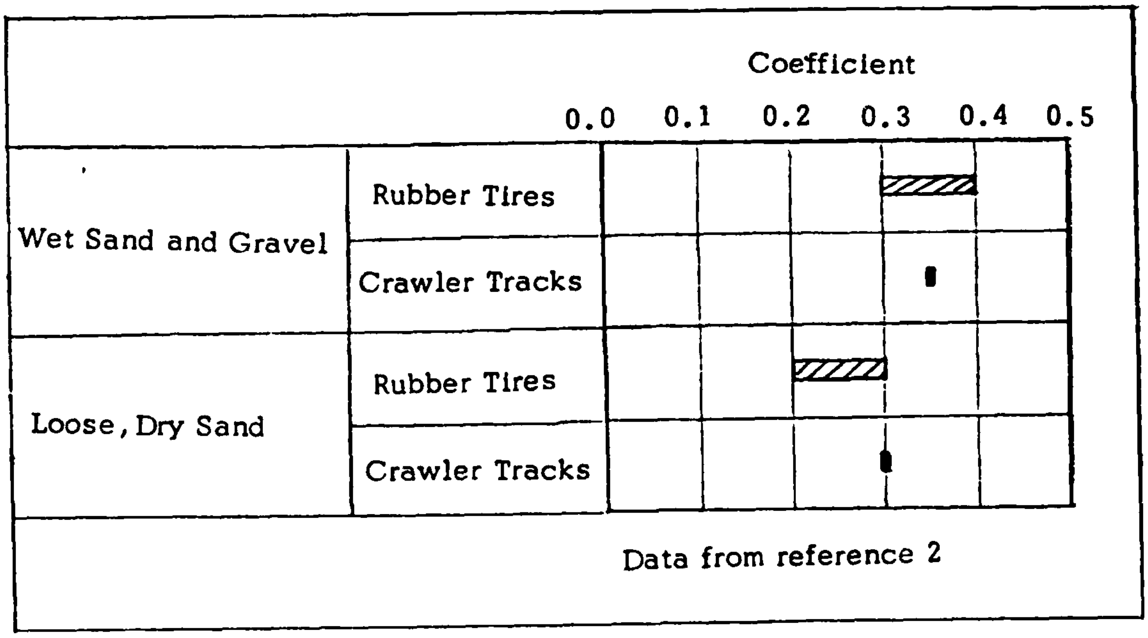
Note: A more efficient pulley system may be developed to have an optimum utilization of CAT-D8 class tractors available on San Nicolas Island.

Chart 3-3 CAT D-8 Class Crawler Tractor Pulling Capacity



Data from reference 2

Chart 3-4 Coefficients of Traction



3.4 Deadmen and Cables

Three deadmen are needed in the proposed launching-pulling mechanism. One of the deadmen will be installed offshore and the other two will be installed onshore. The approximate locations of the deadmen are shown in Fig. 3-1. A minimum distance of 2,500 feet between any two deadmen is required to have sufficient water depth for SIR ROBERT to float freely. For estimating purposes each deadman may consist of two CEL 100 K propellant anchors and a cable pulley. The onshore anchors would most likely be cast-in-place concrete blocks.

Approximately 8,500 feet of 1¼ inches diameter cables with breaking strength of 158,000 lbs are needed to connect the mechanism.

4. STRUCTURAL FRAMES

4.1 Introduction

The basic concept for developing a system of structural frames for SIR ROBERT is to transfer the cable pulling load to the wheeled system without any undesirable distortion to the original jack up barge structure. In order to obtain the stated purpose, a series of trusses parallel to the loading plane are used. The cable pulling load is then transferred from the centre truss to the neighboring trusses through a series of horizontal diagonal braces in the upper and lower levels of the structural frames, as shown in Figs 4-1 and 4-2. These braces are intended primarily to carry the diagonal tensions.

Most of the structural members are tubular shapes to minimize the resultant of drag forces under tow.

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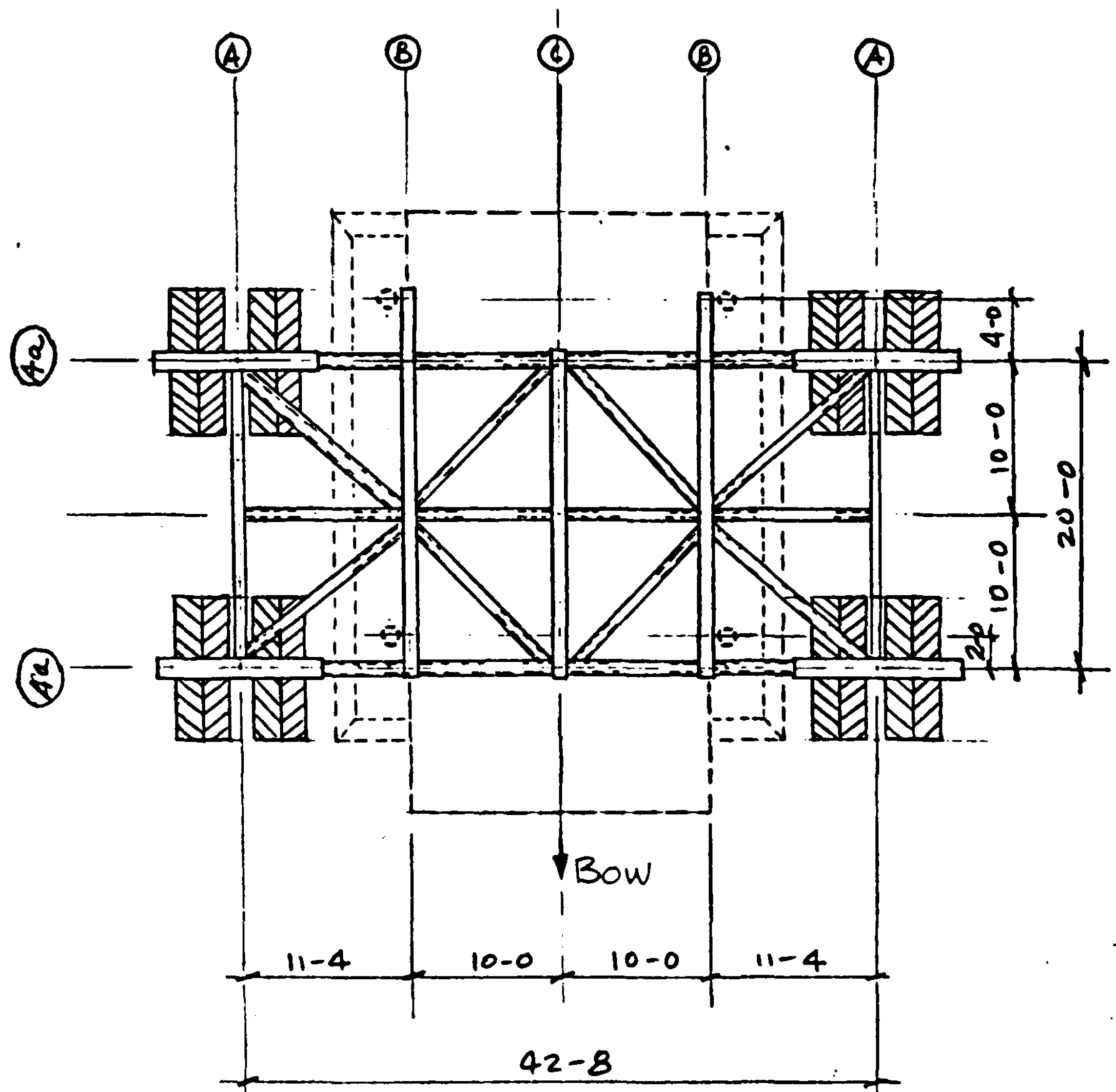

Fig. 4-1 FRAMING @ UPPER LEVEL

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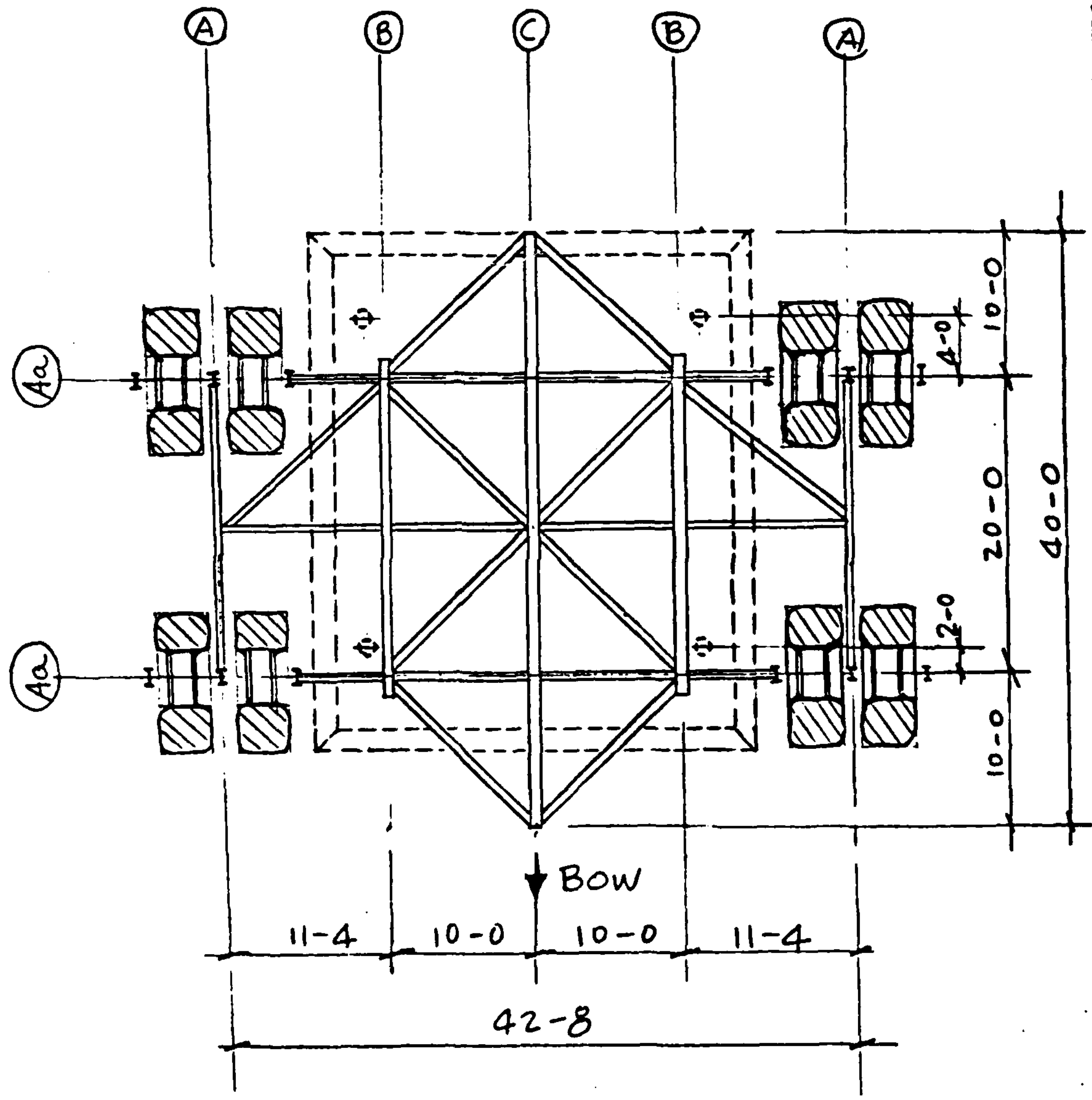

Fig. 4-2 FRAMING @ LOWER LEVEL

4.2 Loading Frames

Two types of loading frames are used:

- Longitudinal trusses which are mainly to carry the total weight of SIR ROBERT. These are Trusses A, B and C, respectively, shown in Figs. 4-3 to 4-5.

- Transverse trusses which behave like reaction beams for the longitudinal trusses. Besides, these trusses also resist bending moment due to wheel reactions. Truss Aa shown in Fig. 4-6 illustrates this type of truss.

Figures 4-7 and 4-8 indicate the sizes of the horizontal diagonal braces through preliminary member selection.

Appendix A.1 provides the calculations of the preliminary truss design.

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W8X40 @ 23'	920#
W10x45 @ 43'	1935#
2-8"φ @ 12'-2"	697#
2-6"φ @ 12'-2"	463#
3-6"φ @ 7'	398#
	4,413#

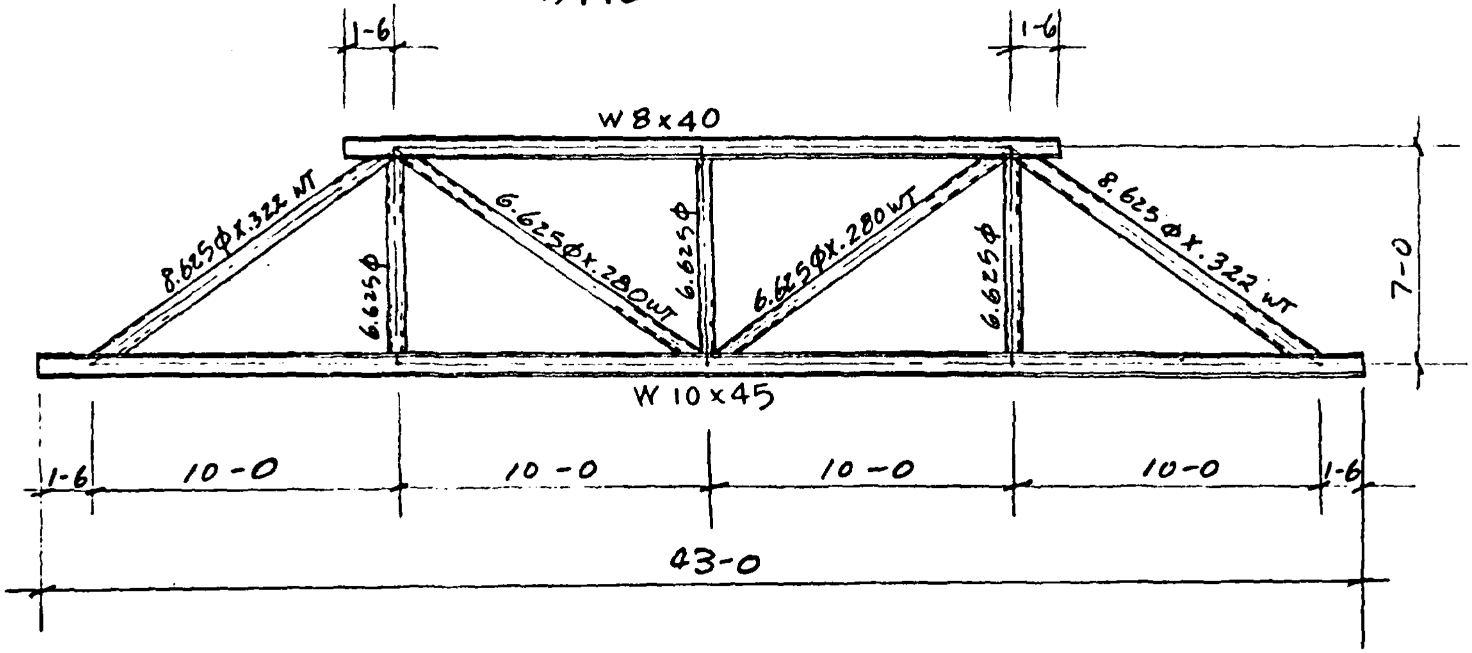

Fig. 4-3 TRUSS C (ONE REQ'D)

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W8x40 @ 25-6	1020 #
W8x40 @ 23-0	920 #
3-6"φ @ 7-0	398 #
2-6"φ @ 12-2	463 #
	2,801 # ea.

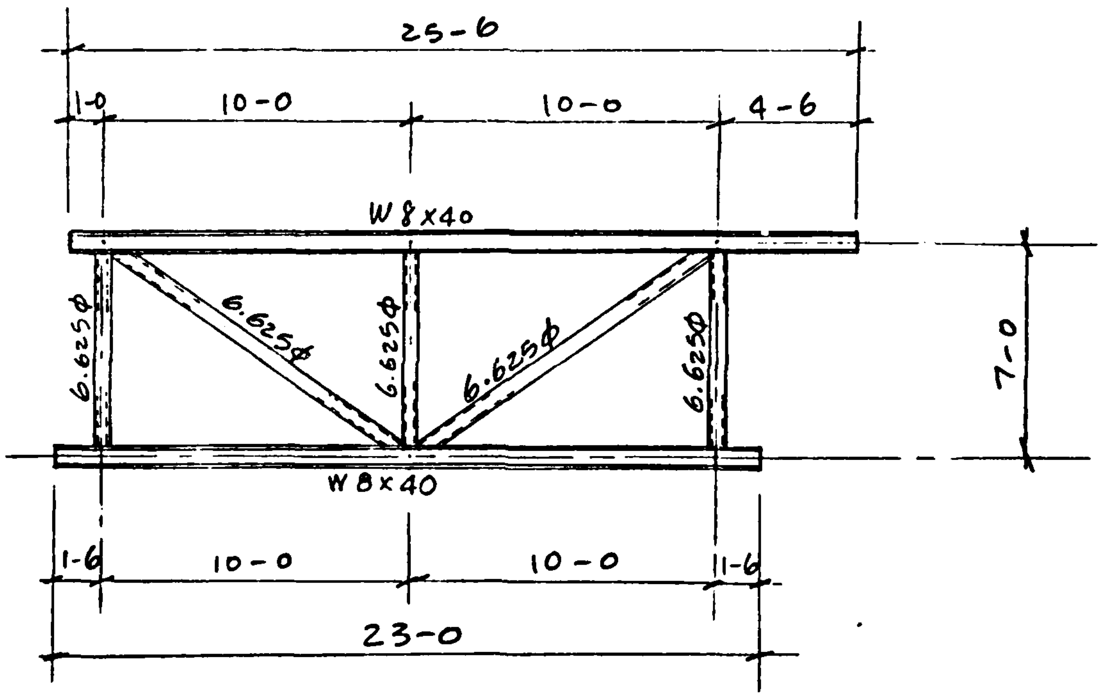

Fig. 4-4 Truss B (Two Req'd)

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2- W8X40@20-0	1600#
1-6φ@7-0	133#
2-6φ@12-2	463#
	2,196# ea.

