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INTRODUCTION

A program has been initiated for improving the Navy's fleet mooring capability through tests of existing fleet moorings and a range of conventional anchors in use and projected for use. These tests by the Civil Engineering Laboratory (CEL) are being performed in seafloors typical of Navy fleet mooring sites in conjunction with Navy Public Works Centers (PWC) where possible. In addition to the gathering of data on mooring and anchor behavior, anchor installation and proofing procedures are being evaluated to determine those most effective within the capabilities of PWC personnel and equipment.

Ultimately, the test data generated can be used: (1) to simplify and refine anchor selection and sizing, (2) to enable stipulation of anchor/mooring installation and proofing procedures, (3) and to improve the Navy's confidence in its moorings.

This report presents the results of site surveys and of instrumented anchor and mooring tests in the harbor at San Diego, Calif., and at Indian Island, Wash. Test data on Navy Stockless and STATO anchors are presented for immediate use by the Navy for selection and sizing of these anchors for sites typical of San Diego sand and Indian Island silty clay seafloors.

Test data are presented primarily as plots of anchor penetration, holding capacity, shank pitch, and shank roll as functions of anchor drag distance. These data allow complete isolation of anchor behavior from mooring behavior and will ultimately enable the development of an empirical scheme to predict anchor behavior. This task is underway and is scheduled for completion during FY81.

PROGRAM OBJECTIVES

The following are the specific program objectives:

1. To determine the capacity of selected existing moorings by proof testing to establish mooring limit.
2. To determine more accurately the capacity of the Stockless anchor at typical mooring locations.
3. To determine a means for efficiently using Stockless anchors in tandem and thus expand the use of the Navy's current anchor inventory.
4. To evaluate the operational practicality of using the Stockless anchor with welded open flukes, since tests have indicated higher capacities for the anchor with this modification.
5. To determine the capacities of high efficiency anchors in seafloors typical of Navy sites.

6. To gather site and anchor performance data to enable the development of an empirical procedure to predict the behavior of typical Navy drag embedment anchors.

BACKGROUND

Stockless Anchor

Most of the Navy's existing fleet moorings use the stockless anchor. This anchor was never intended for use as a permanent mooring anchor; its primary purpose was as a ship's bower anchor for temporary mooring. The Stockless anchor was not designed for high efficiency (high holding capacity to weight ratio). It was designed to be easily stowed in a ship's hawse pipe and to be easily recovered after use; deep penetration was not desired. Efficiencies of this anchor type are reported (Ref 1, 2, and 3) as approximately 2 in mud and 4-1/2 in sand after setting. Since the largest Stockless anchor available to the fleet weighed 30,000 pounds, the maximum capacities would be 60,000 pounds in mud after proper setting in sediment deep enough to accommodate expected penetration (20 feet to fluke tips) and 135,000 pounds in sand.

Many of the sites at which the Navy has fleet moorings have a soft mud seafloor to the maximum expected anchor burial depth or soft mud seafloors overlying stiff clay, sand, or coral. This latter condition could cause very poor anchor performance because proper anchor embedment might be prevented by the harder substrata. Embedment into the more competent sediment substrata is unlikely if it is significantly stronger than the surface mud or simply if it is granular, thus requiring a reduced fluke angle for embedment at this interface.

Stockless anchors are currently used in up to class AA moorings. In a mud seafloor a single 30,000-pound Stockless anchor is suitable for mooring class F and marginally suitable for mooring class E. This suitability is contingent upon proper setting and sufficient sediment in addition to the acceptability of a minimum safety factor for mooring class E. Because of equipment and procedural limitations, lack of funds, or lack of personnel training in anchor use, mooring anchors are typically not preset, and the existence of sufficient sediment for proper burial is often marginal or unknown.

The Stockless anchor is in great supply in Navy inventory and replacement funds for new, higher efficiency anchors will come slowly; thus, it is important to make use of the inventory. To do this, however, some operational complexities will necessarily be introduced. Tests (Ref 1) of the Stockless anchor in mud with flukes free-swinging and with flukes welded open show significant increases in efficiency for the latter condition, 4 versus 2, indicating that the anchor flukes did not open completely or at all for the free swinging (usual) condition. Towne (Ref 1) briefly experimented with Stockless anchors in parallel (side-by-side, attached to a single pulling point through a length of chain). Results showed that the anchors tended to come together, and that load equalization was of concern. Once the anchors come together, they will not re-embed, thus losing the safety advantage of this basic anchor type. Use of anchors in tandem (series) is an alternative to enable more effective use of the Stockless anchor. However, unless the anchors are properly rigged, the capacity of two anchors can be less

than that for a single anchor. Laboratory experiments (Ref 4) have been performed to determine an appropriate rigging technique for tandem anchors. The laboratory tests suggest rigging methods for tandem fixed and movable fluked anchors that appear feasible in practice. Both possibilities, welded open flukes and tandem anchors, would introduce additional installation complexity but could expand the use of the existing Stockless anchor inventory.

STATO Anchor

Limitations in the use of the Stockless anchor may still exist even if the approaches suggested previously can be successfully utilized. For some mooring classes other higher efficiency anchors may be required. One such anchor, the STATO anchor, was developed by the Navy to efficiently fulfill a variety of Navy anchoring needs. The STATO is recognized as the forerunner of a new breed of high efficiency anchors. During its development, it was tested exclusively in two types of sediment, San Francisco mud and Port Hueneme sand (Ref 3). Its design and rated capacities (20 to 1 in sand and 13 to 1 in mud at 50 feet of drag) were established for these two seafloors. The behavior of the STATO in other seafloors will be different; the differences for the Naval sites of interest could be slight, but without verification higher factors of safety would have to be employed at "unknown" sites.

High Efficiency Anchors

Many new high efficiency anchors have been developed and are available; however, performance data are limited to advertising claims. Advertised data suggest extremely high anchor efficiencies. If these data can be verified then these new anchors have the potential for significant cost savings to the Navy.

TEST PROGRAM

To resolve uncertainties in mooring capacity, anchor selection, sizing, configuration, and installation procedure, prototype testing at Navy sites with typical seafloor conditions is underway. In addition to the prototype tests, development of a predictive technique which depends on those engineering properties of the soil that govern soil reaction to loading by the embedded anchor and chain will be needed. Engineering properties are not a factor in presently used prediction schemes; capacity is always stated in terms of holding capacity to weight ratios and is usually based on a few tests in idealized soils (a sand or a clay). Relating capacity to engineering properties has the potential of enabling more accurate sizing of different or larger anchors or anchors used in seafloors in which they have not been tested.

Locations

After a lengthy pre-selection process which evaluated such things as available site boring logs, geologic charts, and site support, three sites were selected for detailed site surveys: San Diego Harbor, Calif., Indian Island, Wash.; and Subic Bay, Phillipines. Indications were that

these sites would provide a cross section of seafloor types typical of Navy fleet mooring sites as well as very uniform soil deposits to avoid confusion in data analysis. The surveys verified the suitability of San Diego and Indian Island sites; the Subic Bay survey results were inconclusive. Fortunately, a survey of Apra Harbor, Guam was being performed by Chesapeake Division Naval Facilities Engineering Command. These data were provided to CEL, and they indicated that Guam would be a suitable third test site. Anchor tests at Guam have been completed and results will be published in a subsequent report.

The locations of the anchor tests and cores at San Diego and Indian Island are shown in Figures 1, 2, and 3. For reference, the typical orientation of the test barge (shown to scale) during tests of anchors and moorings at San Diego is shown. The lay of the mooring legs is also shown for San Diego moorings.

Site Survey

The site survey at each test location consisted of underway acoustic subbottom profiling using a 5-kHz sound source and a hydrophone array and recorder, and coring using a 10-foot piston corer and an Alpine vibracorer for cores typically to 20 feet. One 40-foot core was attempted at Indian Island; 28 feet of core were recovered. The acoustic survey was performed to rapidly assess vertical and areal uniformity to aid the site selection process. The profile did not prove effective at the shallow water (10 to 15 feet) fine sand site at San Diego or at Indian Island where gassy sediments caused confused records. Fortunately, the vibracorer provided a rapid and easy alternative means to assess soil properties at probable test locations.