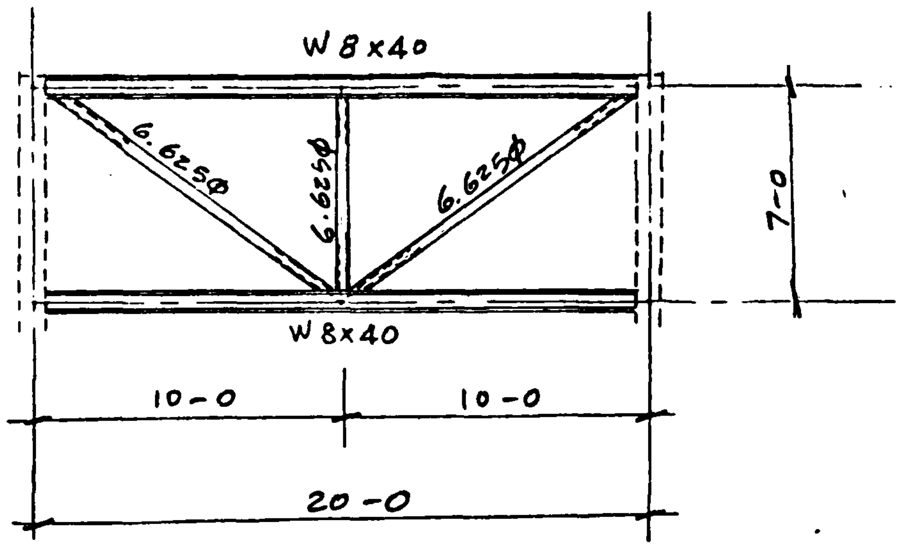

Fig. 4-5 TRUSS A (TWO REQ'D)

sch. 40 { 2-6"φ @ 10'-0 379#
2-6"φ @ 6'-0 228#
2-6"φ @ 12'-2 463#
2-6"φ @ 9'-2 349#

2-W18x64 @ 10-8 1365#
2-W18x64 @ 7-0 896#
4-W8x40 @ 7-0 1120#
5,473#

2-6.625φx.312(10') 421#
2-6.625φx.312(6') 252#

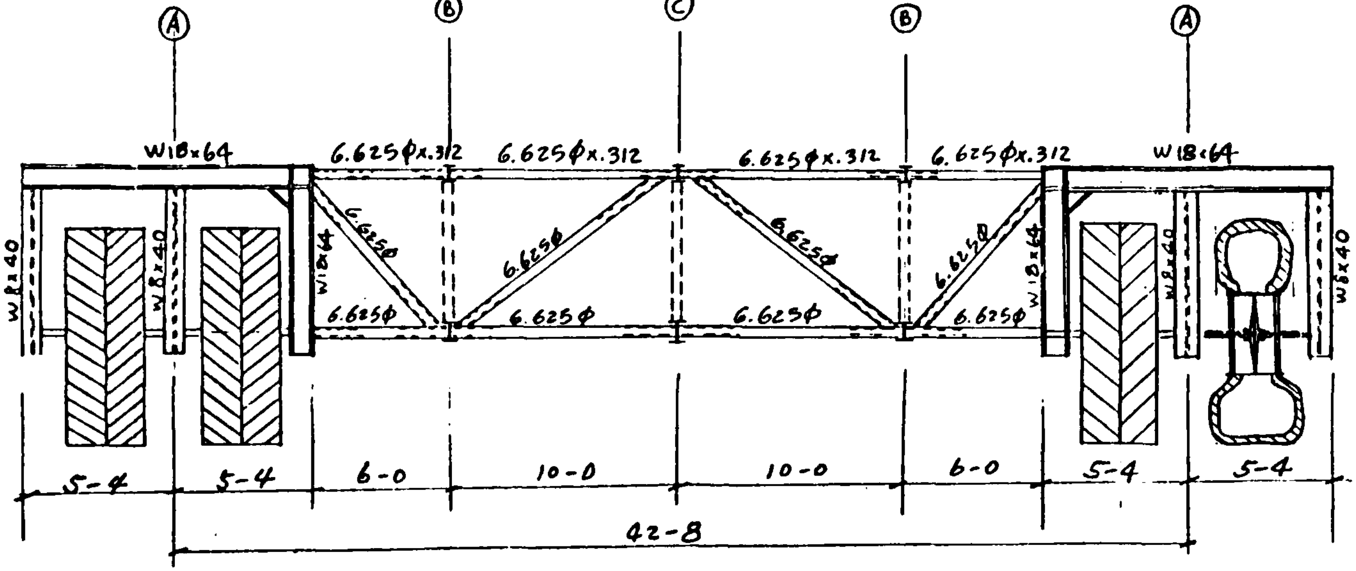

Fig. 4-6 TRUSS Aa (TWO REQ'D)

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8-6"φ @ 14'-1" 2,140#
4-4"φ @ 10-0 364#
2,504#

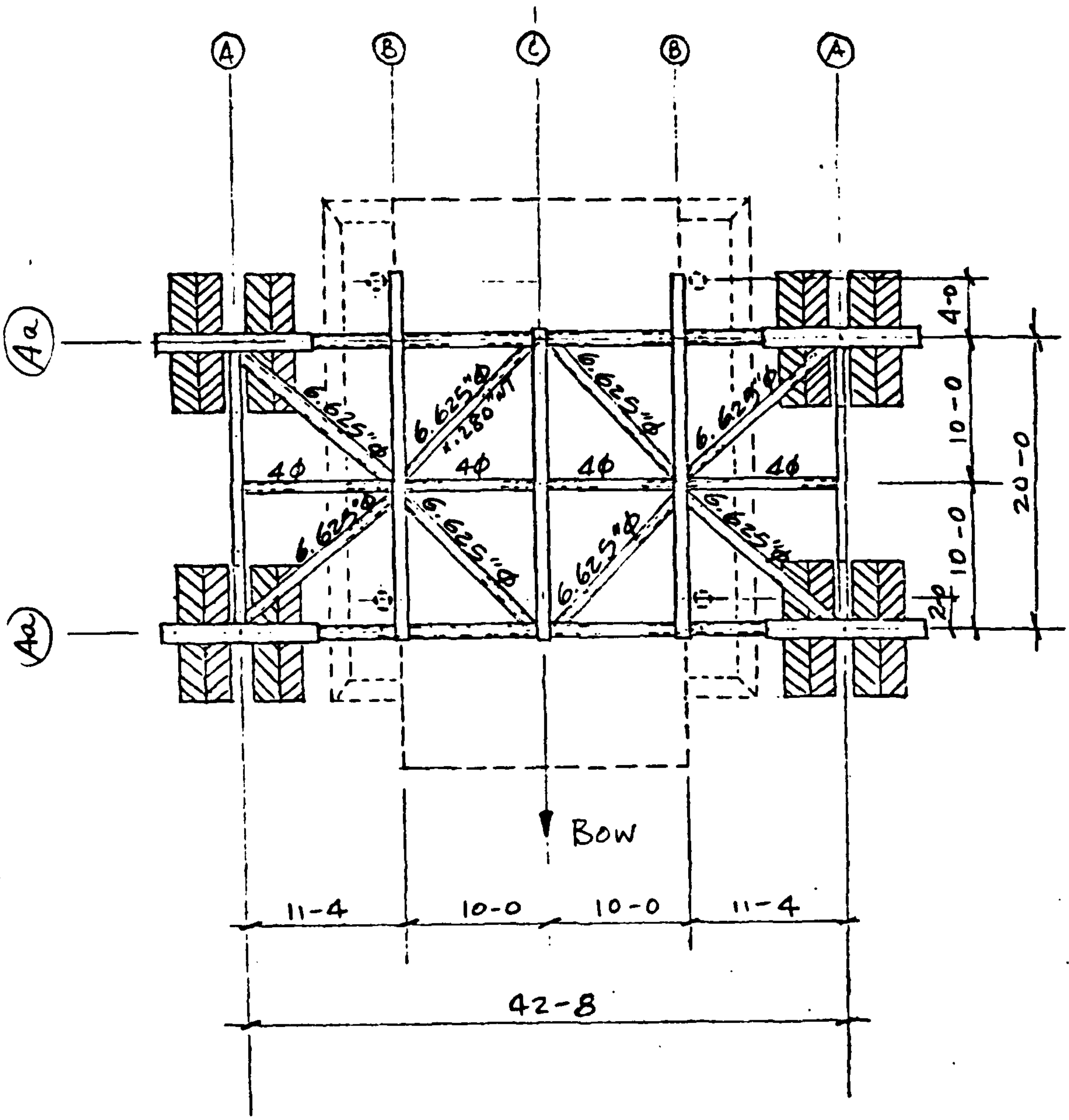

Fig. 4-7 BRACES @ UPPER LEVEL (ONE REQ'D)

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4-6.ϕ @ 14'-1"	1070#
6-4ϕ @ 14'-1"	771#
4-4ϕ @ 10'-0	364#
	2,205#

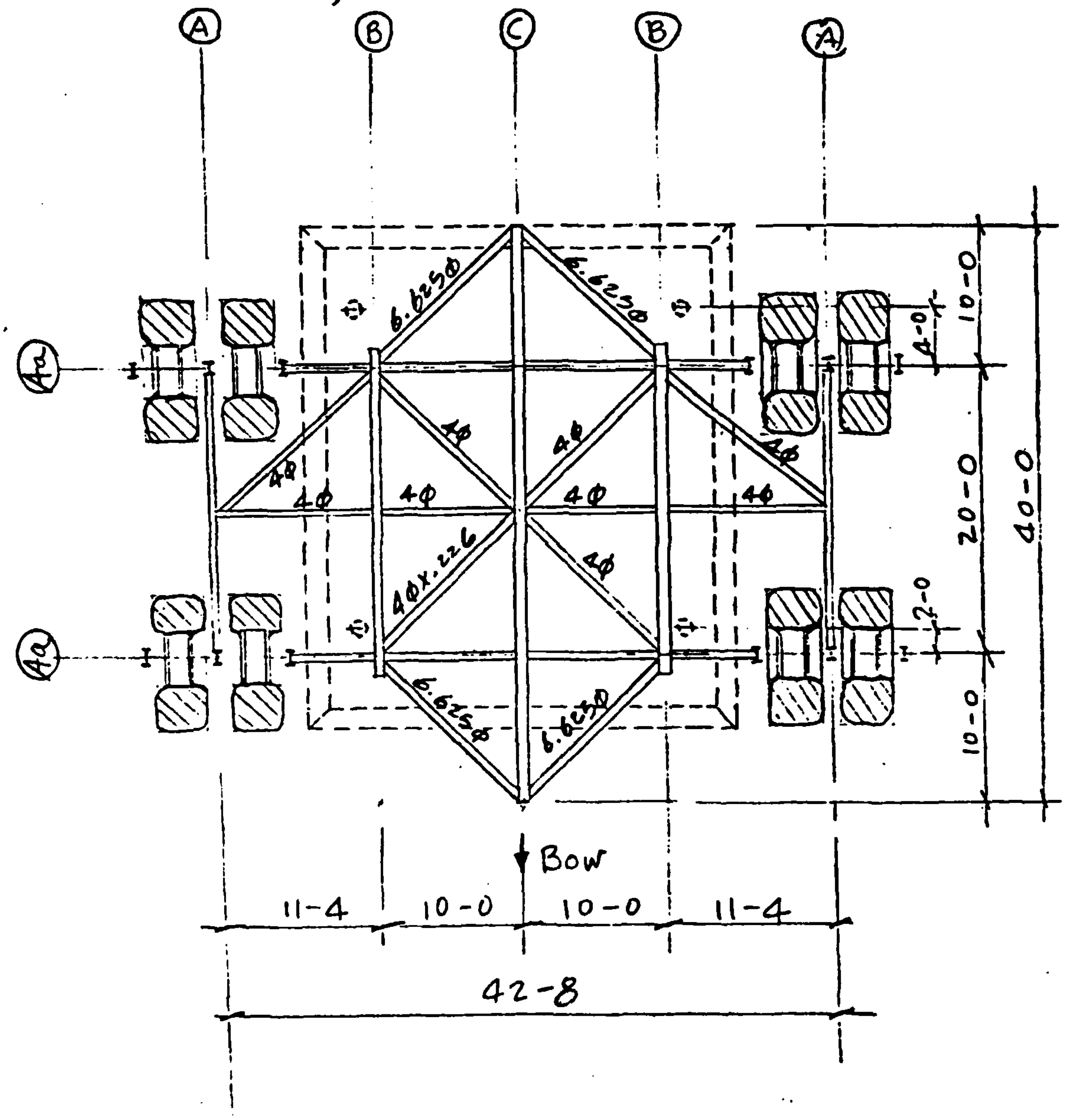

Fig. 4-8 BRACES @ LOWER LEVEL (ONE REQ'D)

4.3 Material Listing

This section provides the list of structural member sizes and quantity for cost estimate purpose. It may also be used for processing advance material purchase orders.

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MEMBER SIZE	MEMBER LENGTH	NO. REQ'D	TOTAL LENGTH	UNIT WT.	TOTAL WEIGHT	UNIT BUOY.	TOTAL BUOYANCY
in. x in.	FT-IN		FT-IN	LBS/FT	LBS	LBS/FT	LBS
W18x64	10-8	4	42-8				
	7-0	4	28-0				
			70-8	64	4,523	8.4	594
W10x45	43-0	1	43-0	45	1,935	5.87	25[illegible]
W8x40	7-0	8	56-0				
	23-0	1	23-0				
	25-6	2	51-0				
	23-0	2	46-0				
	20-0	4	80-0				
			256-0	40	10,240	5.24	1,3[illegible]
8.625φx.322	12-2	2	24-4	28.554	695	25.97	6[illegible]
6.625φx.312	10-0	4	40-0				
	6-0	4	24-0				
			64-0	21.036	1,346	15.32	[illegible]80

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MEMBER SIZE	MEMBER LENGTH	NO. REQ'D	TOTAL LENGTH	UNIT WT.	TOTAL WEIGHT	UNIT BUOY.	TOTAL BUOYANCY
in.x in.	FT-IN		FT-IN	LBS/FT	LBS	LBS/FT	LBS
6.625φx.280	10-0	4	40-0				
	6-0	4	24-0				
	12-2	14	170-4				
	9-2	4	36-8				
	7-0	11	77-0				
	14-1	12	169-0				
			517-0	18.974	9,809	15.32	7,920
4φx.226	14-1	6	84-6				
	10-0	8	80-0				
			164-6	9.109	1,498	5.59	920
			TOTAL		30,046		12,639

5. COST ESTIMATE

5.1 Introduction

This section summarizes cost information for the conversion of SIR ROBERT to an amphibious jackup platform. The main subjects of cost items are as follows:

- Feasibility Study
- Site Survey
- Engineering Design
- Fabrication
- Project Execution Plan
- Barge Transportation
- Launching-Pulling Mechanism

Appendix A.2 provides detailed cost information which represent the results of a current market search for material availability and prices. It is noted that market prices fluctuate approximately every two weeks. Therefore, the quoted prices are not firm values and are subject to change.

5.2 Project Cost

The total cost for the conversion of SIR ROBERT to an amphibious jackup platform is estimated at $252,000

Table 5-1 shows the breakdown subject cost. The cost for feasibility study shown in the table includes the expenditure for the completion of Reference 1. The fabrication cost of wheeled system assumes that U.S. Government will supply without cost five (5) of eight (8) 36 x 41 48 ply rubber tires needed for the system. Launching-Pulling Mechanism does not include the cost of obtaining needed operating power sources.

It is noted that cost for the installation of power and communication cables shwon in Reference 1 is not included in this report. If it is needed, the cost can be directly added into the estimated total project cost.