Each core was cut into 5-foot sections and transported to CEL for determination of the engineering properties. Usable soil strength data were not obtained from the cores taken at San Diego and Indian Island due to significant sample disturbance. It is planned to return to both sites with an in situ test device with cone penetrometer and vane shear capability. Twelve vibracores were taken at San Diego and six were taken at Indian Island. Not all these cores were completely analyzed; this can be done at a later date if need arises. A few cores were thoroughly analyzed with spot checks made on other cores to determine similarities. For example, the cores at Indian Island were extremely similar; thus, only one was analyzed in detail from that location.

Briefly, the primary test site (location 1) at San Diego (Figure 1), is a very uniform fine sand both areally and vertically. Figures 4 and 5 illustrate this with grain size curves of cores taken several hundred feet apart. Indications are that the seafloor is very dense, based on frequent extraordinarily high chain resistance during testing. As mentioned, this will be determined at a later date to enable eventual development of a predictive scheme. Additional data for San Diego Harbor are provided in Appendix A. Figure 2 shows a second site (location 2) described as a dense clayey sand. It is a very dense fissured seafloor in which only six tests were performed to evaluate the behavior of two particular anchors in a very hard seafloor.

The Indian Island site shown in Figure 3 consists of a gassy, soft silty clay with shell fragments. Table 1 lists of soil properties for core 3 at Indian Island. The gas in the soil caused soil expansion upon

core recovery, disturbing the samples and making undisturbed shear strength data meaningless.* Typically, the Indian Island mud was almost evenly distributed between silt and clay sized particles. Figures 6 and 7 show the grain size distributions for core 3V. The curves are almost identical with depth to 10 feet; spot checks showed minimal areal variability. Indian Island soil is classified as an organic silty clay of high plasticity. The liquid limit and water content values are relatively high and approximately equal, varying little with depth to 28 feet. Values range from 110 to 160 for water content and 117 to 142 for the liquid limit. The liquidity index (ratio of the difference between natural water content and plastic limit and the plasticity index) for the mud varies between 0.88 and 1.65 which can indicate either a comparatively soft or firm but sensitive soil. For liquidity indices in the above range, soil sensitivities could vary from 5 to 25. Anchor and chain performance suggests that the soil is quite sensitive; in situ strength measurements will be made for verification.

Test Anchors

A variety of test anchors were gathered from the Navy and private industry and are listed below:

<u>Anchor</u>	<u>Nominal Weight, lb (kg)</u>
Stockless	5,000
Stockless	9,000
STATO	1,000
STATO	3,000
STATO	6,000
BRUCE (twin shank)	748 (340)
BRUCE	1,320 (600)
BRUCE	2,200 (1,000)
STEVMUD	1,100 (500)
STEVMUD	2,200 (1,000)
STEVDIG	2,200 (1,000)
STEVFIX (sand)	1,408 (640)
STEVFIX (mud)	2,068 (940)
Hook	1,232 (560)

*Immediately prior to printing this document, shear strength data for Indian Island mud became available. The seafloor is normally consolidated and shear strength measures almost linearly from zero at the surface to 1-1/2 psi at 21 feet. See Figure A-11 in Appendix A for the data.

These anchors are all shown on the deck of the Army National Guard barge (Figure 8) used at Indian Island. Dimensions of all anchors tested are provided in Appendix B.

The Stockless anchor is depicted in Figures 9, 10, and 11. It can be modified by the addition of stabilizers to slightly increase capacity and improve roll stability. The Stockless anchor typically has a 45-to 48-degree fluke angle which is appropriate for mud seafloors. In sand, the angle should be reduced to 32 to 35 degrees for maximum performance. The Stockless anchor was also tested with welded-open flukes to evaluate speculated performance improvement and operational difficulties and advantages. The welded-open Stockless anchor was also used in tests of anchors in tandem (also called piggy-back).

Three sizes of the STATO anchor were tested to evaluate individual anchor behavior as well as to provide data on size effects. The STATO is shown schematically in its sand (34 degree fluke angle) and mud (50 degree fluke angle) configurations (Figure 12). Figure 13 shows the 6K STATO ready for testing.

Two types of BRUCE anchors were made available to the Navy. Figure 14 depicts the standard cast BRUCE anchor, which is designed to be lowered or dropped to the seafloor without concern for its attitude upon contact. Upon dragging (setting), the anchor rotates to its fluke-down orientation. A new welded version of the BRUCE anchor (Figure 15) was provided for tests at Indian Island. It was not fabricated in time for San Diego sand tests. The welded BRUCE anchor looks like the cast anchor but employs a twin plate shank and a hollow fluke section to allow increased fluke area. In fact, the 340-kg welded anchor had about the same fluke area as the 1,000-kg cast anchor. BRUCE cable depressors (either singly or multiple) are designed to attach to the shank (see Figure 16) between the anchor and chain to "depress" the chain, cause increased anchor penetration, and produce higher anchor holding capacity. Nominally, a depressor adds 20% to total system weight.

Four other types of high efficiency anchor were provided for testing, the STEVDIG, STEVMUD, STEVFIX, and Hook. The STEVDIG (Figure 17) is typically used for competent seafloors. Note the "claws" at the tips of the anchor flukes; they were placed to aid in digging into the dense sand and overconsolidated clay-type seafloors of the North Sea. The STEVMUD (Figure 18) is a single-purpose anchor developed for anchoring in mud. The STEVFIX, however, was designed to be used in sand and mud seafloors. Figure 19 shows the STEVFIX without bolt-on plate and stabilizer extensions for mud application. Fluke angle is adjusted for sand (50 degrees) and mud (32 degrees) by the removal (burnout) or addition (welded) of a small insert in the anchor crown.

A movable fluke, pick-type anchor, called the Hook anchor (Figures 20 and 21), was also tested. This anchor is designed primarily for mud, but is usable in sand by restricting the fluke angle to 32 degrees. The Hook is shown with and without auxiliary flukes on the shank and was tested in both configurations.

TEST PROCEDURES AND EQUIPMENT

The basic test setup showing component layout and instrumentation locations is shown schematically in Figure 22. The layout for the tandem Stockless anchor tests is identical except that the instrument package is located on the outboard anchor. The inboard anchor is uninstrumented.

For this test effort, an instrumentation system was devised to isolate anchor behavior from test mooring behavior. It was felt that isolation of anchor behavior was critical to the eventual development of a scheme to predict anchor size effects on capacity and to understand and predict the behavior of conventional anchors as a function of seafloor engineering properties.

Measurement System

Data gathered for all single and tandem anchor tests included load at the test vessel, load at the anchor, anchor depth, anchor longitudinal rotation (shank pitch), transverse rotation (shank roll), mooring line angle at the test platform, and barge displacement. By knowing barge displacement and accounting for test mooring line catenary changes, anchor drag distance is readily calculated.

Spar Marker. Initially, barge position was to be recorded primarily by means of a portable range-range navigation system with a spar buoy reference system used as a backup. The spar marker system proved to be much simpler, more accurate, and more reliable than the navigation system; thus, it was used exclusively during the test effort. The deck of the YC test platform was marked off in 2-foot increments for 100 feet. At the beginning of each test (identified by test anchor movement) a spar buoy (Figure 23) was placed on the bottom at the corner of the barge. Barge motion was recorded in 2-foot increments directly on the oscillograph and digitape-papertape records. At San Diego, a 20- to 35-foot length of gasoline-filled plastic pipe (depended upon test site) was weighted at its base and used as the spar marker. At Indian Island, water depth approached 100 feet; thus, the spar marker was modified to be less sensitive to current. A 30-foot segment of tube was attached to a subsurface taut mooring comprised of a 1-1/2-ft diam float, 85 feet of 1/8-inch wire rope, and an anchor clump.