TABLE 5-1 ESTIMATED PROJECT COST

SUBJECT	TASK	COST NAVY	COST COMMERCIAL
FEASIBILITY STUDY	Fixed Platform Concept Wheeling Transport Concept	($4,000.) ($2,000.) $6,000.	
SITE SURVEY	SITE SURVEY Soil Sampling	$15,000.	
ENG'RG DESIGN	Wheeling Transport System	$22,400.	
FABRICATION	Structural Framing Wheeling System	$45,069	$21,450
EXECUTION PLAN	Installation Plan & Management	$10,000.	
BARGE TRANSPORTATION			$41,500.
LAUNCHING-PULLING MECHANISM		$89,135.	
CONTINGENCY	10% of Above Cost	$18,760.	$6,295
SUB-TOTAL		$206,364.	$69,245
PROJECT COST		$275,609.	

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

Conclusions drawn from the results of this feasibility study are as follows:

- The concept for the conversion of SIR ROBERT to an amphibious jackup platform is feasible. The work involved in the conversion process will be:

  - Manufacture of a rubber tire wheeled system,
  - Fabrication of supporting structural frames,
  - Installation of a Launching-pulling mechanism,
  - Floatation stability analysis for the converted SIR ROBERT

- The wheeled system is the unique feature in this study. Due to the combination of unusual application and unpopular demand, the needed rubber tires, rims and anti-friction bearings can not be found easily in the commercial market. Special orders are needed to fabricate these items.

- Fabrication of structural frames to support SIR ROBERT and the wheeled system is out of proportion in terms of structural modifications. The required depth of the truss dimensions also results in increase in water depth for launching operation.

- Launching-Pulling mechanism is essential to the converted SIR ROBERT operation. Due to the undesirable environment for crawler tractors to operate most efficiently, an attempt to pull SIR ROBERT up to shore will require a power source of 4 CAT-D8 class tractors or equivalent. A more efficient pulley system may have to be developed to replace the proposed direct tractor pull system.
- Floatation stability is critical to the safe operation of SIR ROBERT. The impact on the stability of the barge due to drastic vertical motion in the breaker zone needs further study. Besides, the added structural frames and the wheeled system will increase by a considerable amount the drag resistance which may impair the existing propulsion capability of the barge.

6.2 Recommendations

Based on this feasibility study, the following recommendations are made for action:

- The wheeled concept of converting SIR ROBERT to an amphibious jackup platform shall be regarded only as a possible alternative.

- A thorough project review of engineering services should take place as soon as possible if this option is accepted. The original schedule of spring - summer time frame for the installation of SIR ROBERT on site will soon slip off.

REFERENCES

1. A Feasibility Study: Conversion of Sir Robert To A Permanent Gravity Platform, TR/FPO-1E-7, CHESNAVFACENGCOM (FPO-1), March 1977

2. Construction Planning, Equipment, and Methods, McGraw-Hill, 1956

APPENDICES

A.1 Structural Frame Member Sizes

Preliminary selection of structural member sizes are documented hereinafter. No refinement of the member sizes will be preformed within the stated scope of work.

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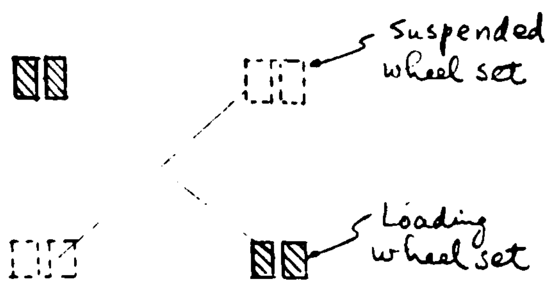
LOADS

Dry weight of Barge & Mat	130,000#
8 wheels each wheel	16,250#
Load @ each wheel set	32,500#

Assuming that the critical condition occurs when two sets of wheels in a diagonal are suspended in the air. The total load is thus carried only by the other two sets of wheels in the diagonal.



Load @ each wheel set = 65,000# ←

Say 30% impact load on 4 wheel sets

1.3 × 32,500 = 42,250#

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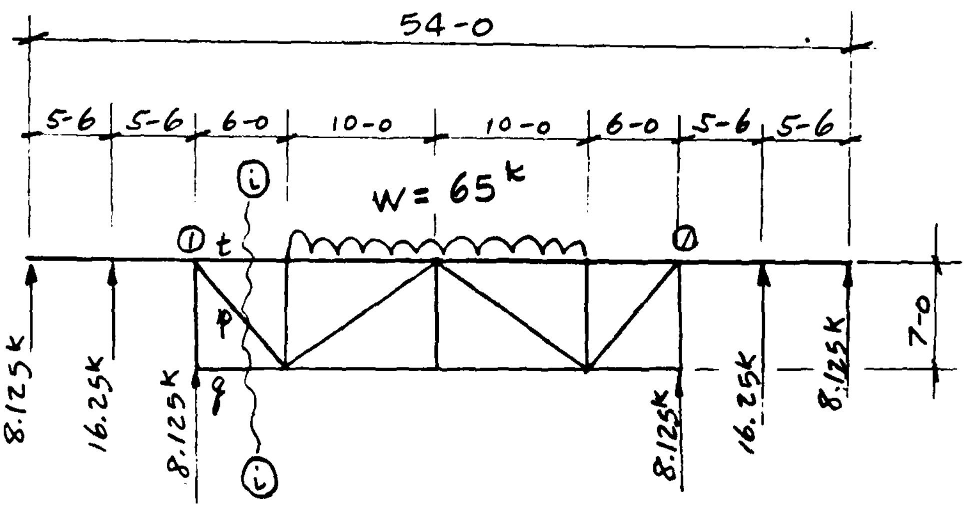
Truss Aa

Static Loading Condition



Moment @ pt. ①

$$M = (8.125 \times 11 + 16.25 \times 5.5) \times 12$$

$$= 2145 \text{ "K}$$

$$\sigma_b = 22^{ksi}$$

$$S = \frac{2145}{22} = 97.5 \text{ in}^3$$

Use W18×64 $S = 118 \text{ in}^3$

$$\sigma_b = \frac{2145}{118} = 18.2^{ksi}$$ o.k.

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Shear @ Section ①-①

$$T_p = \frac{\sqrt{6^2+7^2}}{7} \times (8.125+16.25+8.125)$$

$$T_p = 42.8 \text{ kips}$$

$$\sigma_a = 22 \text{ ksi}$$

$$A = \frac{T_p}{\sigma_a} = \frac{42.8}{22} = 1.94 \text{ in}^2$$

Member p

6.625"Φ x .280" WT $\quad A = 5.581 \square" > 1.94 \square"$ o.k.

Member q

6.625"Φ x .280" WT $\quad A = 5.581 \square"$

$$T_q = \frac{2145}{(84)} = 25.54 \text{ kips}$$

$$\text{Area Req'd} = \frac{25.54}{22} = 1.16 \square" < 5.581 \square" \text{ o.k.}$$

Member t

6.625"Φ x .280" WT $\quad A = 5.581 \square"$

$$C_t = \frac{(8.125 \times 17 + 16.25 \times 11.5 + 8.125 \times 6) \times 12}{84}$$

$$= 53.3 \text{ kips}$$

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$$f_a = \frac{53.3}{5.581} = 9.6 \text{ ksi}$$

Lateral unbraced Length $\doteq$ 11'-6" = 138"

$$\frac{KL}{r} = \frac{1.0 \times 138}{2.246} \quad \text{(approximately } K=1.0\text{)}$$

$$= 61.44$$

$$F_a = 17.28 \text{ ksi}$$

$$\frac{f_a}{F_a} = \frac{9.6}{17.28} = 0.56 \qquad \text{O.K.}$$

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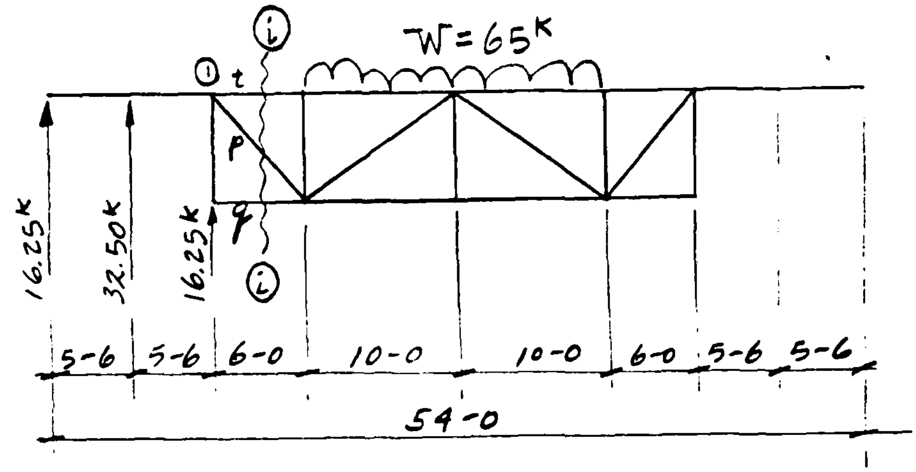
Instantaneous Balancing Condition

(Approximate estimate of wheel Load reactions)

Total Load carried by the pair of wheel set in the diagonal.



Moment @ pt. ①

$$M = (16.25 \times 11 + 32.50 \times 5.5) \times 12$$

$$= 4290 \; "^{K}$$

W18x64 $S = 118 \; in^3$

$$\sigma_b = \frac{4290}{118} = 36.4 \; ksi$$

Use hunch bracket at 1'-6"

$$M = (16.25 \times 9.5 + 32.50 \times 4.0) \times 12$$

$$= 3412.5 \; "^{K}$$

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$$\sigma_b = \frac{3412.5}{118} = 28.9 \text{ ksi}$$

For short duration of Loading application

$$\sigma_a = 1.3 \times (0.6 F_y)$$

Use $F_y = 36$ ksi

$$\sigma_a = 1.3 \times 0.6 \times 36 = 28.1 \text{ ksi} \doteq 28.9 \text{ ksi}$$

Say o.k.

Shear @ Section ⓘ-ⓘ

Member P

$$T_p = \frac{\sqrt{6^2+7^2}}{7} \times (16.25 + 32.50 + 16.25)$$

$$= 85.6 \text{ kips}$$

6.625"φ x .280" WT   A = 5.581 □"

$$f_a = \frac{85.6}{5.581} = 15.3 \text{ ksi} < 22 \text{ ksi} \quad \text{o.k}$$

Member q

$$T_q = \frac{4290}{84} = 51.1 \text{ kips}$$

6.625"φ x .280" WT   A = 5.581 □"

$$f_a = \frac{51.1}{5.581} = 9.2 \text{ ksi} < 22 \text{ ksi} \quad \text{o.k}$$

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<u>Member t</u>

$$C_t = \frac{(16.25 \times 17 + 32.5 \times 11.5 + 16.25 \times 6) \times 12}{84}$$

$= 106.8$ kips

6.625"φ x .280" WT A = 5.581 □"

$$f_a = \frac{106.8}{5.581} = 19.1 \text{ ksi} > 17.28 \text{ ksi} \quad \text{N.G.}$$

Use 6.625"φ x .312" WT A = 6.188 □"

$$f_a = \frac{106.8}{6.188} = 17.3 \text{ ksi}$$

$$\frac{kL}{r} = \frac{138}{2.238} = 61.7$$

$$F_a = 17.3 \text{ ksi}$$

$$\frac{f_a}{F_a} = 1.0 \qquad \text{Say o.k.}$$

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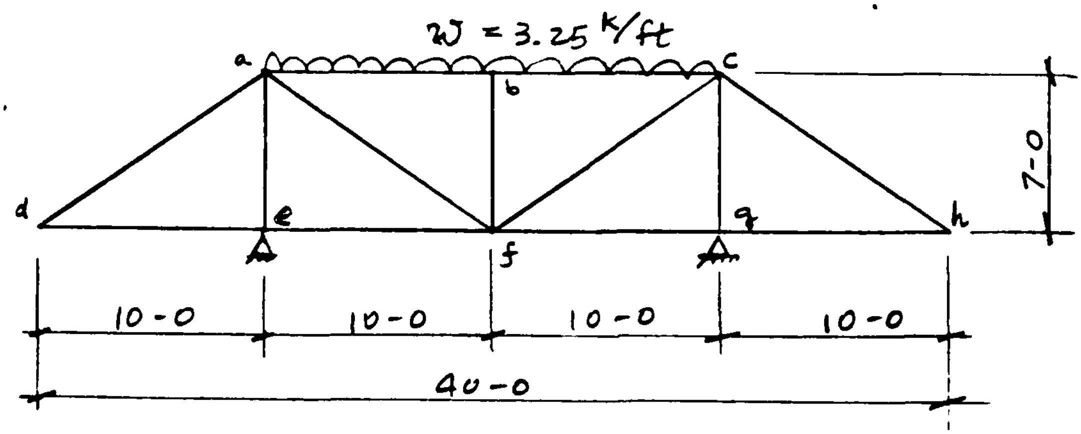
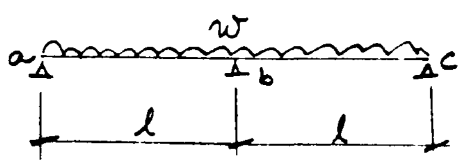
TRUSS C

STATIC LOADING CONDITION



Upper Chords



@ Mid support

$$M_{max} = \frac{1}{8} w l^2$$

$$= \frac{1}{8} \times 3.25 \times 10^2 \times 12$$

$$= 487.5''^{k}$$

Try W8x40 $S = 35.5^{in^3}$

$$\sigma_b = \frac{487.5}{35.5} = 13.7^{ksi} < 22^{ksi}$$

O.K

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<u>Member bf</u>

6.625"ϕ X .280" WT   A = 5.581 □"

$$f_a = \frac{32.5}{5.581} = 5.8 \text{ ksi}$$

$$\frac{kL}{r} = \frac{1.0 \times 7 \times 12}{2.246} = 37.4$$

$$F_a = 19.39 \text{ ksi}$$

$$\frac{f_a}{F_a} = \frac{5.8}{19.39} = 0.3 \qquad \text{o.k.}$$

<u>Members af, fc</u>

$$T = \frac{\sqrt{7^2+10^2}}{7} \times 32.5 = 56.7 \text{ kips}$$

6.625"ϕ X .280" WT   A = 5.581 □"

$$f_a = \frac{56.7}{5.581} = 10.2 \text{ ksi} < 22 \text{ ksi} \quad \text{o.k.}$$

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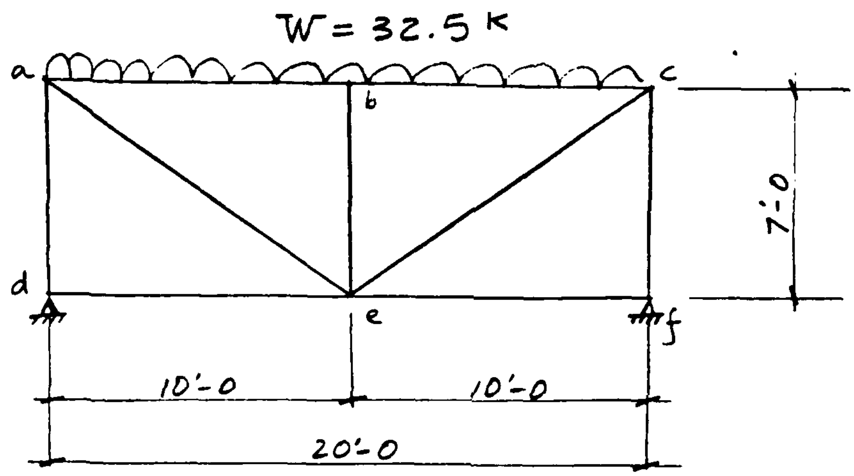
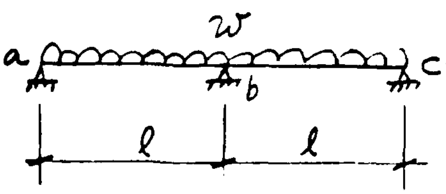
TRUSS B

STATIC LOADING CONDITION



Upper Chords



@ Mid-span

$$M_{max} = \frac{w l^2}{8}$$

$$= \frac{16.25 \times 10 \times 12}{8}$$

$$= 243.75 \ ''K$$

W8x40 $S = 35.5 \text{ in}^3$

$$\sigma_b = \frac{243.75}{35.5} = 6.9 \text{ ksi} < 22 \text{ ksi}$$

OK.

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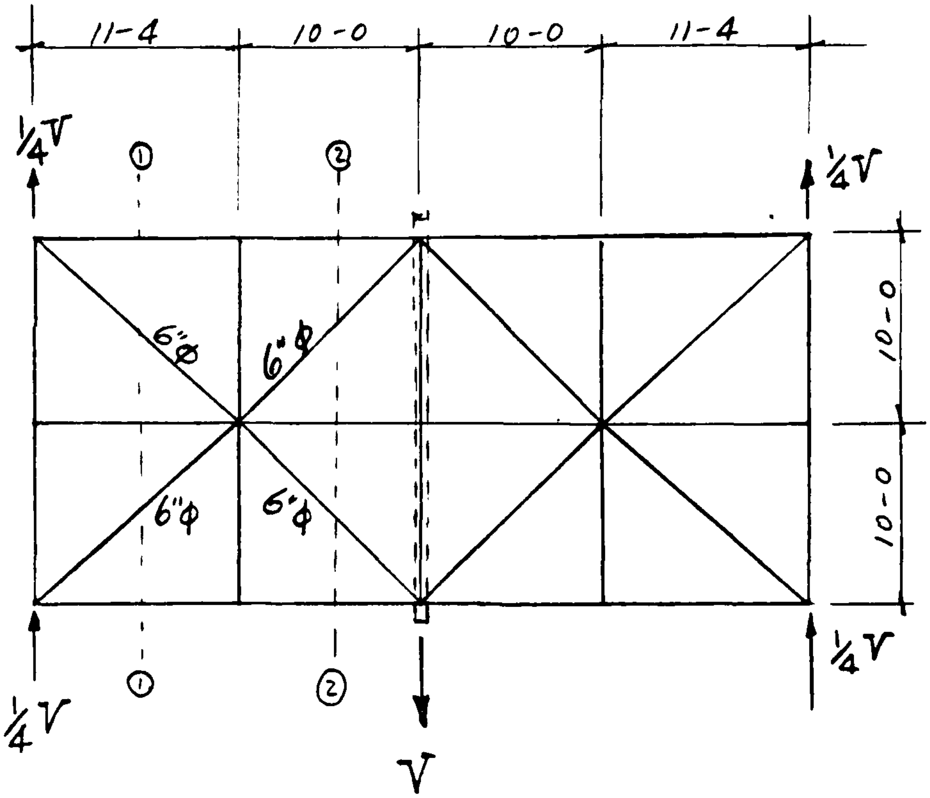
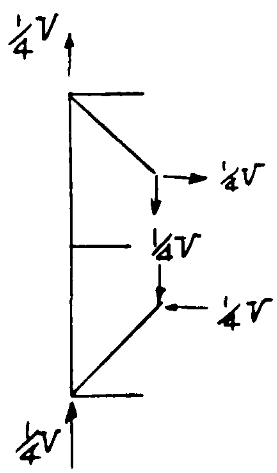
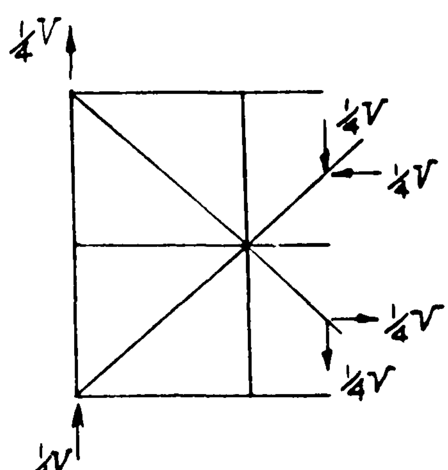
BRACES @ UPPER LEVEL



Section ① - ①



Section ② - ②



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Try
4"φ x .226" WT @ 15.11' (181")

$A = 2.680\ in^2$; $r = 1.337''$

$$n = \frac{KL}{r} = \frac{1.0 \times 181}{1.337} = 135$$

A36 Steel $F_a = 8.19$ ksi

$$\frac{\sqrt{2}}{4} V = 2.68 \times 8.19$$

$V = 62.0$ kips ← Compression Control

Tension Control $V = 2 \times 22 \times \frac{2.68}{\sqrt{2}} = 8$ [illegible]

Try 6.625"φ x .280" WT @ 15.11' (181")

$A = 5.581\ in^2$ $r = 2.246''$

$$n = \frac{KL}{r} = \frac{1.0 \times 181}{2.246} = 80.6$$

A36 steel $F_a = 15.30$ ksi

Compression Control

$$\frac{\sqrt{2}}{4} V = 5.581 \times 15.30$$

$V = 241.5$ kips

Tension Control

$$V = 2 \times 22 \times \frac{5.581}{\sqrt{2}} = 173.6 \text{ kips} \leftarrow$$

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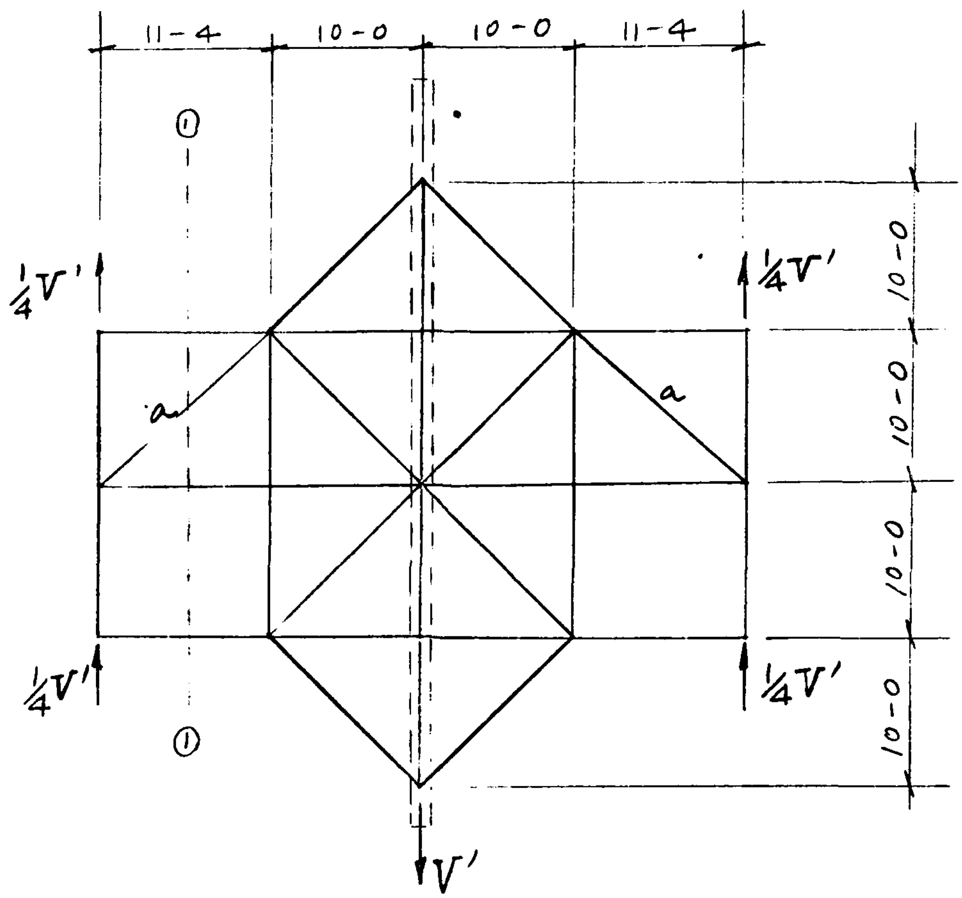
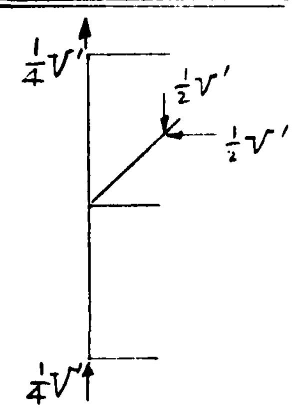
BRACES @ LOWER LEVEL



Section ①-①



Compression Control

4"φ x .226" WT @ 15.11' (181")

A36 Steel $F_a = 8.19$ ksi

$$\frac{\sqrt{2}}{2} V' = 2.68 \times 8.19$$

$$V' = 31 \text{ kips}$$

Consider "member a" do not exist.

A.2 Itemized Cost Information

Itemized cost information provided in this article were obtained through telephone quotations from related industries or estimated from available literature. These prices are, therefore, by no means firm.

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4-19-77

ENGINEERING DESIGN

ITEM	MAN-HR	RATE	TOTAL
1. Managerial Support	70		
2. Engineering Support			
Analysis/Design	200		
Specification	160		
Final Report	80		
Traveling	40		
Environmental Assessment	80		
3. Drafting Support	200		
	830	16.49	$13,686.7
4. Administrative Support			2,398.8
Direct Cost			$16,085.5
5. Contingency			1,608.5
TOTAL DIRECT COST			$17,694.

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4-19-77

ITEM	MAN-HR	RATE	TOTAL
6. Stability Analysis (Outside consultant)			$2,500.
7. Computer Usage			1,000.
8. Transportation (2 trips @ $500/trip)			1,000.
9. Per diem (6 days @ $35/day)			210.

TOTAL PROJECT COST $22,404.

C. Chern
4-19-77

STRUCTURAL FRAMING FABRICATION

ITEM	UNIT COST	QUANTITY	TOTAL COST
Structural Steel	$1.50/Lb*	30,046 Lbs	$45,069.
TOTAL			$45,069.

* QUOTATION from West coast steel fabricator

C. Chern
4-19-77

WHEELING MECHANISM

ITEM	COST
36x41 48 ply tires 5 from GSA 3 from Goodyear	$17,600.
Rims & Bearings	$3,850.
TOTAL	$21,450.

C. Chern
4-19-77

(a) TIRES

DESCRIPTION	UNIT COST	UNIT TRANSP'N COST	QUANTITY	TOTAL COST
36x41 48 ply GSA Supply	-	$100.[1]	5	$500.
36x41 48 ply Goodyear New	$5,500[2]	$200.[1]	3	$17,100.
TOTAL				$17,600

(1) Estimated cost
(2) See Ref. 2

C. Chern
4-19-77

(b) Rims & Bearings *

DESCRIPTION	UNIT COST $	QUANTITY	TOTAL COST $
RIM	255.	8	2,040.
DISK	20.	8	160.
HUB, BEARING & AXLES	325.	4	1,300.
SHIPPING			350.
TOTAL			$ 3,850.

* QUOTATION from a wheeling company

C. Chern
4-19-77

BARGE TRANSPORTATION *

ITEM	COST
1. Rent transport barge @ $6500/mon. for 1 month	$ 6,500.
2. Tow charge from Long Beach, Calif. to Port Hueneme	$ 1,500.
3. Land Crane rental	$ 3,000.
4. Tie down @ $2000/day for 1 day	$ 2,000.
5. Insurance @ 1% of Sir Robert	$ 2,500.
6. Tow to San Nicolas Island	$ 3,000.
7. Unload Sir Robert	$ 12,000.
8. Tow Back	$ 6,000.
9. Profit, Supervision	$ 5,000.
TOTAL	$ 41,500.

* QUOTATION from a west coast general contractor.

C. Chern
4-19-77

LAUNCHING - PULLING MECHANISM

ITEM	COST
EQUIPMENT RENTAL	$21,000.
MATERIALS	65,210.
LABOR	2,925.
TOTAL	$89,135.

C. Chern
4-19-77

(a) EQUIPMENT *

DESCRIPTION	RATE ** $/Day	DAY REQ'D	TOTAL $
Transporting from Pt Hueneme to Site	3,000	2	6,000.
Operation at site	3,000	3	9,000.
Transporting from Site to Pt Hueneme	3,000	2	6,000.
TOTAL		7	21,000.

* One warping barge with propellant anchor installation equipment

** See Ref. 1.

C. Chern
4-19-77

(b) MATERIALS

DESCRIPTION	UNIT COST	QUANTITY	TOTAL $
CEL 100K Propellant Anchor	$5,125.[1]	6	30,750.
1"Φ Steel Cable	$3.76/ft[3]	8,500 ft	31,960.
Miscellaneous Fitting[2]			2,500.
TOTAL			65,210.

(1) See Ref. 1.
(2) Cable end fittings, pulleys, splicings, etc.
(3) Quotation from U.S. Steel Wire Rope Division Sales Office, Newark, N.J.

C. Chern
4-19-77

(c) LABOR

DESCRIPTION	DAY RATE $/Day	PER DIEM $/Day	DAY COST $/Day	MAN-DAY	TOTAL COST $
DIVER	-	20.	20.	20 (1)	400.
MECHANICS-TECHNICIAN	125. (4)	35.	160.	10 (2)	1,600.
Engineer	150. (4)	35.	185.	5 (3)	925.
					2,925.

(1) 4-diver team @ 3 days ops & 2 day trans.
$4(3+2) = 20$ man-day

(2) 1 CEL 100k Anchor installation technician
1 Pulley-Deadman installation technician
@ 3 days ops & 2 day trans.
$2(3+2) = 10$ man-day

(3) 1 Engr @ 3 days ops & 2 day trans.

(4) Supplied from NAVY Organization

PART III Report: TR FPO-1E/15

FOUNDATION ANALYSIS AND TIRE STUDY

FOR PROJECT METEOR

8 APRIL 1977

By: S. Mendelsohn

Approved by: S. C. Ling, Manager
Engineering Analysis
Branch

Approved by: C. E. Bodey, Director
Engineerng and Design
Division

OCEAN ENGINEERING AND CONSTRUCTION PROJECT OFFICE
CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON, D. C. 20374

CONTENTS

FIGURES

1.0 PURPOSE:

This report assesses the foundation and the anticipated scour for the permanent installation of the jack-up barge, SIR ROBERT (Figure 1). It also includes an investigation of the utilization of large tires for mobilizing SIR ROBERT in and out of the water for a non-permanent installation. This investigation includes bearing capacity; tire size, pressure and contact area; anticipated tire penetration; and tire availability and cost.

2.0 BACKGROUND:

SIR ROBERT will be used for measurements offshore of the northwest corner of San Nicolas Island, California. San Nicolas Island lies approximately 65 miles seaward from Point Mugu, and 75 miles from Los Angeles, California.

Two of the available options are either to permanently install SIR ROBERT or to mobilize it from the beach to make measurements. Both require a knowledge of the seafloor with respect to its bearing capacity. The latter also requires information on large tires and their interaction with the seafloor.

This report addresses both the seafloor information and the tire information. It assumes a sandy bottom with a ϕ equal to 30° with ϕ being the angle of internal friction which is a characteristic of the sand.

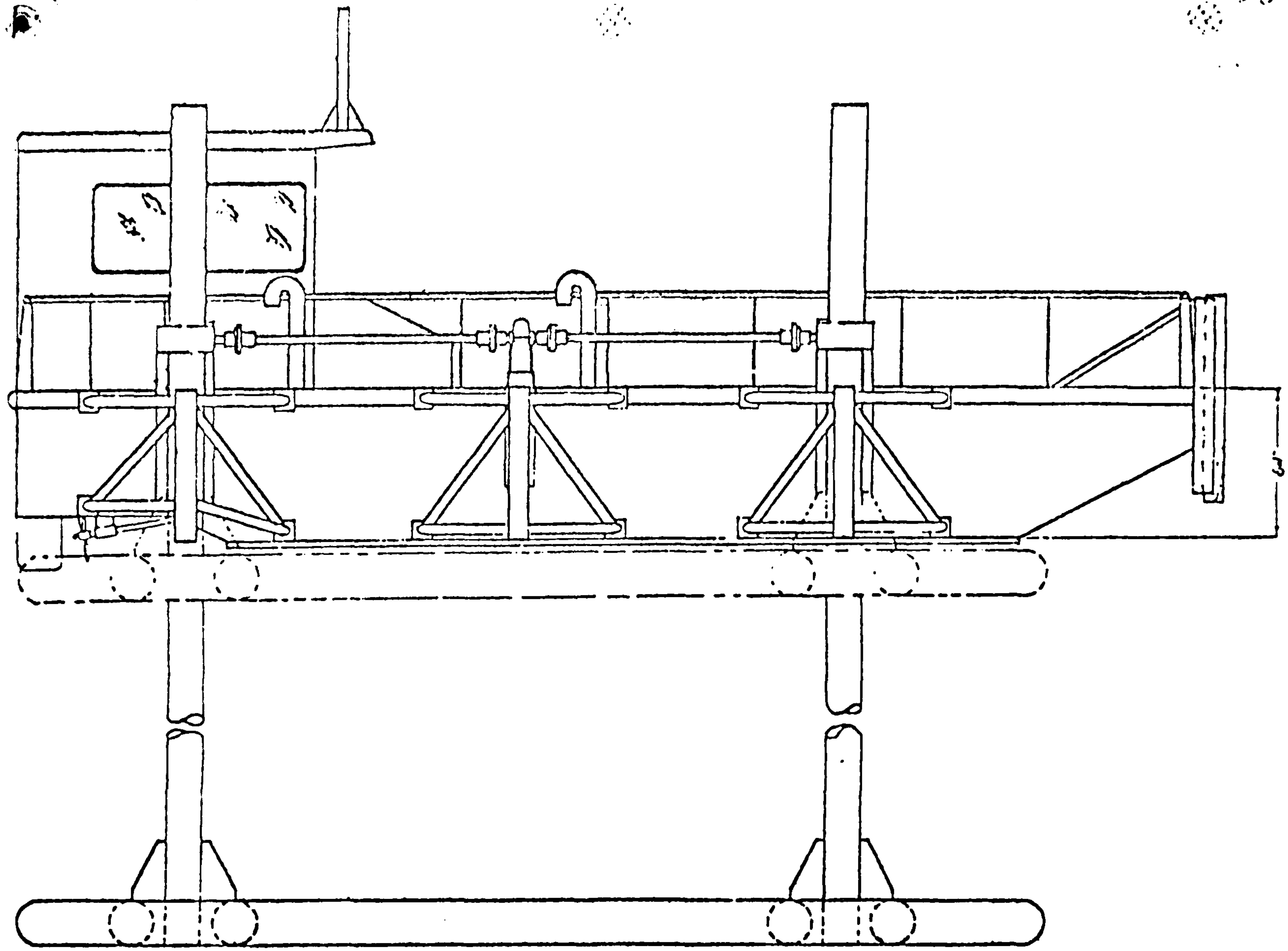


FIGURE 1 Side View of SIR ROBERT

3.0 RESULTS:

Scour will be a problem for a permanently installed structure which would require a protective mat with large armor stones (3.4 foot diameter). This is with the assumed sand bottom (Appendix 1).