Instrumentation System. Figure 22 is to be referred to for the overall measurement system layout. The underwater portion of the system is shown in Figure 24 for San Diego and Indian Island. The instrument pack was further streamlined for Indian Island. The load cell is the slender object attached directly between the anchor shank and chain; it measures load at the anchor only. Included in the instrument pack shown strapped to the anchor shank is a pressure transducer to measure water depth from anchor to surface, two inclinometers to measure shank angle and shank/anchor rotation, all signal conditioning equipment, and amplifiers for the load cell. The load cell was connected to the package

by an 8-foot electrical cable. A hose connected to the pressure transducer at the package was connected to a buoy (shown in Figure 24) to ensure that the bitter end remained out of the seafloor. The underwater system was connected to the surface barge by a 1,300-ft-long, six-conductor, underwater electrical cable.

The surface system consists of a deck load cell to measure load between pulling barge and test anchor, a cable inclinometer to measure cable angle at the barge, signal conditioning equipment, biasing and voltage calibrator unit, and recording equipment. Two methods were used to record the data: (1) an analog-to-digital recorder recorded data every 10 seconds and (2) an analog oscillograph was used to record continuously during test.

All transducers (load cells, inclinometers, and pressure transducers) were calibrated before each series of tests and rechecked afterward and found to be within specification of calibrations.

All load cells used for measurements on anchor tests were calibrated at the CEL on a Baldwin load machine with an accuracy of 0.303% of full scale.

Repeatability of the load cells was:

- No. 1 underwater cell - 0.4%
- No. 2 underwater cell - 0.4%
- No. 1 deck load cell - 0.35%
- No. 2 deck load cell - 0.35%

The underwater load cells were checked for temperature drift and found to change 0.019/ $^{\circ}$ or 38 lb/deg; this is a positive temperature coefficient.

Pressure cells used for depth measurement were calibrated with a deadweight tester and have a built-in signal conditioner and amplifier. Repeatability of pressure transducers was:

- No. 1 pressure transducer - 0.005%
- No. 2 pressure transducer - 0.0045%

The pressure transducers were checked for temperature drift and found to change 0.139 ft/ $^{\circ}$; this is a negative temperature coefficient. This change occurred within 60 seconds; therefore, relative changes in depth were correct during testing. Actual recorded depth could be as much as 1-1/2 feet too high, considering the temperature difference between deck and water. Inclinometers were calibrated and found to have an accuracy of 0.2-degree resolution.

Single Anchor Test

The test procedure was the same at San Diego and Indian Island; however, equipment did differ somewhat. A YC barge about 120 feet long served as the anchor pulling and data recovery platform. Photographs of the actual deck layout are given by Figures 25 and 26. A 100-ton-capacity, hydraulic cable puller was provided by the Supervisor of Salvage for the test effort. The cable puller basically consists of a fixed and a movable 2-inch cable gripper controlled through a remote console. The

grippers are alternately actuated and deactuated to haul-in or pay-out the 2-inch hauling line. About 4 feet of movement occurs at each cycle at rates from 0 to 17 ft/min. Each anchor was pulled at about 2 ft/min primarily to agree with previous controlled anchor tests. The cable puller operates as a load-controlled, rather than a strain-controlled, system; it is felt that, even though loading is briefly interrupted during a puller reset cycle, the loading is realistic. The cable puller pulled the anchor and its fixed-length mooring line toward a restraint mooring comprised of one preset 9,000-pound STATO anchor, 2-1/2-inch chain, and a peg-top buoy.

The YC barge was not heavily loaded during mooring or anchor testing; load was transferred from the restraint mooring through the cable puller (which simply rests on the deck) to the test anchor and mooring by a heavy duty padeye fixed to the YC. The padeye-deck attachment had to withstand only the environmental forces on the barge. Barge orientation was maintained during testing because both test and restraint lines passed through open chocks welded at opposite ends of the barge.

A crane barge was used to install and recover all test anchors at each site. The orientation of test barge and crane barge for Indian Island tests is shown in Figure 27. The crane barge was attached to the test barge by a 5/8-inch wire from an 8-ton salvage winch. At San Diego, wind proved to be a formidable problem in controlling crane barge location. Two pusher boats and an LCM-8 were barely able to control crane barge position. During the latter phase of San Diego tests, a stern anchor was placed to help control position in addition to helping restretch the test mooring after completion of a test series. The Figure 27 setup was a further refinement of the test procedure. This setup allowed the crane barge to move back and forth between its stern anchor and the test barge with help from its pusher boats.

For each test location, an attempt was made to minimize the number of times the restraint and test moorings had to be readied and deployed. The barge was layed out as shown in Figure 28. The 400 feet of 2-inch hauling wire was attached to the preinstalled restraint mooring buoy, and the wire was stretched out. The test mooring wire was subsequently stretched out using the crane barge. Two to three shots of chain were then attached to the test line and stretched. This configuration was typical for the beginning of each test day. At this point the LCM-8 would pull the 5/8-inch wire to the test barge and then return to the barge crane with the floated electrical line which would then be connected to the test anchor attached to the test mooring chain.

At San Diego the test anchor was lifted and lowered directly to the seafloor through the crown wire. The tug was released and the anchor pulled. After at least 50 feet of anchor drag the anchor was lifted, hosed off and relowered for another test. Three to four tests could be performed sequentially in a single line before the 2-inch haul line had to be pulled back through the cable puller while the test mooring was restretched. The test mooring was then layed 50 to 75 feet counter-clockwise for the next series.

At Indian Island, crane lift height was not sufficient to lower the anchor directly to the seafloor (about 100-foot depth); therefore, a large sheave was connected to the no. 1 hook. A 160-foot crownwire shackled to the deck at one end and attached to the anchor at the other was then placed in the sheave. With only a 50-foot crane lift, the

anchor was easily lowered to 100 feet through the two-part line. This approach was simple and should be useful to the PWC's where controlled anchor lowering in water depths between 80 and 180 feet is required.

Tandem Anchor Tests

Three tandem anchor arrangements with the Navy Stockless anchor were evaluated. The first method, referred to as the shank-to-shackle technique, and described by Figure 29, proved effective during a brief model study performed in Holland (Ref 4). In the shank-to-shackle method, both Stockless anchors were stabilized and had welded-open flukes because the model tests (Ref 4) showed superior performance with these modifications. A length of chain somewhat in excess of water depth was placed between outboard anchor shank and a padeye welded to the top of the inboard anchor's shank near its shackle connection. It was believed that this aft connection would allow the inboard anchor to function properly. During deployment, the chain would be lightly lashed over the crown of the inboard anchor to prevent fouling.

Figure 29 also shows the second tandem arrangement evaluated (crown-to-shackle technique). It was similar except the joining chain was connected to a padeye attached to the top of the Stockless anchor crown. Again, the flukes were welded open; otherwise they may have closed as soon as any load was applied to the crown by the outboard anchor chain. Figure 30 illustrates the third tandem test arrangement, the ground-ring-to-shackle technique. In this approach the inboard anchor is placed first and then the outboard anchor is lowered and the chain stretched. Welding the flukes open for all three tandem techniques also ensured that both anchors would penetrate immediately, thus insuring a taut mooring.

In addition to evaluating anchor system capacity, installation difficulties were also assessed. The best anchor system could be one that can be installed reliably with PWC assets even though it did not prove to be the highest capacity arrangement. Figure 31 describes the procedure used at Indian Island to install the shank-to-shackle and crown-to-shackle tandem anchor systems. This procedure is similar to that which could be used with fleet moorings, except the mooring would be laid off the bow of a Navy crane barge and chain length between anchors would depend on water depth.

Mooring tests were performed only at San Diego. During these tests, barge displacement, deck load, and line angle were measured. The direction of pull was established to ensure that load was being applied to a single mooring leg. Mooring leg layouts were defined by Reference 5. Load was applied to the test mooring until the rate of barge displacement increased and load dropped off. The test was then abruptly stopped to avoid excessive barge moor displacement and a requirement for leg repositioning.

Two test setups were used (see Figure 32). Pulling one mooring against another was a timesaver because it eliminated the need to install a restraint mooring; however, this could only be done if the mooring leg layouts were suitable. For a dual test setup, the spar marker reference buoy was placed midbarge. By monitoring the direction and displacement rate of the barge relative to the spar, it was possible to determine which of the test moorings yielded.

RESULTS AND DISCUSSION

Anchor Test Results - General

Fifty single and tandem anchor tests and three mooring proof tests were performed at San Diego; twenty-five single and tandem anchor tests were completed at Indian Island. These tests are summarized in Tables 2 through 4. Results of all Navy anchor (Stockless and STATO) tests are described and significant results provided. Each of these anchor tests is further described by a data plot and a data tabulation (see Appendix C). The results of all commercial anchor tests are the subject of a later report.

One data summary is described for guidance. Seven parameters are plotted as functions of true anchor drag distance in Figure 33. In the bottom block, horizontal force at the pulling barge, anchor tension, and chain weight on bottom are plotted versus drag distance. The difference between tension measurements is attributed solely to chain drag both on and in the seafloor. As shown by Figure 33, the contribution of the chain to total mooring load is substantial; this was typical for all the tests. At anchor tension equal to zero, the deck force reflects only chain drag. The 20,000 pounds of chain on bottom caused almost 30,000 pounds of drag resistance in the silt at Indian Island. At 58 feet of drag, roughly 10,000 pounds of chain (about 250 feet) in contact with the seafloor causes about 50,000 pounds of drag resistance. The 3,000-pound (nominal) STATO (actual weight 3,500 pounds) provided about 37,000 pounds of resistance at 58 feet of drag. A safe capacity of this anchor in Indian Island silt is 37,000 pounds. With information on the amount of chain in contact with the seafloor, capacities in excess of the basic anchor capacity could be assumed.

In the center block of Figure 33, anchor shank pitch angle and anchor shank roll angle are plotted versus drag distance. A positive pitch angle indicates shank tip down. As shown, the shank assumes a tip up (negative angle) orientation of about 10 degrees as the anchor approaches peak capacity. During drag, the anchor appeared relatively stable, remaining within 6 to 10 degrees of horizontal.

The top block of Figure 33 presents anchor crown and shank tip penetration as functions of drag distance. In the future, only one depth will be plotted for clarity. Penetration leveled out at about 15 feet to the crown, which translates to 19 feet to the tip of the fluke. It appears that the anchor is still penetrating but at a very shallow angle.

Table 5 is an example of the tabulated data for each anchor test. The table lists the data plotted in Figure 33 in addition to various other pieces of data that may be of use in the eventual analysis of these data. Item number 13 is anchor fluke tip depth; it is assumed that the flukes are completely open. For fixed fluke anchors this is valid but for movable fluke anchors the number must be used with care. In sand it is usually obvious when the fluke is open; there is a sudden increase in shank angle associated with a gradual increase in anchor tension. In mud it is not as obvious but is assumed to occur if anchor penetration is initiated and continues.

Tests of the many anchors in various configurations produced results which are greatly, but not totally, dependent on the testing media, San Diego fine sand and Indian Island mud (silty clay). Six tests were also run in overconsolidated silt at San Diego. Overall results would have been somewhat different (degree of difference unknown at this time) with different mooring line, type, or size. The differences would most likely occur with anchor and deck tension readings and anchor penetrations. Pitch and roll of the anchor would probably not be as sensitive to changes. In selecting chain size, an attempt was made to size it according to previous performance data or to advertised data. Often, the anchors would hold less than expected, thus chain size could have been less. Since the behavior of anchor and chain were isolated in these tests, it is felt that mooring line effects on anchor behavior will eventually be understood and quantified in a usable prediction scheme. Until then, care should be exercised when extrapolating these data to other sites, anchor sizes, and mooring lines.

Stockless Anchor (Single)

This anchor was tested in its normal use condition (unstabilized and with movable flukes free to open to 45 to 48 degrees relative to the centerline of the shank) at both San Diego and at Indian Island. These tests were run for confirmation of previous results (Ref 6) and to illustrate problems with using the Stockless anchor in this configuration for fleet moorings; results were similar. Behavior in sand was erratic for the 5K size (efficiencies of 3 to 5) while behavior in mud was consistent but poor. In comparison, the performance of the stabilized Stockless anchor with flukes welded in the open position at 35 degrees for sand and 48 degrees for mud was quite good.

In sand, anchor behavior was consistent with an average anchor efficiency of 5 to 6 for the 9K anchor and 10 for the 5K anchor. Most significantly, these efficiencies were achieved with minimal drag distance which would result in very taut moorings. Tests were not run with a stabilized anchor with 35-degree movable flukes in sand, but previous data (Ref 7) show that the flukes will eventually dig in sands of low to medium density; the improvement due to the reduced fluke angle could be as much as a factor of two. In dense sand and stiff clay seafloors the probability of the Stockless anchor flukes digging in is very low. Welding open the anchor flukes should greatly increase the probability of suitable anchor behavior in these more competent seafloors. Care should be exercised in comparing the mentioned efficiencies with previously reported data because the above values are for the anchor alone. Previous researchers attempted to determine true anchor capacity by separating the chain effect determined through chain pull tests. As can be seen from the results in Appendix A, the chain effect often increases as the anchor is dragged, and the shank forces chain into the seafloor. This effect will be different for different seafloors. The chain effect is real and is part of the total anchor resistance, but, particularly in sand and until it is better understood, the anchor tension alone provides a conservative estimate of expected performance.

In mud at Indian Island, each of the three configurations (i.e., standard, stabilized with movable flukes, and stabilized with fixed flukes) of the 9K Stockless anchor behaved sufficiently different to

clearly show the advantage of fixing the flukes in the open position in mud. Anchor penetrations at comparable drag distances were greater, anchor tensions were greater, and most importantly, mooring tensions were significantly greater. At 41 feet of drag, deck tensions for the above three configurations were 48,000, 50,000, and 67,000 pounds, respectively. Also, the first anchor appeared to have reached peak depth, the second increased slightly to 53,000 before peaking, and, based upon relative shank angles between two and three, option three would probably penetrate further. To put these differences into proper perspective, the effect of the chain laying on (not in) the seafloor is subtracted to show the "true" difference in capacities for Indian Island mud. The values then become 26,000, 30,000, and 50,000 pounds which translate, according to previous methods of figuring anchor efficiency, to 2.5, 2.6, and 4.4, respectively, for the nominal 9K anchor (true weights were used in determining efficiency). A possible reason for these differences is that the anchor flukes stabilized at a partially open position. Previously reported differences (Ref 1) for San Francisco Bay mud show the same relative differences - 2 versus 3.7 to 4. The lower overall values are explained by the reported lower chain drag in San Francisco Bay mud.

Stockless Anchor (Tandem)

In sand, three methods of rigging tandem anchors were tested (see previous section for descriptions). In terms of performance each was satisfactory; there appears to be a slight performance advantage for the shank-to-shackle rigging arrangement. The outboard anchor carried the instrument pack and outboard anchor performance paralleled that of the single anchor. The performance of the inboard anchor is inferred from the difference between deck tension and anchor tension. Based on the differences, the inboard anchor was functioning at least equally to the outboard anchor. Of the three techniques, the shank-to-shackle and crown-to-shackle techniques were equal in terms of installation ease. The ground-ring-to-shackle approach was also effective but somewhat more difficult to install in shallow water at San Diego. In deeper water at Indian Island, installation would have been significantly more difficult, thus it was not tried there. Model tests (Ref 4) in sand of both shank and crown-to-shackle techniques showed superior performance for the shank-to-shackle technique; attachment to the crown caused rotation of the inboard anchor. Prototype tests in sand and mud with the Stockless anchor with welded-open flukes, showed no indication of inboard anchor instability, inferred by overall mooring capacity. Attachment of chain to the crown rather than the shank does simplify installation in deeper water and does not seem to degrade overall performance.