Bearing capacity will not be a problem unless it is desired for the mat to penetrate. If this is required, it might take as much as 3000 additional pounds per square foot to gain full penetration (18 inches). This again is with the assumed sand bottom. If a fixed structure were to be installed, cores of up to 40 feet would be necessary to assess the foundation (Appendix 1).

After looking at tires made by both Goodyear Tire and Rubber Co., and Firestone Tire and Rubber Co., one of the only tires that would work in the sand off San Nicolas Island and on the beach is the Firestone pneumatic all non-skid tire. This high floatation, 36.00-41 tire has a 48 ply rating. It is the type used for amphibious barges. Firestone sells these tires for about $5500 each. There are also five tires presently available through the Defense Property Disposal Service of the Defense Supply Agency. They are presently in Stockton, CA and were due to go to GSA for sale on 12 April 1977. They have been placed on hold for CHESNAVFACENGCOM (FPO-1), however, until 19 April 1977. By this date a go, no-go decision must be made unless an extension can be obtained. These surplus tires are free to FPO-1 if a TAC number is used for shipping. Because of bearing capacity and the gross contact area of each tire, eight tires would be required so as not to penetrate the sand beyond six inches. If further tests could be run to show that higher penetration would not impede the towing of SIR ROBERT, six tires might be sufficient (Appendix 2).

Whether the tires are purchased or obtained as excess property, rims are still necessary at a cost of about $400 each. The wheels needed would depend on the structure design for the installation of the tires.

4.0 CONCLUSIONS AND RECOMMENDATIONS:

From the calculations made assuming certain bottom conditions, it is seen that the biggest problem of a permanently installed structure is the bottom protection from scour. Bearing capacity and lateral movement should not be a problem. Before a fixed structure could be installed, however, a detailed bottom survey including vibracoring would be necessary.

Mobilizing SIR ROBERT using large tires appears feasible with respect to bottom interaction as long as sufficient pull is available on the beach to tow it. The towing force required will depend on the system developed to install the tires on the structure and on its ability to keep the bearings free from sand. If the tires are not free to turn, it is felt that the wheels will dig into the sand under pulling load and become embedded and near impossible to pull. The beach approach must also be free from large obstructions such as rocks.

Eight tires appear to be an optimum number, but six might be sufficient if further tests could be run to show trafficability. It is also recommended that if the tire concept is an acceptable approach, the weekly excess property list be checked weekly until the structure is complete in case additional tires become available.

5.0 REFERENCES:

1. Shore Protection Manual, U.S. Army Coastal Engineering Research Center, 1973.

2. Soil Mechanics, Lambe, T.W. and Whitman, R.V., Wiley and Sons, Inc., 1969.

3. A Feasibility Study, Conversion of SIR ROBERT to a Permanent Gravity Platform, Chern, C., CHESNAVFACENGCOM FPO-1, March 1977.

4. The Pentrometer and Soil Exploration, Sanglevat, G., Elsevier Publishing Co., 1972.

5. Handbook of Ocean and Underwater Engineering, McGraw-Hill Book Co., 1969.

6. Fonecon - S. Mendelsohn (CHESNAVFACENGCOM) to Mr. Gairo (Firestone Tire and Rubber Co.) of 5 April 1977.

7. Engineering Tests of Landing Craft Retriever, Mark II, CEL TR 171, September 1961.

6.0 APPENDICES

APPENDIX 6.1

Permanent Structure Calculations

Scour

The maximum depth of scour is equal to the maximum height of the unbroken wave that can be supported (reference 1). For the 20 foot depth off of San Nicolas Island, this would be about 17 feet (Figure 2). To design a mat foundation for scour protection, the design wave could be used since waves exceeding it occur less than ten percent of the time and for relatively short duration and scour is a gradual erosion. Any damage done by larger waves would not be catastrophic, though inspection for determination of damage and subsequent repairs would be necessary after each storm that exceeds design conditions.

Calculation of size of armor units:

$$W = \frac{Wr\ H^3}{N_s^{\ 3}\ (Sr - 1)^3}$$ from reference 1, p. 7-203

where,

W = mean weight of individual armor unit, lbs.

W_r= unit weight of rock, lbs/ft^3 (assumed 170 pcf)

H = design wave height (13')

S_r= specific gravity of armor stone relative to the water around structure ($S_r = W_r/W_w$)

W_w= unit weight of water (64.0 pcf)

N_s= design stability number for rubble foundations (from fig. 7-99 of reference 1)

$$\therefore W = \frac{(170)(13)^3}{(24)(1.66)^3}$$

$$W = 3402 \text{ lbs} \rightarrow D \approx 3.4 \text{ feet}$$

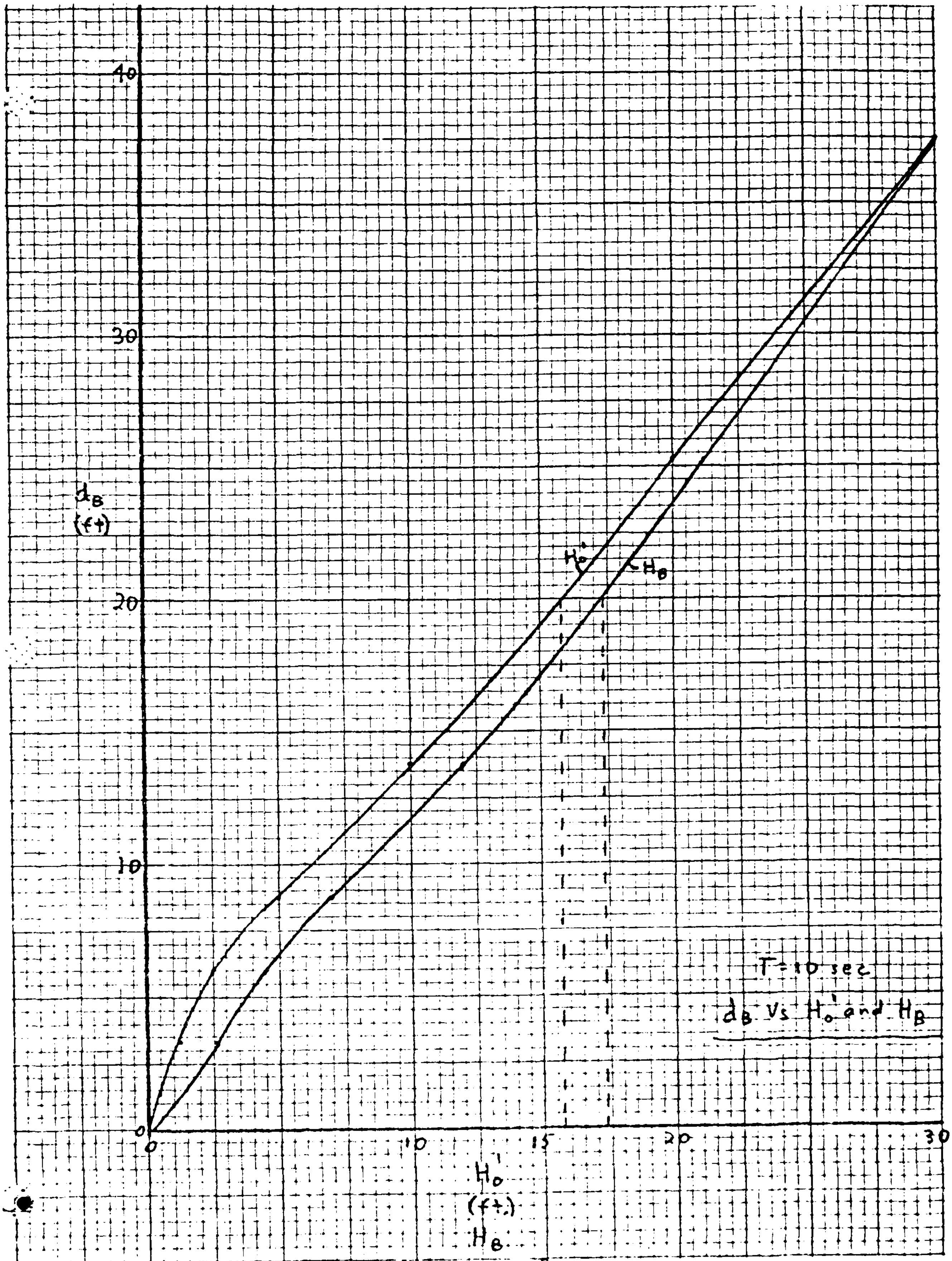
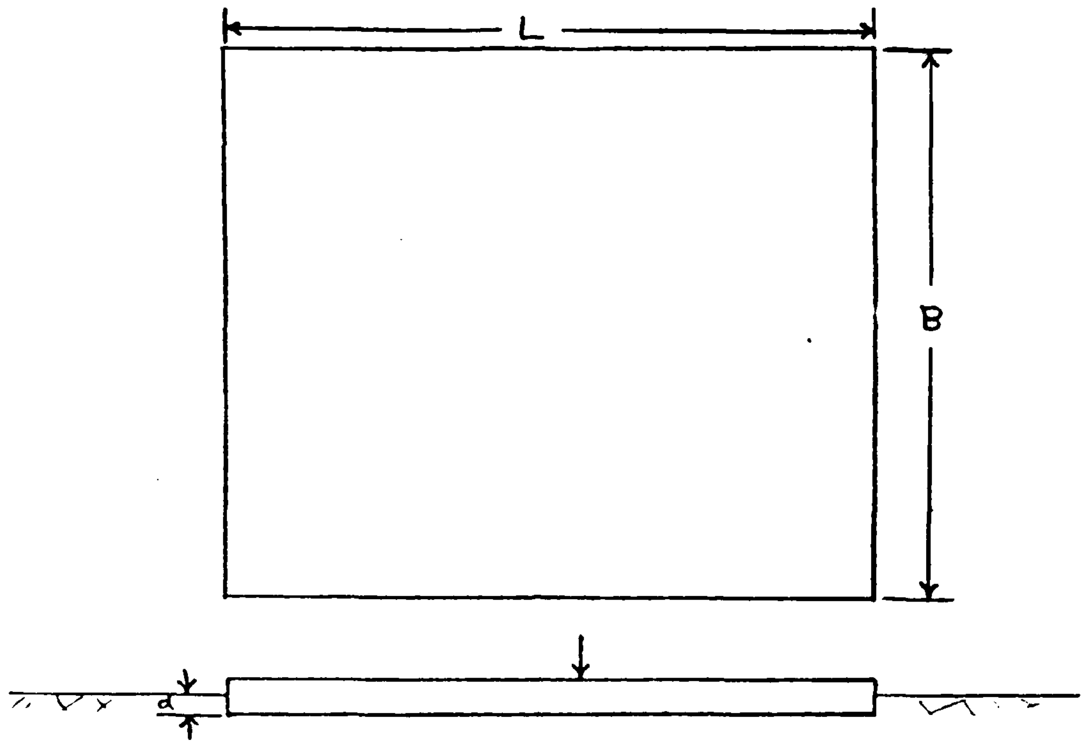


FIGURE 2

Bearing Capacity

Case I - Mat assumed as rectangular area



q = bearing capacity

$q = \frac{1}{2} \gamma' B N_\gamma (1 - .3 \frac{B}{L}) + \gamma' d N_q (1 + .2 \frac{B}{L})$ from reference 2

γ' = submerged bulk unit weight of soil

N_γ, N_q - bearing capacity coefficients assuming
$\phi = 30^{o}$, $N_\gamma = 20$
$N_q = 22$ from reference 2

B = width of mat = 29' 8"

L = length of mat = 35' 0"

$$\therefore\ q = \tfrac{1}{2}\,(60)(29.67)(20)\left[1 - .3\left(\frac{29.67}{35}\right)\right] + 60d(22)\left[1 + .2\left(\frac{29.67}{35}\right)\right]$$

$$q = 13275 \text{ psf} + 1544d \text{ psf}$$

for the load = 114160 lbs (total buoyed wgt of structure) ref. 3

$$\text{Area} = (29.67)(35) = 1038.45 \text{ ft}^2$$

$\therefore$ bearing pressure = 110 psf

$$\text{F.S.} = \frac{13275}{110} = 120 \text{ for the surface}$$

Therefore, if the mat were solid, bearing would be no problem.

Figure 3 shows how q varies with depth under a square footing which is a close approximation for SIR ROBERT.

Case II - Mat with pipe bottom assumed as strip footing. From Figure 4, the pipe diameter = 1.5' which is assumed to be equal to B when d = 9 inches. L is considered much larger than B and not a factor.

$$q = \tfrac{1}{2} N_\gamma \gamma' B + N_q \gamma' d \qquad \text{from reference 2}$$

$$q = (\tfrac{1}{2})(20)(60)(1.5)+(22)(60)(.75)$$

$$q = 900 \text{ psf} + 1320(.75) = 1890 \text{ psf}$$

for d=.1" q = 143 psf

d= 1" q = 522 psf

d= 9" q = 1890 psf (see Figure 5)

d=18" q = 3282 psf

To calculate the structure's bearing pressure, it is first necessary to calculate the area, A, for different depths of penetration, d, since it varies due to the pipe being a cylinder. There are about 312 feet of 18" Ø pipe and about 47 feet of 8" Ø pipe (Figure 4).

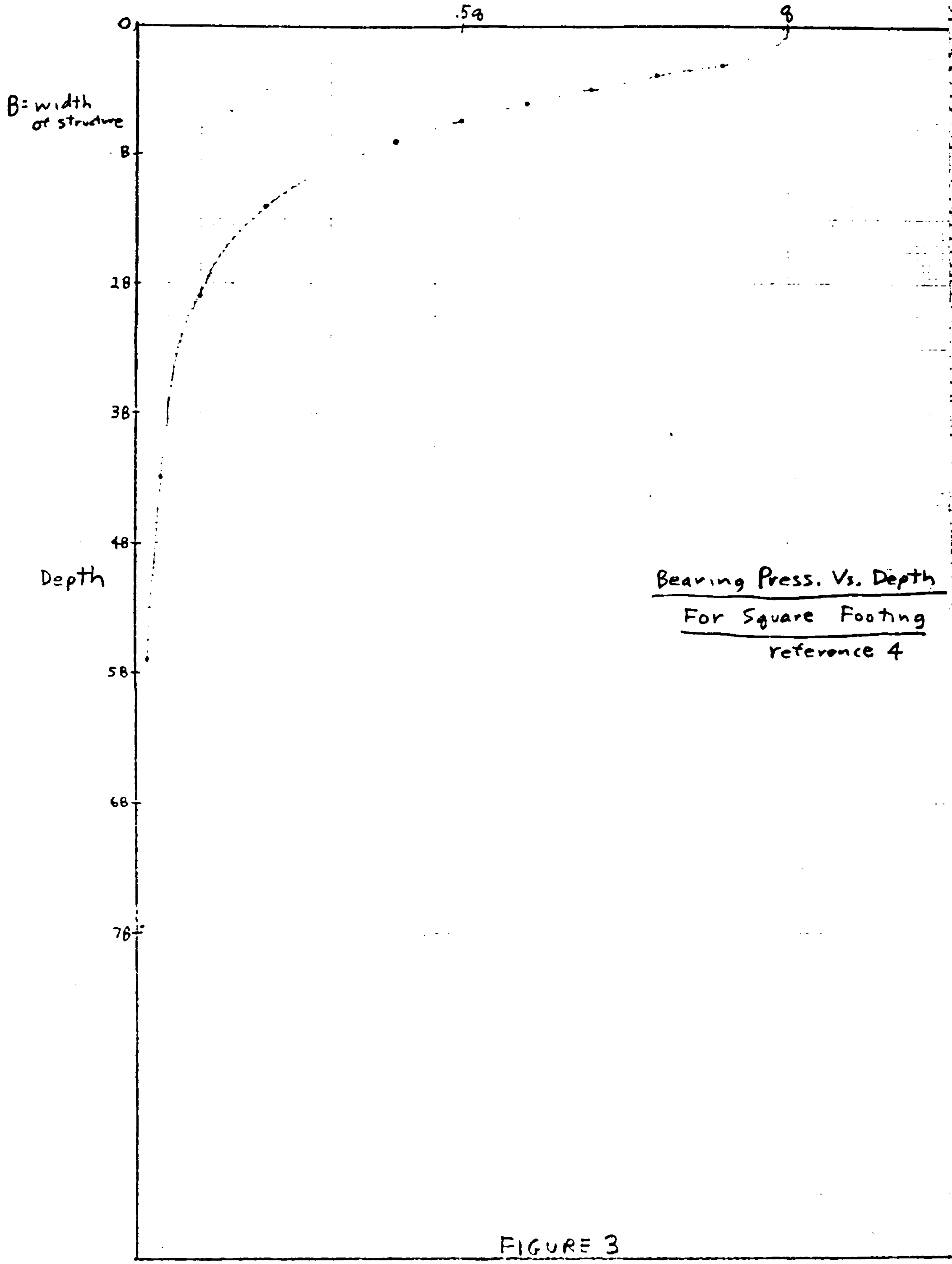

.5q
q
0
B
2B
3B
4B
5B
6B
7B
B= width of structure
Depth
Bearing Press. Vs. Depth
For Square Footing
reference 4