The techniques found suitable for the Stockless anchor in fine sand and soft silty clay will probably be applicable to the vast range of intermediate soil types.

Use of these rigging techniques with higher efficiency anchors has not been proven at prototype size. Higher efficiency anchors need to penetrate deeply in mud and their light weight in relation to their capacity makes them more sensitive to external forces caused by tandem chain attachments. Tandem anchor chain attachment to the inboard anchor

shackle or chain would seem to limit rotational influences on the inboard anchor and, as long as deployment technique is not compromised, may be the safest alternative for higher efficiency anchors at this time.

STATO Anchor

Three sizes of STATO anchor (1K, 3K, and 6K) were tested in sand at San Diego and mud at Indian Island. The 3K STATO was also test-pulled in a dense clayey sand seafloor at San Diego.

Initially, three sizes were to be tested to get some idea of scale effects and to provide a good basis for comparison with other high efficiency anchors. However, initial results in sand were unexpectedly poor, and sufficient scale data were not obtained. Slight modifications to the STATO were required to bring performance back to its expected level. The chronological test sequence which leads to what appears to be necessary changes to expand STATO utility to a broader range of soil types and strengths is described in the following paragraph.

The 1K STATO was first tested in sand and at 5 to 6 feet of drag the anchor rotated out after a peak load of only about 6,000 pounds, far less than expected. This rapid instability would normally indicate that the anchor was improperly stabilized. Stabilizer width agreed with that listed by the drawings (16 inches); however, it did not agree with that projected from a plot of anchor width versus anchor weight for all other STATO anchors. The 1K STATO had not been fabricated previously, thus this problem had gone undetected. "Normal" stabilizer length should have been about 26 inches. While new 1K anchor stabilizers were being fabricated, the 3K STATO with normal stabilizers was tested. It also proved unstable after achieving an anchor load of about 30,000 pounds. The effect of the mooring chain on anchor stability was insignificant because in the two tests performed, the anchor rotated in opposite directions. The 1K STATO with normal 26-inch stabilizers was tested, and it reached about 10,000 pounds before becoming unstable. Its behavior paralleled that of the 3K STATO with its normal stabilizers. Extended stabilizers were fabricated for the 3K STATO with the intent of shortening them sequentially to determine their minimum allowable length. With 18-inch stabilizer extensions (Figure 34) (143-inch total anchor width), the anchor was pulled again. It built up load initially to about 40,000 pounds and then rotated out. Through 140 feet of drag it did not improve and continued to try to embed as evidenced by the fluctuating shank angle. Anchor fluke angle was checked to verify that it was 35 degrees as intended; it was 37 degrees. A 2-degree reduction in fluke angle was not considered adequate to improve performance. Therefore, it was reduced from about 37 to 31-1/2 degrees (by the addition of a 1/2-inch plate between shank and wedge insert, Figure 35), and the anchor was retested. A 30 to 32-degree fluke angle is currently used by the majority of anchor manufacturers for competent seafloors. The anchor built up load gradually until reaching 65,000 pounds. The load appeared to stabilize. On later examination of the data it was noticed that the anchor was beginning to rotate. To determine whether both the fluke angle reduction and stabilizer extensions were necessary, the normal stabilizers were replaced on the anchor and the anchor re-tested. The anchor rotated at about 12 feet of drag. Apparently, both modifications

were necessary. Since it appeared that the 18-inch extension was a good first guess based upon the slight tendency for rotation, smaller extensions were not tried.

The 6K STATO was then tested using its normal stabilizers. Specified fluke angle was 35 degrees yet measured angle was 32 degrees. This tolerance error was fortunately in the right direction for the San Diego sand. Three tests were performed, and the anchor held 105,000 pounds, 72,000 pounds, and about 60,000 pounds. Anchor rotation was again a problem. When fitted with normal stabilizers, all three sizes of STATO anchor behaved in a similar fashion. It appears that the lengths of stabilizers determined as adequate in Port Hueneme beach sand are not adequate for the denser, more uniform, finer grained sand of San Diego Harbor. As of this writing, accurate soil density measurements in San Diego sand were not available; they will be taken shortly. Based on the behavior of all anchors tested and the large chain resistances recorded, it appears that San Diego sand is of high relative density; the need for STATO fluke angle reduction further substantiates this.

Results of tests in mud at Indian Island were in reasonable agreement with previous results reported for San Francisco Bay mud (Ref 3). Recorded efficiencies, for anchor alone, of the 1K and 3K STATO anchors at 50 feet of drag were 14 and 11, respectively; while total efficiencies, including the effect of buried chain were 20 and 17 respectively. Anchor tension for the 6K STATO was not recorded, however; total efficiency near 50 feet of drag was 14. The 1K and 3K anchors appeared to be nearing their peak load while the 6K anchor load was still increasing; however, the 6K anchor was steadily rotating. At 41 feet of drag the measured maximum rotation of about 45 degrees was recorded and the test stopped to avoid electrical cable failure. Longer stabilizers would probably have limited rotation. The extended stabilizers on the 3K anchor did not seem to noticeably inhibit anchor penetration or degrade performance; stability was apparently helped.

The three tests of the 3K STATO with extended stabilizers in a dense clayey sand were in a designated anchorage area in San Diego Harbor. These data were probably the most interesting. In each test the anchor dug in and increased to peak load rapidly and then pulled out. When recovered, soil was packed between the shank and flukes which would prevent further embedment.

Based on tests performed to date on the STATO it is possible to make some general recommendations for modifications to expand utility of the STATO to a broader range of soil characteristics. For specific applications, perhaps these changes should be made only if performance is less than expected or if data indicate a very competent seafloor. For general utility, the following changes are recommended prior to further usage.

1. For use in sand, measure the fluke angle with the wedge insert in place; if greater than 32 degrees, insert a plate spacer or fabricate a new wedge to achieve the needed fluke angle.

2. For sand and mud, extend the stabilizers according to the recommendations of Figure 36. Existing and projected curves of anchor width versus anchor weight are provided. Obviously, extrapolation on the basis of a single data point can be considered highly questionable

but high efficiency anchors are typically scaled as a direct function of anchor weight. Anchor dimensions are normally scaled according to (anchor weight)^{1/3}; however, as can be seen from Figure 36, STATO scaling differs. A line proportional to $wt^{1/3}$, straight line on a log-log plot, is drawn through the single data point available (3K STATO with 18-inch stabilizer extensions). The reason for this deviation from normal geometric scaling was structural limitations due to required use of mild steel (Ref 8). Using geometric scaling with the single data point, the 200-pound anchor seems suitably stabilized and the 15,000-pound STATO seems reasonably close. However, until additional data are available, the upper curve which parallels the actual data and amounts to about a 35% increase in anchor width should be used to provide a conservative estimate of required anchor width from which stabilizer length can be determined.

3. Use of mud palm extensions in sand does not seem to degrade performance. Reference 3 supports this contention; therefore, unless the STATO will be used exclusively for competent seafloors, the mud palm extensions should be included as a standard part of the anchor.

Stockless Anchor Moorings

All moorings tested at San Diego were class B riser-type moorings with a design load of 125,000 pounds. The principal soil type at each mooring location was fine sand. Standard, unstabilized, 20,000-pound Stockless anchors with 45- to 48-degree fluke angles were typical of all the tested moorings. Each anchor was jetted in until flukes were fully open in the down position. Based upon the data gathered at San Diego, it was determined that the anchors in their standard condition probably would not have embedded during normal dragging. Each mooring was pulled in only one direction, and care was taken not to displace the mooring; thus, load was increased to the onset of slippage and loading was stopped immediately. Moorings 17, 18, and 51 held 118,000, 115,000, and 99,000 pounds maximum, respectively. At these loads - in fact at far less than these loads - all chain was off the seafloor. These loads reflect true anchor capacity for the above described conditions. Continued dragging of the anchors, as could occur during storm activity, would probably have caused them to come out of the seafloor, with low probability of re-embedment. A fleet mooring anchor should continue to sustain near peak load with drag to minimize catastrophic damage. The reduction in fluke angle to 35 degrees and the addition of stabilizers will produce this type of desired behavior. If anchors are to be jetted into sand or stiff clay seafloors then these modifications should be made. Also, by welding the flukes open, the principal advantage of jetting (achievement of a taut mooring) can be realized without the need for diving support.

SUMMARY AND CONCLUSION

This report provides the results of anchor and mooring tests in fine sand and dense clayey sand at San Diego and in mud at Indian Island. Tests at a third site with a clay seafloor are planned for early 1980.

Anchors typical of fleet moorings, Stockless and STATO, as well as a variety of new high efficiency anchors potentially useful with fleet moorings, were tested under controlled conditions to: (1) provide immediate use data for the Navy and (2) provide the basis for the eventual development of a scheme to predict the behavior of anchors as a function of seafloor engineering properties. A great deal of data was gathered, and the implications of these data are not fully understood at this time. Care should be exercised in using these data to specify the performance of larger sizes of the tested anchors in similar or different soils than those of the test sites. The tests clearly provided surprises in anchor behavior and illustrated the great dependence of anchor behavior on soil characteristics. An effort is underway toward a more complete understanding of the data and toward the development of an anchor behavior predictive scheme. Results will be reported at a later date. In the meantime, some tentative conclusions can be drawn and guidance given concerning the use of the various anchors tested.

1. In sand, the stabilized Stockless anchor with welded-open flukes to 35 degrees was often 2 to 4 times more efficient than the standard Stockless anchor. It also held its load more uniformly with drag and developed its peak capacity within a few feet of drag.
2. Tandem anchor arrangements using Stockless anchors with welded-open flukes were found that could be reasonably installed with Navy Public Works assets and that appeared to develop individual anchor efficiencies at least equal to those achieved when pulled singly in sand and mud.
3. In mud, the efficiency of the stabilized Stockless anchor with welded-open flukes (fully opened) was approximately twice that of the stabilized or unstabilized Stockless anchor with freely moving flukes.
4. The standard STATO anchor performed poorly in San Diego sand; however, an increase of about 35% in anchor width (stabilizer extension) and a reduction in fluke angle to about 32 degrees for the 3,000-pound STATO corrected penetration and stability problems and increased anchor efficiency from less than 10 to greater than 20.
5. In mud, STATO performance was in relative agreement with previously reported data; however, some rotational instability was noticed, particularly in the 6K STATO, suggesting the need for an increase in stabilizer length.
6. Previous STATO tests were concentrated in Port Hueneme sand and San Francisco Bay mud. The STATO was designed on the basis of tests in these seafloors. The recent tests were performed in seafloors which expanded performance data to a more dense sand and to a softer mud; these tests suggest anchor modifications. To expand the utility of the STATO to a broader range of soil conditions, stabilizers should be extended. When used in sand only, the standard fluke angle should be 32 degrees rather than 35 degrees.

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REFERENCES

1. Naval Civil Engineering Laboratory. Technical Memorandum M-097: Tests of anchors for moorings and ground tackle design in mud bottom, by R. C. Towne and J. V. Stalcup. Port Hueneme, Calif., Dec 1954.
2. Naval Facilities Engineering Command. Design Manual DM-26: Harbor and coastal facilities. Alexandria, Va., Jul 1968.
3. Naval Civil Engineering Laboratory. Technical Report R-044: New and modified anchors for moorings, by R. C. Towne and J. V. Stalcup. Port Hueneme, Calif., Mar 1960.
4. Holland Shipbuilding, Anker Advies Bureau. Anchors in tandem or use of backup anchors (piggy-backs), by P. J. Klaren.
5. Civil Engineering Laboratory. Technical Memorandum M-42-78-12: San Diego fleet mooring inspection, by J. F. Wadsworth. Port Hueneme, Calif., Aug 1978.
6. Naval Civil Engineering Research and Evaluation Laboratory. Technical Note N-195: Tests of BUSHIPS anchors in mud and sand bottoms, by R. C. Towne and J. V. Stalcup. Port Hueneme, Calif., Aug 1954.
7. _____. Technical Memorandum M-066: Test of anchors for moorings and ground tackle design, by R. C. Towne. Port Hueneme, Calif., Jun 1953.
8. _____. Technical Note N-1463: OTEC single anchor holding capacities in typical deep sea sediments, by P. J. Valent, R. J. Taylor, J. M. Atturio, and R. M. Beard. Port Hueneme, Calif., Dec 1976.

Table 1. Soil Property Data for Vibracore 3 - Indian Island

1. Original vane shear strength data and density data not presented. Soil gases caused significant sample disturbance.
2. Shells and shell fragments were found throughout the cores.
3. Core color was dark olive gray.
4. Soil classification is silty clay.

Increment (in.)	Water Content, %	Remolded Vane Shear Strength, psi	Liquid Limit, %	Plastic Limit, %	Plasticity Index	Specific Gravity	Liquidity Index
0-3	148.30	0.241	142.13	64.40	77.7	2.543	1.09
24-27	146.74	0.198					
36-39	150.49	0.313					
48-51	152.67	0.217	124.64	65.45	59.2	2.521	1.47
60-63							
72-75	143.97	0.313	138.64	71.59	67.1	2.511	1.08
84-87	153.16	0.318					
96-99	161.23	0.194	125.84	70.34	55.5	2.515	1.65
108-111	158.05	0.174					
116-119	155.16	0.184	140.25	70.40	69.9	2.498	1.2
18 ft	134.02						
28 ft	110.46		117.00	65.86	51.1		0.88

Table 2. Summary of Test Data for San Diego Harbor Anchor Tests

Test		Anchor	Calendar Date (Julian)	Anchor Description				Water Depth, ft	Remarks	
No.	Series			Nominal Weight, lb (kg)	Actual Weight, lb (kg)	Fluke Angle, deg	Fixed/Movable Fluke			Anchor Specifics
Location 1 - San Diego Harbor - Uniform Fine Sand										
1	4	Stockless	3/29/79 (88)	5,000	5,350	48	M	Without stabilizers	12	Anchor performance was erratic; efficiency varied from 3 to 5.
2	4	Stockless	3/29/79 (88)	5,000	5,350	48	M	Without stabilizers	11	
3	4	Stockless	3/29/79 (88)	5,000	5,350	48	M	Without stabilizers	12	
1	5	Stockless	3/30/79 (89)	5,000	5,950	35	F	With stabilizers	16	Chain connector parted; peak load not recorded. Anchor performance was very uniform; Load built up rapidly and remained stable during pull.
2	5	Stockless	3/30/79 (89)	5,000	5,950	35	F	With stabilizers	12	
3	5	Stockless	4/2/79 (92)	5,000	5,950	35	F	With stabilizers	15	
1	6	STATO	4/2/79 (92)	1,000	1,070	35	M	With 16 in. stabilizers	16	Anchor flipped over at about 12 ft of drag at an efficiency of 6.
1	7	Hook	4/3/79 (93)	(560)	1,230 (560)	32	M	With auxiliary flukes	12	
2	7	Hook	4/3/79 (93)	(560)	1,230 (560)	32	M	With auxiliary flukes	12	
3	7	Hook	4/3/79 (93)	(560)	1,230 (560)	32	M	With auxiliary flukes	12	

continued

Table 2. Continued

Test		Anchor	Calendar Date (Julian)	Anchor Description				Water Depth, ft	Remarks
No.	Series			Nominal Weight, lb (kg)	Actual Weight, lb (kg)	Fluke Angle, deg	Fixed/ Movable Fluke		
Location 1 - San Diego Harbor - Uniform Fine Sand (continued)									
1	10	BRUCE	4/3/79 (93)	(600)	1,320 (600)	-	F	15-1/2	
2	10	BRUCE	4/3/79 (93)	(600)	1,320 (600)	-	F	15-1/2	
3	10	BRUCE	4/4/79 (94)	(600)	1,320 (600)	-	F	13	
1	11	BRUCE	4/4/79 (94)	(600)	1,320 (600)	-	F	14-1/2	With 1 cable depressor (120 kg) after load cell
2	11	BRUCE	4/4/79 (94)	(600)	1,320 (600)	-	F	14-1/2	
1	12	BRUCE	4/4/79 (94)	(600)	1,320 (600)	-	F	14-1/2	With 2 cable depressors (240 kg) after load cell
1	15	STEVDIG	4/4/79 (94)	(1,000)	2,550 (1,160)	32	M	15-1/2	
2	15	STEVDIG	4/4/79 (94)	(1,000)	2,550 (1,160)	32	M	15	
3	15	STEVDIG	4/5/79 (95)	(1,000)	2,550 (1,160)	32	M	15	