FIGURE 3

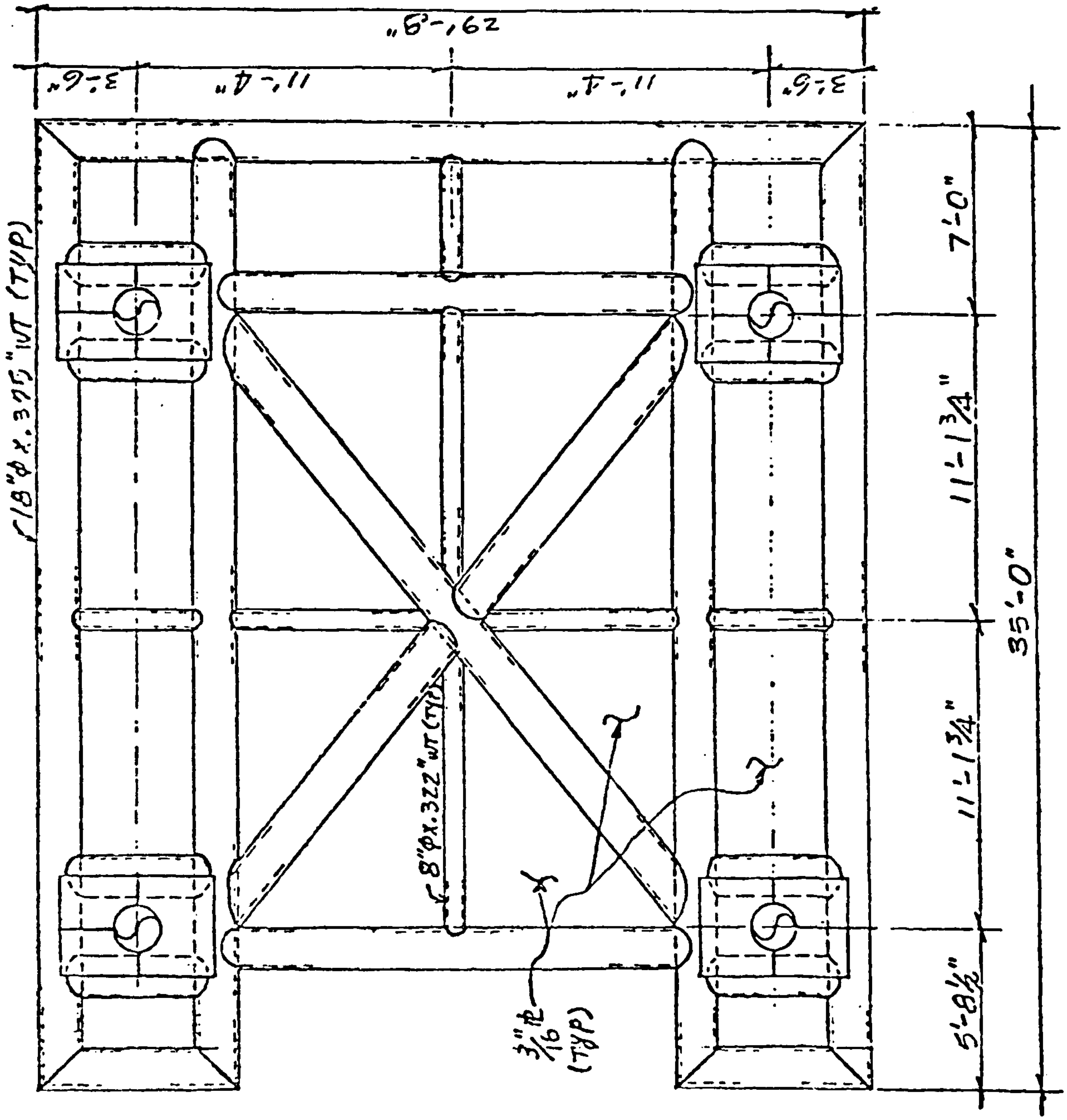


Figure 4 Supporting Mat of SIR ROBERT

for d = 0.1" A = 69.6 ft^2 total buoyed wgt of struc = 114,160 lbs

1.0" A = 214.3 ft^2 assumed to be loaded uniformly

9.0" A = 499.9 ft^2

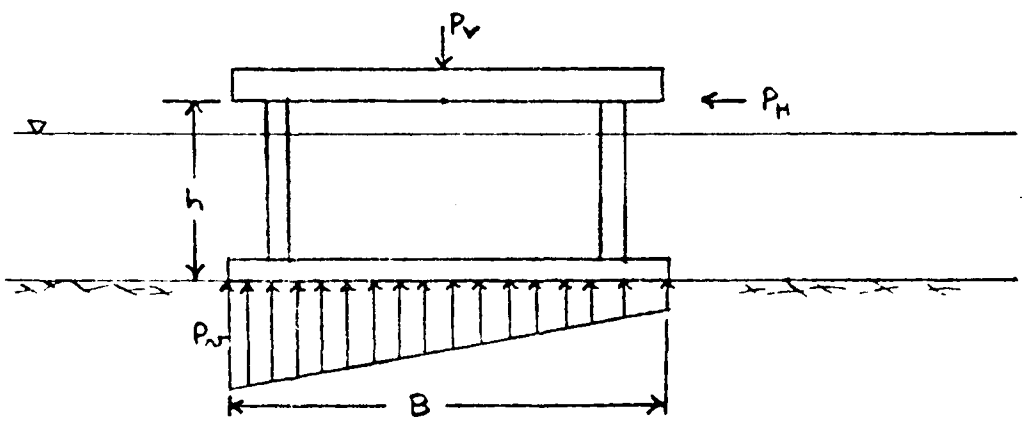
$$\therefore \text{ for } d = 0.1" \quad P = \frac{114,160}{69.6} = 1640 \text{ psf}$$

$$d = 1" \quad P = \frac{114,160}{214.3} = 533 \text{ psf}$$

$$d = 9" \quad P = \frac{114,160}{499.9} = 228 \text{ psf}$$ (see Figure 5)

This shows that the structure will probably sink on its own about one inch. Therefore, again bearing capacity will not be a problem since as the structure sinks, the bearing capacity increases while the bearing pressure decreases. At the 9 inch penetration depth the F.S. = 8.3. Without additional weight, the structure will not reach this depth.

Case III - Assuming overloading to one side creating a maximum bearing pressure:



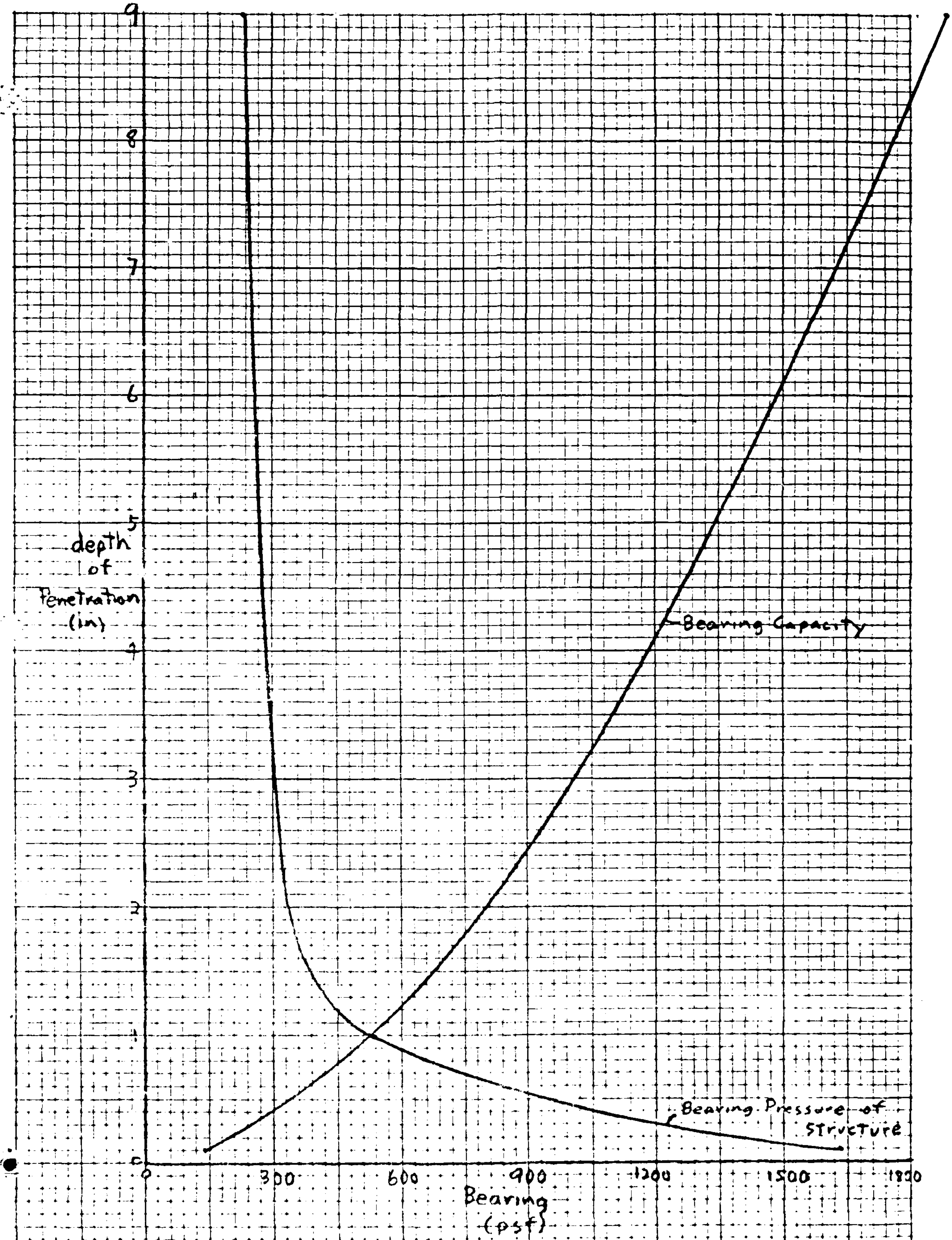

9
8
7
6
5
depth of Penetration (in)
4
3
2
1
0
0
300
600
900
1200
1500
1800
Bearing (psf)
Bearing Capacity
Bearing Pressure of Structure

FIGURE 5

Under operating conditions which is earthquake plus 30% of the design wave (13 feet) and wind (60 mph) load, the horizontal force, P_H, equals 31.44 kips (reference 3).

The maximum bearing pressure under this condition is

$$P = \frac{P_V}{BL} + \frac{P_H\ h\ B}{2I} \qquad I = \frac{B^3\ L}{12} \qquad \text{from reference 5}$$

$$P = \frac{114.16}{(29.67)(35)} + \frac{(31.44)(25)(29.67)}{2\left[\frac{(29.67)^3\ (35)}{12}\right]}$$

$$P = .263 \text{ ksf} = 263 \text{ psf}$$

this also treats the mat as a rectangle area as in Case I.

$$\therefore \text{F.S.} = \frac{13275}{263} = 50 \text{ again for surface}$$

Lateral Movement

If the worst case is assumed which is no penetration of mat:

$$q_H = P_V \tan \alpha$$

where, P_V = vertical load = 114,160 lbs

α = assumed = 20° for $\phi = 30^\circ$

$$\therefore q_H = 114.16 \tan 20^\circ$$

$$q_H = 41.55 \text{ kips}$$

This gives an F.S. = $\frac{41.55}{31.44} = 1.3$

with the penetration expected, sliding should not be a problem.

APPENDIX 6.2

Tire Study Calculations

Tire Description

Firestone Tire & Rubber Co. (reference 6)

Pneumatic all non-skid tire - high floatation

Tire size: 36.00-41 48 ply

Rim size: 26"

Gross contact area*: 1746 in^2 (@ 20 psi)

Weight: 3362 lbs

Section width: 38.9" unloaded

43.0" loaded

Outside diameter: 114"

Static loaded radius: 50"

Rated load capacity: 128,800 lbs, @ 5MPH

Loads at various pressures @ 5 MPH:

20 psi - 55250 lbs

25 psi - 62950 lbs

30 psi - 70040 lbs

35 psi - 76650 lbs

* reference 7

Bearing Capacity and Penetration

Assuming a rectangular contact area for each tire:

$$q = \frac{1}{2}\gamma' B N_\gamma \left(1 - .3\,\frac{B}{L}\right) + \gamma' d N_q \left(1 + .2\,\frac{B}{L}\right)$$

where

$B = 3.38'$ $\gamma' = 60$ pcf $N_q = 22$
$L = 3.58'$ $N = 20$

$\therefore q = 1454 + 856\,d$ psf

d(ft)	q(psf)	q(psi)	Contact area Required	Number of* Tires Req'd
0	1454	10.1	14851	10 (8.51)
½	1882	13.1	11450	8 (6.56)
1	2310	16.0	9375	6 (5.37)

*Assuming 20 psi and a gross contact area (GCA) = 1745 in^2 each

Example Calculations

Contact area required (CAR) $= \frac{\text{load}}{q} = \frac{150,000}{10.1} = 14851$ sq. inches

No. tires required $= \frac{\text{CAR}}{\text{GCA}} = \frac{14851}{1746} = 8.51$ or 9 tires

This would mean 10 tires since there must be an even number.

PART IV

PROJECT METEOR

WEIGHT AND MAINTENANCE OF SIR ROBERT

APRIL 1977

BY: J. E. BABER

OCEAN ENGINEERING AND CONSTRUCTION PROJECT OFFICE
CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON NAVY YARD
WASHINGTON, DC 20374

FPO-1EA23:db
5 April 1977

MEMORANDUM

From: FPO-1EA23
To: FPO-1EA21

Subj: Weight and Maintenance of Sir Robert and Mat

Encl: (1)

1. The drawings and pictures of the Sir Robert and Mat were reviewed. Calculations are provided in enclosure (1). The approximate weight of the system, based on an approximate water displacement of 1871 ft^3, is 119, 744 lbs.

2. The total weight of mat is approximately 45,200 lbs. based upon wt. of pipe + 10% for rust and other items. If the water line on the Sir Robert (S. R.) was formed with the S. R. floating and the mat resting on the bottom of the harbor, the approximate weight of the system is equal to the volume of water displaced by the S. R. proper, i. e., 1300 ft^3 83,200 lbs. plus 45,200 lbs. of the mat or 128,400 lbs.

3. The approximate area of the Sir Robert and mat that requires painting is 6200 ft^2. The cost of sandblasting is $7,130 @ $1.15/$ft^2$ and priming and painting $1,550 @ $0.25/$ft^2$.

4. The approximate cost of 5-250# high amperage zinc anodes is $1,000. The total cost for refurbishment of S. R. is:

FPO-1EA23:db
5 April 1977

Subj: Weight and Maintenance of Sir Robert and Mat

Cost of sandblasting	$ 7,130
Coat of Painting & Labor	1,550
Cost of Anodes	1,000
Approximate Profit	800
Total	$10,480

5. The exposed areas of the S. R. including the entire mat and legs should be sandblasted and painted. Anodes should be placed at the junction of the 4 vertical legs and mat and at the mat cross brace. Structure and anodes should be inspected at three-year intervals. System will probably require no more than minor touch-up painting during the first six years. Projections beyond six years cannot be made on a practical basis.

Jack E Baber
JACK E. BABER

Copy to:
FPO-1EA23
FPO-1ES
FPO-1E
Daily

Calculations for Weight of Sir Robert and Cost of Maintenance

Dimensions of pipe, plate, etc., taken from AMMCO drawings of work over rig and mat, 3K-45-537D, 3K-45-539-D and dwg. 10089-E of 10 Dec 1965. Other dimensions calculations inferred from January 1977 photographs of Sir Robert and mat on shore.