continued

Table 2. Continued

Test		Anchor	Calendar Date (Julian)	Anchor Description				Water Depth, ft	Remarks
No.	Series			Nominal Weight, lb (kg)	Actual Weight, lb (kg)	Fluke Angle, deg	Fixed/Movable Fluke		
Location 1 - San Diego Harbor - Uniform Fine Sand (continued)									
1	9	STEVFIX	4/5/79 (95)	(640)	1,408 (640)	32	M	14-1/2	
2	9	STEVFIX	4/5/79 (95)	(640)	1,408 (640)	32	M	14	
3	9	STEVFIX	4/5/79 (95)	(640)	1,408 (640)	32	M	14	
1	14	STATO	4/5/79 (95)	3,000	3,000	37	M	14-1/4	Anchor flipped over after reaching an efficiency of about 10; appeared that stabilizers are too short.
2	14	STATO	4/5/79 (95)	3,000	3,000	37	M	14-1/4	
1	13	Stockless	4/5/79 (95)	9,000	11,370	35	F	14-3/4	Anchor held stably at an efficiency of about 5.
2	13	Stockless	4/5/79 (95)	9,000	11,370	35	F	15-3/4	
1	16	BRUCE	4/6/79 (96)	(1,000)	2,200 (1,000)	-	F	13	
2	16	BRUCE	4/6/79 (96)	(1,000)	2,200 (1,000)	-	F	13-1/2	

continued

Table 2. Continued

Test		Anchor	Calendar Date (Julian)	Anchor Description				Water Depth, ft	Remarks
No.	Series			Nominal Weight, lb (kg)	Actual Weight, lb (kg)	Fluke Angle, deg	Fixed/Movable Fluke		
Location 1 - San Diego Harbor - Uniform Fine Sand (continued)									
1	17	BRUCE	4/6/79 (96)	(1,000)	2,200 (1,000)	-	F	13-1/2	Anchor flipped over at an efficiency of about 10; stabilizers are too short. Anchor performance was erratic; initiated embedment then rotated and came out. Anchor built up load uniformly, was stable, developed an efficiency of 21. Anchor flipped at about 10 ft of drag.
2	17	BRUCE	4/6/79 (96)	(1,000)	2,200 (1,000)	-	F	13-1/2	
2	6	STATO	4/9/79 (99)	1,000	1,070	35	M	14-1/2	
3	14	STATO	4/10/79 (100)	3,000	3,000	37	M	15	
4	14	STATO	4/10/79 (100)	3,000	3,000	31-1/2	M	14-1/2	
5	14	STATO	4/10/79 (100)	3,000	3,000	31-1/2	M	15-1/4	Anchor efficiency varied between 9 and 16; anchor unstable and flipped at above efficiencies; longer stabilizers appear needed.
1	19	STATO	4/11/79 (101)	6,000	6,000	32	M	15-1/4	
2	19	STATO	4/11/79 (101)	6,000	6,000	32	M	15	
3	19	STATO	4/11/79 (101)	6,000	6,000	32	M	14-1/2	

continued

Table 2. Continued

Test		Anchor	Calendar Date (Julian)	Anchor Description				Water Depth, ft	Remarks	
No.	Series			Nominal Weight, lb (kg)	Actual Weight, lb (kg)	Fluke Angle, deg	Fixed/Movable Fluke			Anchor Specifics
Location 1 - San Diego Harbor - Uniform Fine Sand (continued)										
1	20	Stockless	4/11/79 (101)	5,000	5,950 (ea)	35	F	Tandem - shank to shackle rigging; total weight of 11,900 lb	13	Arrangement easy to install; both anchors apparently functioned to peak capacity.
2	20	Stockless	4/11/79 (101)	5,000	5,950 (ea)	35	F		13	
1	21	Stockless	4/12/79 (102)	5,000	5,950 (ea)	35	F	Tandem - crown to shackle rigging; total weight is 11,900 lb	16-3/4	Performance somewhat less than shank-to-shackle technique but somewhat easier to install.
2	21	Stockless	4/12/79 (102)	5,000	5,950 (ea)	35	F		16-1/2	
1	22	Stockless	4/12/79 (102)	5,000	5,950 (ea)	35	F	Tandem - ground ring to shackle rigging; total weight is 11,900 lb	13	Performance comparable to crown to shackle technique but installation more difficult.
4	7	Hook	4/12/79 (102)	(560)	1,230 (560)	32	M	Without auxiliary flukes	12	
5	7	Hook	4/12/79 (102)	(560)	1,230 (560)	32	M	Without auxiliary flukes	11-1/2	
Location 2 - San Diego Harbor - Anchorage Area (1-3 Ft Mud Over Dense Clayey Sand)										
1	24	STATO	4/16/79 (106)	3,000	3,000	31-1/2	M	With 18-in. stabilizer extensions	41	Anchor embedded quickly and reliably to a peak anchor efficiency of 15 to 18, but pulled out with continued drag; ultimately, the dense clayey sand clogged the flukes and prohibited re-embedment.
2	24	STATO	4/16/79 (106)	3,000	3,000	31-1/2	M	With 18-in. stabilizer extensions	41	
3	24	STATO	4/16/79 (106)	3,000	3,000	31-1/2	M	With 18-in. stabilizer extensions	39	

continued

Table 2. Continued

Test		Anchor	Calendar Date (Julian)	Anchor Description				Water Depth, ft	Remarks
No.	Series			Nominal Weight, lb (kg)	Actual Weight, lb (kg)	Fluke Angle, deg	Fixed/ Movable Fluke		
Location 2 - San Diego Harbor - Anchorage Area (1-3 Ft Mud Over Dense Clayey Sand)									
1	25	STEVFIX	4/16/79 (106)	(640)	1,408 (640)	32	M	38	
2	25	STEVFIX	4/16/79 (106)	(640)	1,408 (640)	32	M	37	
3	25	STEVFIX	4/16/79 (106)	(640)	1,408 (640)	32	M	36	

Table 3. Summary of Test Data for San Diego Harbor Mooring Tests

Date	Mooring Number	Mooring Class	Anchor	Anchor Weight, lb	Mooring Chain Size/Length Buoy to Anchor	Water Depth	Remarks
3/26/79	17	B	Stockless without stabilizers	20,000	22 ft - 2-3/4 in. riser; 225 ft - 2-1/2 in. leg	36	Anchors jettied-in with flukes down on all San Diego moorings; -SE pull on mooring, max load was 118,000 lb.
3/26/79	18	B	Stockless without stabilizers	20,000	23 ft - 2-3/4 in. riser; 225 ft - 2-1/2 in. leg	37	-SW pull on mooring; max load 115,000 lb.
3/27/79	50 & 51	B	Stockless without stabilizers	20,000	16 ft - 2-3/4 in. riser; 225 ft - 2-1/2 in. leg	28	-E-W pull on moorings, max load 99,000 lb; buoy 51 displaced at above load.