Bill of Material item (dimensions taken from drawings)

#1	18" dia pipe 70.59 #/ft	4659 lbs.
#2		4659
#3		1480
#4		1836
#5		1836
#6		2401
#7		776
#8		2965
#9, 10, 11, 12	8" dia pipe 28.55 #/ft	1456
#13		2353
#14		183
#15		344
#16		978
#17		122
#18 & 19		1891
Legs 14" dia pipe 54.57 #/ft		13097
	Total	41036 lbs

Vol.	18" diameter pipe - 300 ft	530.14 ft^3
Vol.	8" diameter pipe - 51 ft	17.80
Vol.	legs in water when mat is raised	9.26
Vol.	½" plate	1.64
Vol.	3/8" plate	4.81
Vol.	3/16" plate	6.99
Vol.	Sir Robert proper at water line @ 26" from base	1300.00
	Total	1871.00 ft^3

1871 ft^3 @ 64#/ft^3 119,744 lbs.

ENCLOSURE (1)

Assume S. R. floating free of mat and loaded as shown in Jan 1977 photographs.

Wt. of assembly = Wt of mat			41,036 lbs.
add 10% rust/paint welds/fitting etc.,			4,164 lbs.
Wt. of 1300 ft^3 of H_2O			83,200 lbs.
		Total	128,400 lbs.

Approximate area to be painted

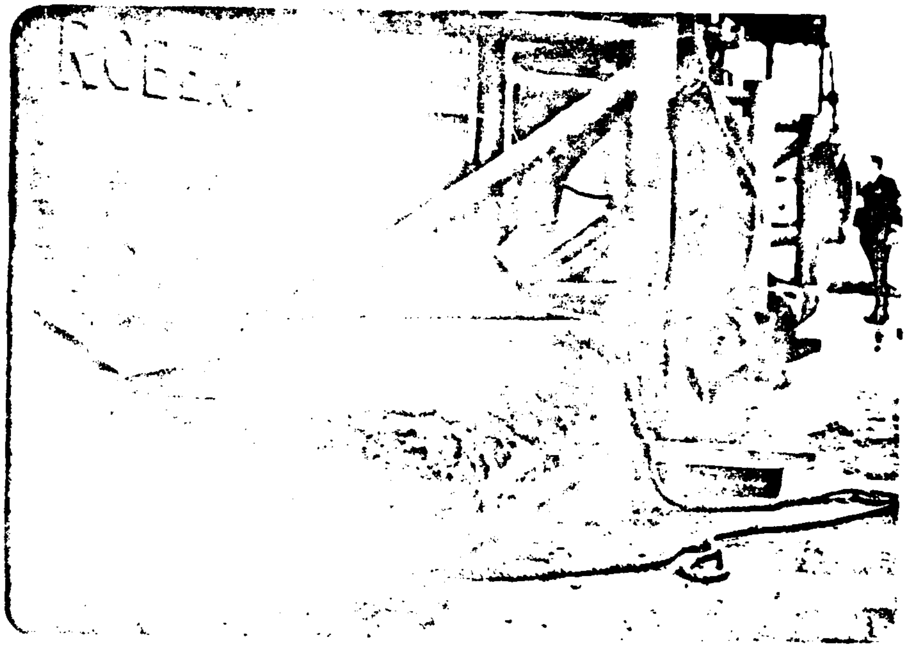
Sir Robert Top and Bottom	20 x 40 x 2	1600
Front back + misc.	20 x 6 x 2	240
Both sides	40 x 6 x 2	480
Cabin	8 x 6 x 2	96
		2416

Area of 18" pipe		1414 ft^2
Area of 8" pipe		107 ft^2
Area of 14" pipe		880 ft^2
Area of ½" plt.		79 ft^2
Area of 3/16 plt.		921 ft^2
Area of 3/8 plt.		308 ft^2
	Total Area	6125 ft^2
	use 6200 ft^2	

Approximate cost of sandblasting including labor from cost estimating section @ \$1.15 ft^2		\$ 7130
Approximate cost of painting + primer and labor @ \$0.25 ft^2		1550
Cost of 5-250 lb zn anodes @ \$200 estimated from cost provided by MATCOR		1000
Add 10% of \$8,000 for profit		800
	Approx cost	\$10480

The paint system plus anodes should provide a combined material protection system good for 5-10 years. Inspection of Sir Robert, mat, and anodes should take place at 3-year intervals to check the system. It is anticipated that repair/maintenance will be limited to minor touch-up of paint system.

ENCLOSURE (1)



PART V

PROJECT METEOR

RECOMMENDED PERIODS FOR OFFSHORE CONSTRUCTION OPERATION VIVINITY OF SAN NICOLAS ISLAND, CALIFORNIA

MARCH 1977

BY: W.A. VOGEL

OCEAN ENGINEERING AND CONSTRUCTION PROJECT OFFICE
CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON NAVY YARD
WASHINGTON, DC 20374

FPO-1ED13:bw
8 March 1977

MEMORANDUM

From: FPO-1ED13
To: FPO-1EA21

Subj: Recommended Periods for Offshore Construction Operation Vicinity of San Nicolas Island, CA

Ref: (a) Naval Weather Service Environmental Detachment Climatological Study, Southern California Operating Fleet Weather Facility, San Diego - March 1971
(b) U.S. Naval Weather Service Command Summary of Synoptic Meteorological Observations, North American Coastal Marine Areas - Revised, Volume 5, Area 32 - San Diego, May 1976
(c) Climatic Handbook for Pt Mugu and San Nicolas Island, Part 1, Surface Data, Pacific Missile Range, Pt Mugu, CA, 14 Mar 74

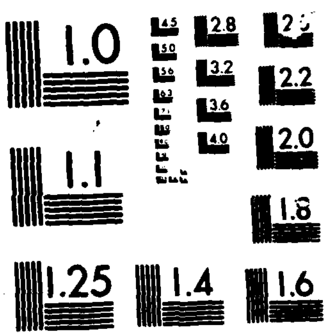
Encl: (1) Total Percentage Frequency of Wave Heights Monthly in Feet
(2) Percentage Frequency of Monthly Wave Heights in Feet with Wave Length $<$185 ft. - All Observed Waves
(3) Percentage Frequency of Monthly Wave Heights in Feet with Wave Lengths of 185-250 ft. - All Observed Waves
(4) Percentage Frequency of Monthly Wave Heights in Feet with Wave Heights in Feet with Wave Lengths of 328-415 feet
(5) Percentage Frequency of Wave Heights shown each month in Feet with Wave Length $>$ 415 feet
(6) Percentage Frequency of Wave Heights Shown Monthly in Feet According to Wind Speed in Knots - Plate I
(7) Percentage Frequency of Wave Heights Shown Monthly in Feet According to Wind Speed in Knots - Plate II

1. Enclosures (1) through (5) are charts depicting monthly percentages where wave heights have been observed to exceed 2 ft, 6 ft and 9 ft in waters adjacent to San Nicolas Island off Southern California. Reference (a) was used as the basic source for this data. Enclosures (6) and (7) correlate monthly percentage frequencies of wave heights according to wind speed in knots.

2. The greatest likelihood of encountering waves $\leq$ [illegible] ft high would occur between July and September according to enclosure (1). One could conclude from the aspect of observed sea heights that the optimum weather window would generally be found during the above months. Note that the slope toward higher waves is steeper from September into October as contrasted with the more gently [illegible] toward smaller waves from May into July.

AD-A165 768 PROJECT METEOR FEASIBILITY STUDIES ON THE CONVERSION OF THE SIR ROBERT TO..(U) NAVAL FACILITIES ENGINEERING COMMAND WASHINGTON DC CHESAPEAKE.. C CHERN JUN 77 4/4

UNCLASSIFIED CHES/NAVFAC-FPO-1-7717-VOL-2 F/G 13/10 NL



MICROCOPY RESOLUTION TEST CHART

NATIONAL BUREAU OF STANDARDS-1963-A

FPO-1ED13:bw
8 March 1977

Subj: Recommended Periods for Offshore Construction Operation
Vicinity of San Nicolas Island, CA

3. Enclosures (2), (3), (4) and (5) show monthly percentages of observed waves of heights > 2 ft, 6 ft, and 9 ft when the length of the waves are < 185 ft, 185-250 ft, 328-415 ft, and > 415 ft, respectively. Note that the vertical scale on each of these charts was varied according to the range of observed percentages. Reference (b) was used as the source for this data. Enclosure (2) shows that no waves > 9 ft were observed when the length of the waves remained < 185 ft. Quietest seas would most likely be encountered during November and December. According to enclosure (3) seas ≤ 6 ft would be least frequent during November with waves 185-250 ft in length. However, the months of May - August indicate a longer interval of relatively calm seas. The period between June and September is indicated on enclosure (4) as that associated with the calmest seas when wave lengths are 328-415 ft. July-October are indicated as an interval of generally calmer seas with the exception of September, when the length of the waves exceed 415 ft.

4. Other than the calmer conditions shown in enclosure (6), during January and February when winds range between 11-21 kts, wave heights vary little over particular wind intervals from one month to the next. Enclosure (7) does indicate calmer seas from May - October during intervals when winds exceed 22 kts. According to reference (c), Northwesterly winds predominate throughout the year. On an annual average, these Northwesterlies are 4-10 kts over 15%, 11-21 kts over 20% and 22-33 kts over 5% frequency. However, these values are exceeded during the months of March - June with May averaging 4-10 kts over 15%, 11-21 kts over 25%, 22-33 kts over 10% and ≥ 34 kts over 1% of the time. Due to the more predominate and stronger Northwesterlies from March - June, it is suggested that the most favorable weather window would be found between the months of July and October.

W. A. Vogel
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FPO-1E
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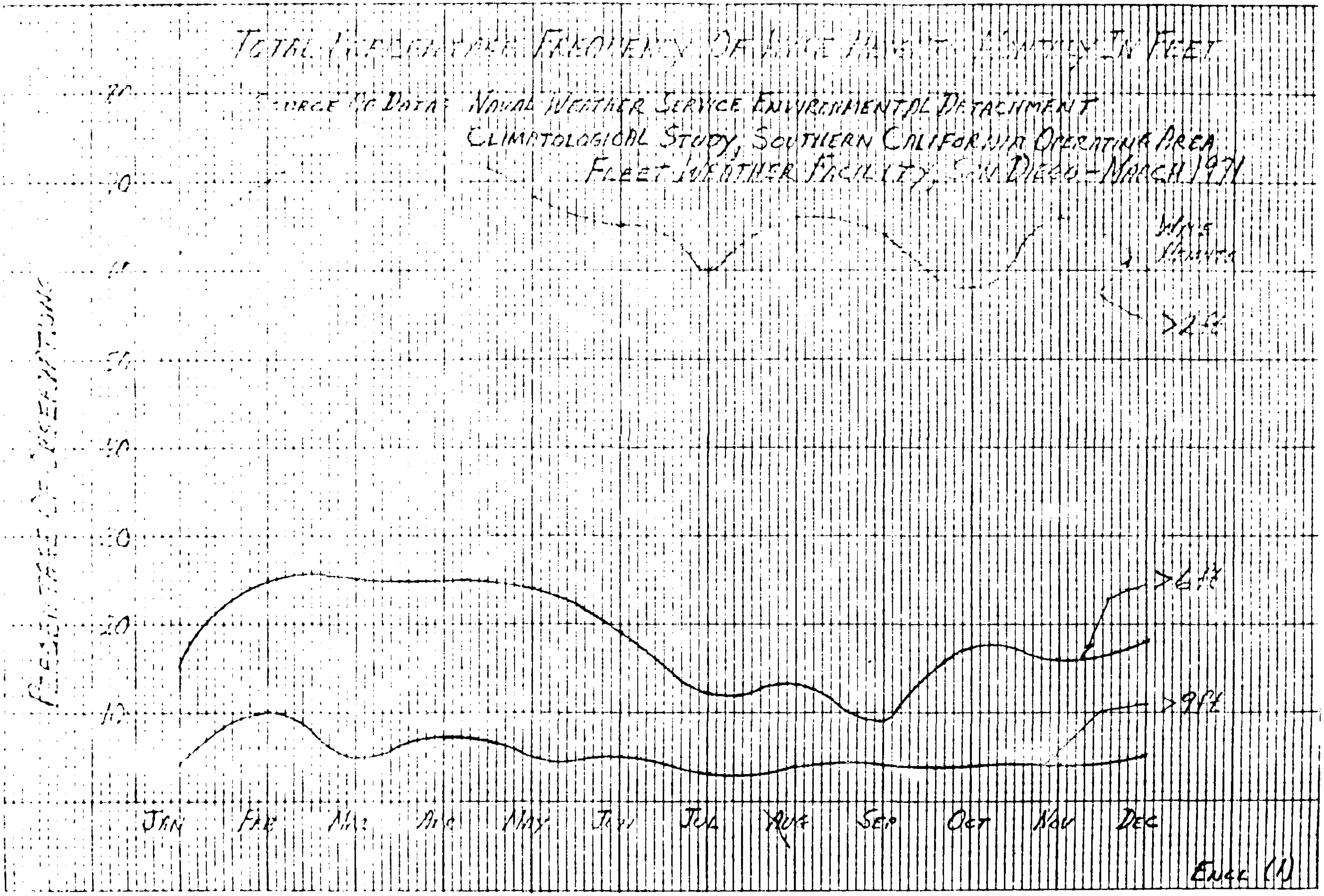
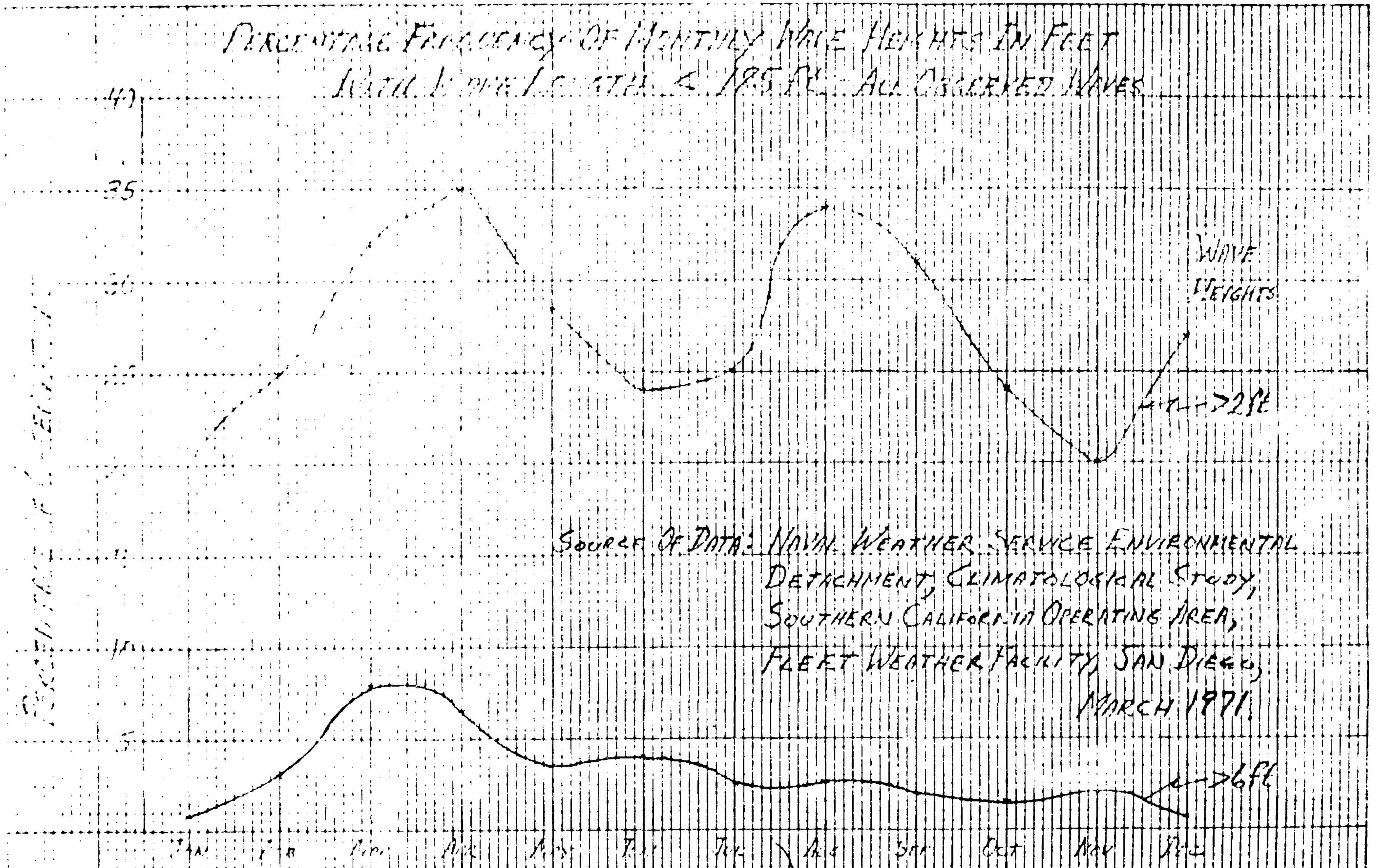
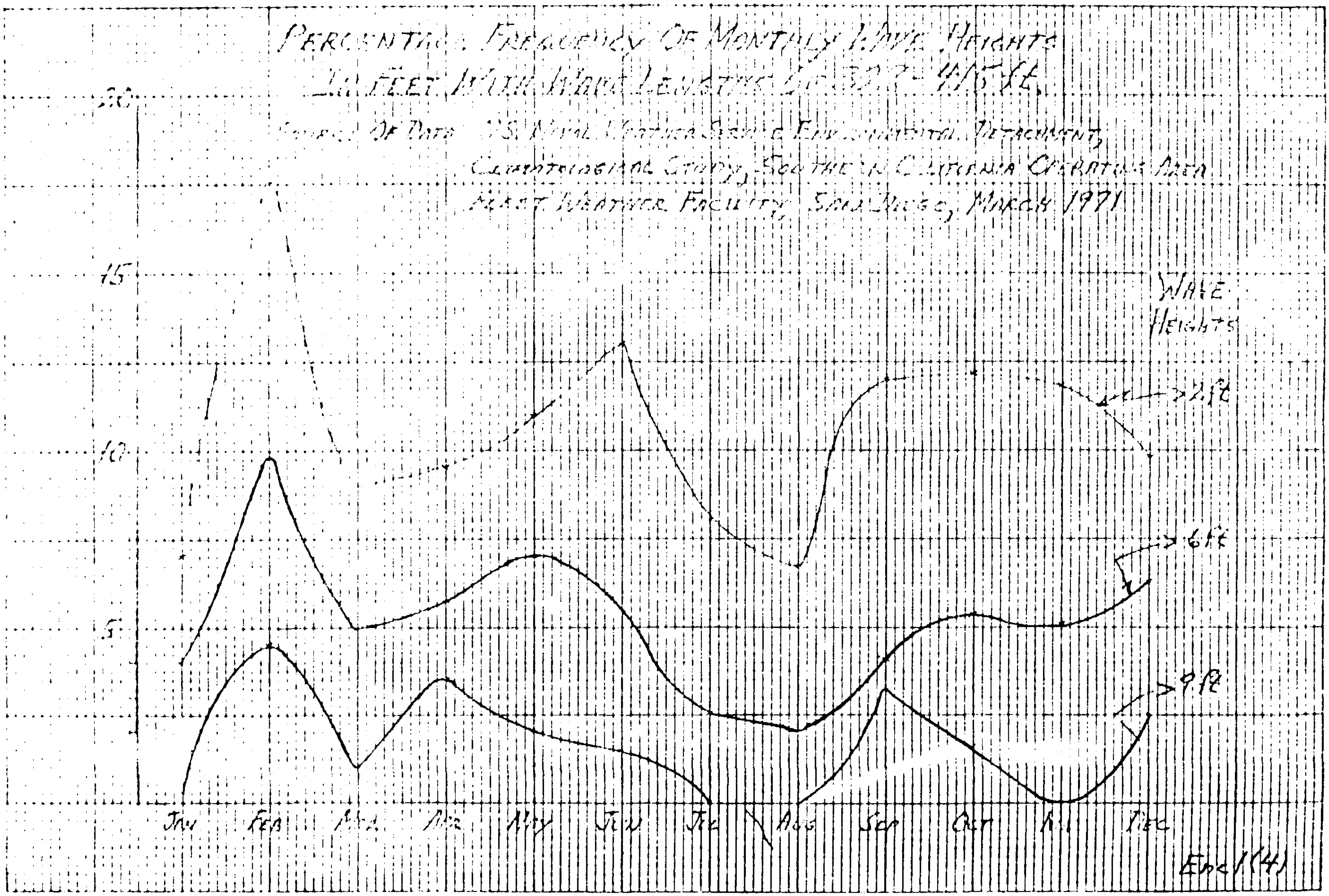

Source of Data: Naval Weather Service Environmental Detachment
Climatological Study, Southern California Operating Area
Fleet Weather Facility, San Diego - March 1971
>2 ft
>6 ft
>9 ft
10
20
JAN
FEB
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
Encl (1)


PERCENTAGE FREQUENCY OF MONTHLY WAVE HEIGHTS IN FEET
WITH WAVE LENGTH < 185 FT. ALL OBSERVED WAVES
40
35
30
25
15
10
5
WAVE HEIGHTS
>2ft
>6ft
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
SOURCE OF DATA: NAVAL WEATHER SERVICE ENVIRONMENTAL DETACHMENT, CLIMATOLOGICAL STUDY, SOUTHERN CALIFORNIA OPERATING AREA, FLEET WEATHER FACILITY, SAN DIEGO, MARCH 1971.

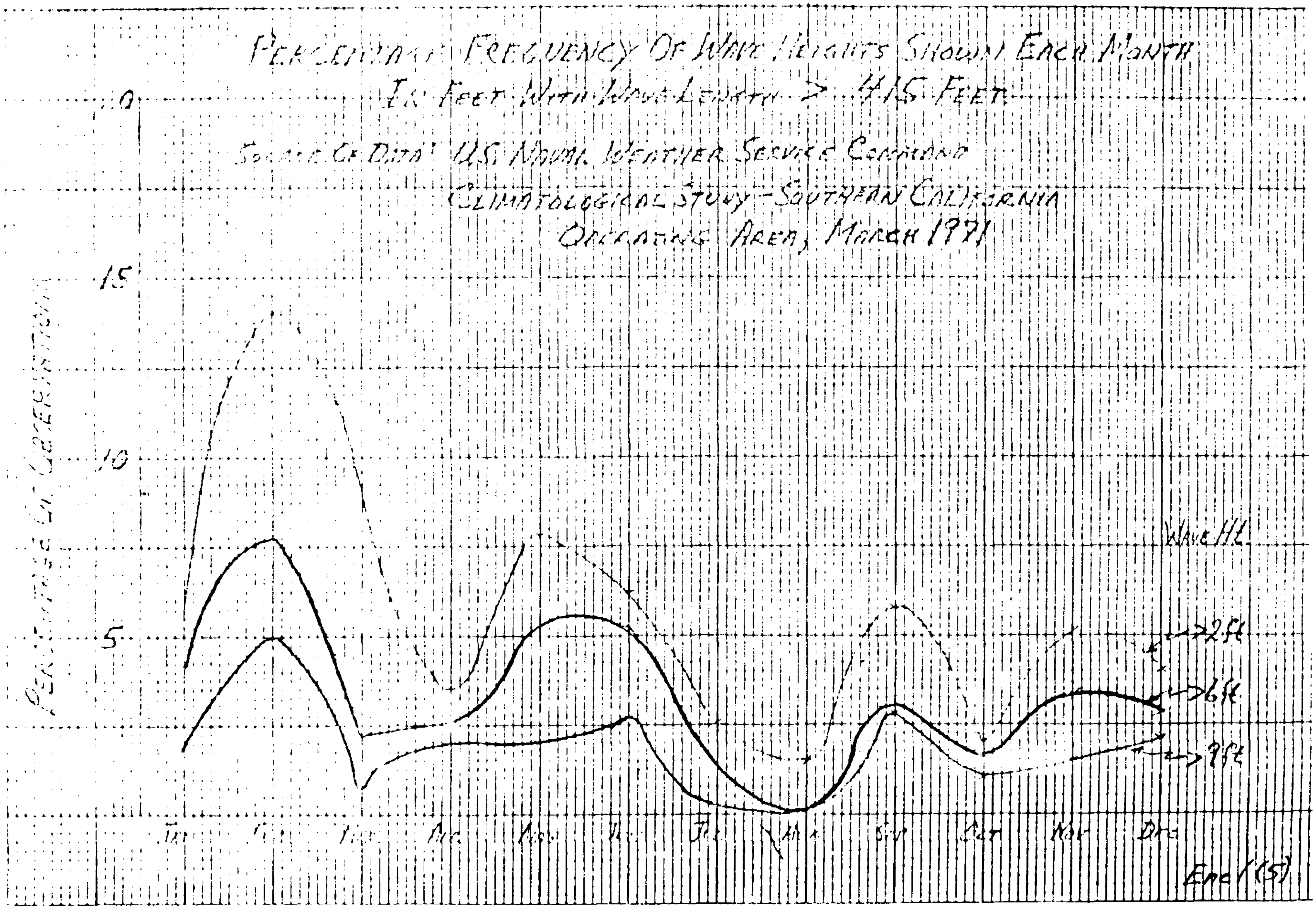
ENCL (2)

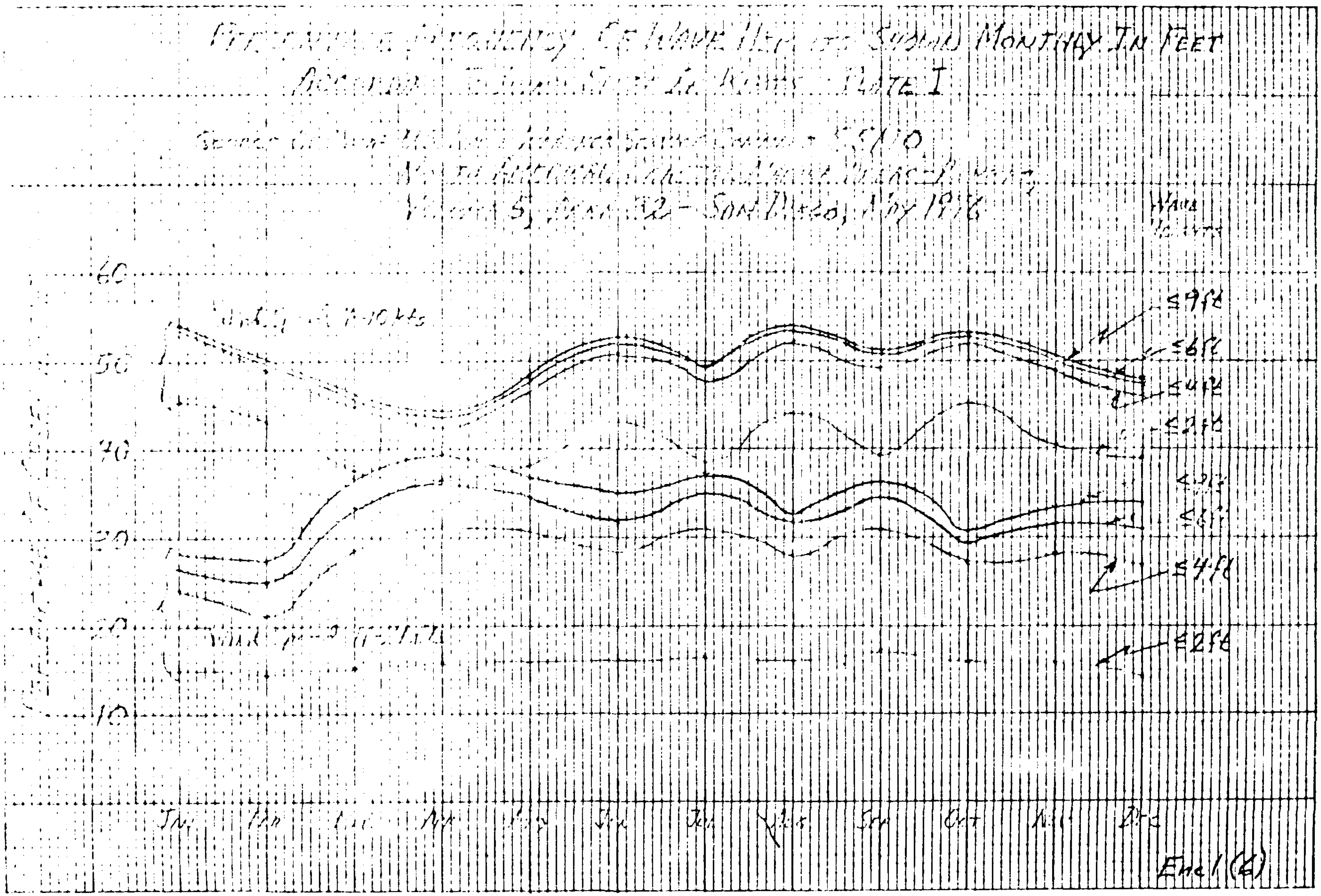
Percentage Frequency Of Monthly Wave Heights In Feet With Wave Lengths Of 185-250 Ft.

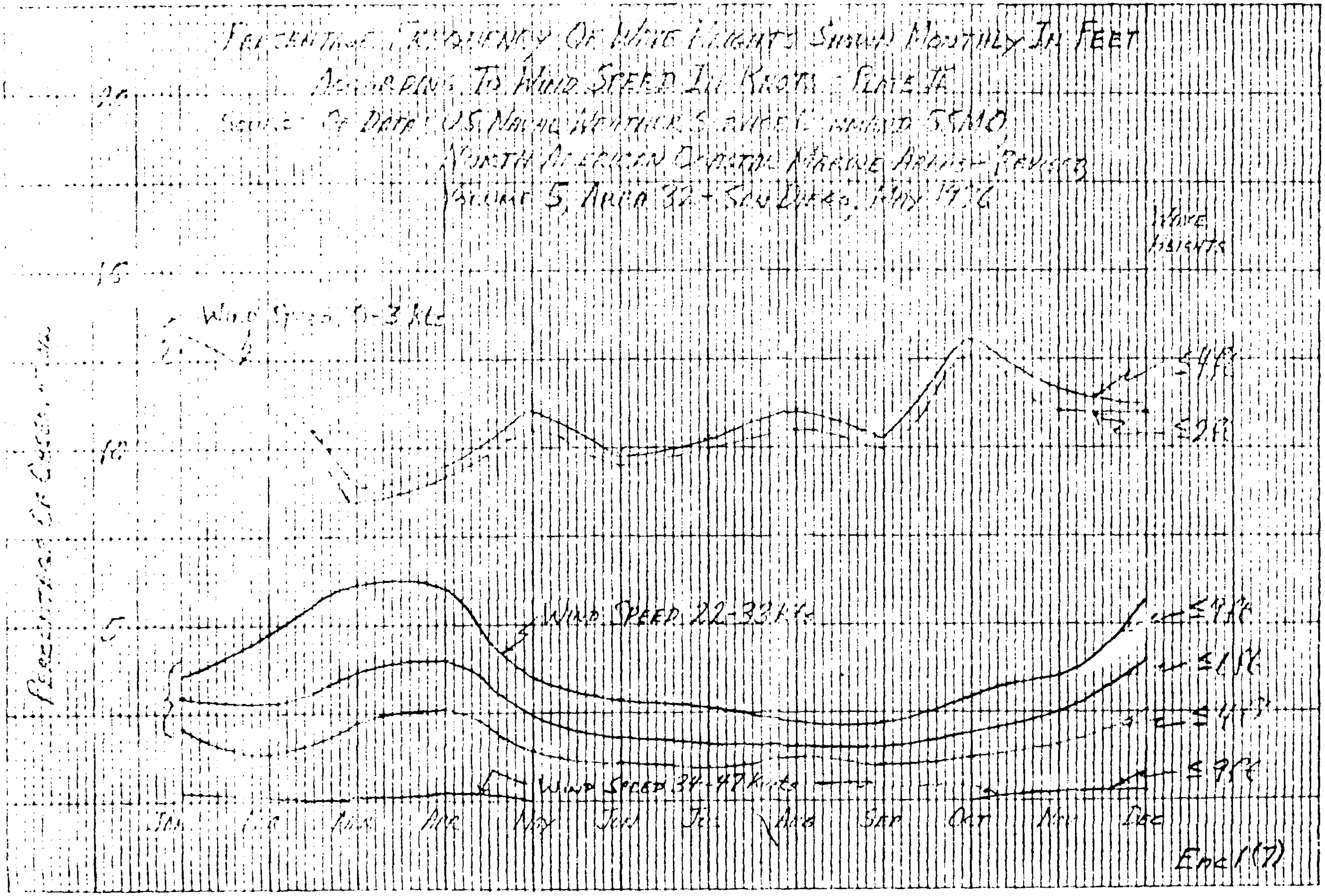
Encl (3)



Fleet Weather Facility, San Diego, March 1971
20
15
10
5
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Wave Heights
>2 ft
>6 ft
>9 ft
Encl (4)


Frequency Of Wave Heights Shown Each Month
In Feet With Wave Length > 415 Feet
Source Of Data: U.S. Naval Weather Service Command
Climatological Study - Southern California
Operating Area, March 1971
Percentage Of Observation
0
15
10
5
Wave Ht
2ft
6ft
9ft
Encl (5)


Monthly In Feet
Plate I
San Diego
60
50
40
20
10
≤9ft
≤6ft
≤4ft
≤2ft
≤4ft
≤2ft
Oct
Dec
Encl 1(4)


Percentage Frequency Of Wave Heights Shown Monthly In Feet
According To Wind Speed In Knots
Source Of Data: U.S. Naval Weather Service Command SSMO
North American Coastal Marine Areas - Revised
Volume 5, Area 32 - San Diego, May 1976
Wave Heights
20
15
10
5
Percentage Of Occurrence
Wind Speed 0-3 Kts
≤4 ft
≤2 ft
Wind Speed 22-33 Kts
≤13 ft
≤11 ft
≤4 ft
≤9 ft
Wind Speed 34-47 Knots
Jan
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Enc 1(7)

END
FILMED
4-86
DTIC