Table 4. Summary Test Data for Indian Island Anchor Tests

Test No.	Date	Anchor	Anchor Description					Water Depth (ft)	Remarks
			Nominal Weight lb (kg)	Actual Weight lb (kg)	Fluke Angle (deg)	Fixed/Movable Fluke	Anchor Specifics		
1	6/19/79	STATO	1,000	1,070	50	M	26 in. long stabilizers	86	Anchor embedded quickly; began to rotate at about 30 ft drag.
2	6/20/79	Hook	(560)	1,230 (560)	50	M	Without auxiliary flukes	82	
3	6/20/79	Hook	(560)	1,230 (560)	50	M	Without auxiliary flukes	87	
4	6/20/79	BRUCE	(1,000)	2,200 (1,000)	-	F		87	
6	6/20/79	BRUCE	(1,000)	2,200 (1,000)	-	F	With 1 cable depressor (200 kg) after load cell	81	
7	6/21/79	Stockless	9,000	11,370	48	F	With stabilizers	79	Anchor load cell erratic for test 7; at comparable drag distance (41 ft) fixed-fluke anchor deck tension was 17,000 lb higher than movable fluke anchor.
8	6/21/79	Stockless	9,000	11,370	48	M	With stabilizers	91	
9	6/21/79	Stockless	5,000	5,950	48	F	With stabilizers	92	Anchor consistently held 4-5 times its own weight; also refers to single anchor performance of tests 11 and 12.
10	6/21/79	Stockless	5,000	5,950	48	F	With stabilizers	92	

continued

Table 4. Continued

Test No.	Date	Anchor	Anchor Description					Water Depth (ft)	Remarks
			Nominal Weight lb (kg)	Actual Weight lb (kg)	Fluke Angle (deg)	Fixed/Movable Fluke	Anchor Specifics		
11	6/22/79	Stockless	5,000	5,950 (ea)	48	F	Tandem - shank to shackle; total weight is 11,900 lb	98	Both tandem arrangements were equally efficient; crown-to-shackle approach slightly easier to install; anchor seems to be initiating rotation near 35 ft of drag (about 15 ft actual anchor drag).
12	6/23/79	Stockless	5,000	5,950 (ea)	48	F	Tandem - crown to shackle; total weight is 11,900 lb	92	
13	6/23/79	Stockless	5,000	5,950	48	M	With stabilizers	87	Anchor penetration about one-half that of fixed fluke anchor; 10,000-15,000 lb reduction in deck tension from fixed fluke anchor.
14	6/23/79	Stockless	5,000	5,950	48	M	With stabilizers	89	
15	6/23/79	BRUCE	(340)	750 (340)	-	F	Twin shank anchor	88	
17	6/23/79	STEVFIX	(640)	1,408 (640)	50	M		92	
18	6/24/79	STEVFIX	(640)	1,408 (640)	50	F	With flukes fixed open	84	
19	6/24/79	STEVFIX	(940)	2,068 (940)	50	F	With fluke extensions and flukes fixed open	83	
20	6/24/79	STEVMUD	(1,000)	2,200 (1,000)	50	M		82	
21	6/25/79	Stockless	9,000	10,500	50	M	Without stabilizers	89	Peak deck tension almost 20,000 lb less than stabilized welded-open fluke version.

continued

Table 4. Continued

Test No.	Date	Anchor	Anchor Description				Water Depth (ft)	Remarks
			Nominal Weight lb (kg)	Actual Weight lb (kg)	Fluke Angle (deg)	Fixed/Movable Fluke		
22	6/25/79	BRUCE	(600)	1,320 (600)	-	F	83	Extended stabilizers did not appear to degrade performance; anchor penetrated and held well.
23	6/25/79	STATO	3,000	3,000	50	M	82	Extended stabilizers did not appear to degrade performance; anchor penetrated and held well.
24	6/25/79	STEVMUD	(500)	1,100 (500)	50	M	83	Anchor penetrated and held well but rotated; extended stabilizers might improve performance.
25	6/25/79	STATO	6,000	6,600	50	M	89	Anchor penetrated and held well but rotated; extended stabilizers might improve performance.

Table 5. Typical Data Output for Anchor Test Pull

TEST DATE		STATO		ANCHOR		TEST									
TEST NO.		101													
TEST SERIES		1													
TEST AREA		19													
START-END TIMES		SAN DIEGO HARBOUR 1500 FT. SOUTHEAST OF BUOY 49													
SEA-FLOOR TYPE		1101 - 1122													
ANCHOR TYPE		FINE SAND BOTTOM. DEPTH 11-12 FT. MLLW													
ANCHOR WEIGHT		STATO 6000LB. NORMAL STABILIZERS		32 NEG. MOV. FLUKES											
FLUKF ANGLE-TYPE		6000.00 LB.													
AUX. ANCHOR TYPE		32.00 DEG. - 0		0=MOV 1=FIX											
AUX. ANCHOR WEIGHT		0.00 LB.													
MAIN-AUX ANCHOR SEPARATION		0.0 FEET													
DEPRESSIONS, NO.-WT. EACH-TOTAL WT.		0 - 0.0 - 0.0 LB.													
MOORING LINE DESCRIPTION		ANCHOR TO 180FT 2.5IN. STUMLINK CHAIN TO 340FT 2IN WIRE ROPE													
NOTE - INITIAL SHANK DEPTH ZEROED TO REFLECT MEASURED WATERDEPTH															
NOTE - POSITIVE SHANK ANGLE INDICATES SHANK TIP BELOW CROWN															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
FEET	KIPS	KIPS	FEET	DEG	DEG	DEG	KIPS	FEET	LB	FEET	FEET	FEET	FEET	LB	
0.0	20.0	0.0	14.0	-4.5	5.0	7.3	19.0	172.8	8665.1	14.2	15.3	18.5	15.3	14665.1	
2.0	38.5	7.5	14.9	-4.3	4.0	5.8	38.3	145.9	7315.7	14.4	15.2	18.6	15.3	13315.7	
4.0	44.5	11.3	14.9	-4.3	3.2	5.6	44.3	136.0	6864.0	14.5	15.1	18.6	15.3	12864.0	
6.0	49.5	15.0	14.6	-2.5	10.5	5.4	49.3	130.6	6548.0	13.2	15.4	18.0	15.3	12548.0	
7.9	65.0	25.0	15.0	-2.5	8.0	4.9	64.8	112.7	5654.3	13.9	15.6	18.5	15.3	11654.3	
9.7	80.0	37.5	15.3	-2.5	7.0	4.3	79.8	103.9	5208.1	14.4	15.8	18.9	15.3	11208.1	
11.6	102.0	57.5	15.3	-2.5	7.0	3.9	101.8	85.1	4268.8	14.4	15.8	18.9	15.3	10268.8	
13.6	108.0	67.5	15.5	-2.5	7.5	3.7	107.8	84.5	4236.9	14.5	16.1	19.1	15.3	10236.9	
15.5	120.0	80.0	15.5	-2.5	8.0	3.5	119.8	77.8	3880.6	14.4	16.1	19.0	15.3	9880.6	
17.5	128.0	85.0	15.5	-3.5	9.0	3.4	123.8	76.8	3852.4	14.3	16.2	19.0	15.3	9852.4	
19.5	130.0	91.3	15.6	-4.5	10.0	3.4	129.8	69.7	3496.6	14.2	16.3	19.0	15.3	9496.6	
21.5	132.0	93.8	15.6	-6.0	10.3	3.3	131.8	71.9	3607.9	14.2	16.3	19.0	15.3	9607.9	
23.5	131.0	94.4	15.5	-8.5	11.5	3.3	139.8	73.1	3665.5	13.8	16.2	18.7	15.3	9665.5	
25.5	140.0	105.0	15.4	-10.8	12.5	3.3	139.8	62.8	3147.4	13.5	16.1	18.4	15.3	9147.4	
27.5	134.0	100.0	15.2	-18.5	15.0	3.2	133.8	74.3	3726.3				15.3	9726.3	
29.4	117.0	81.3	15.1	-27.5	17.8	3.2	116.8	93.2	4675.3				15.3	10675.3	
31.4	46.0	20.6	15.0	-50.0	33.0	4.0	45.9	159.5	7997.6				15.3	13997.6	
DISTANCE BARGE TRAVELLED								32.0							
DISTANCE ANCHOR TRAVELLED								31.4							

Note: Anchor depth at end of drag measured - centerline of shank at anchor crown = (-15) inches.

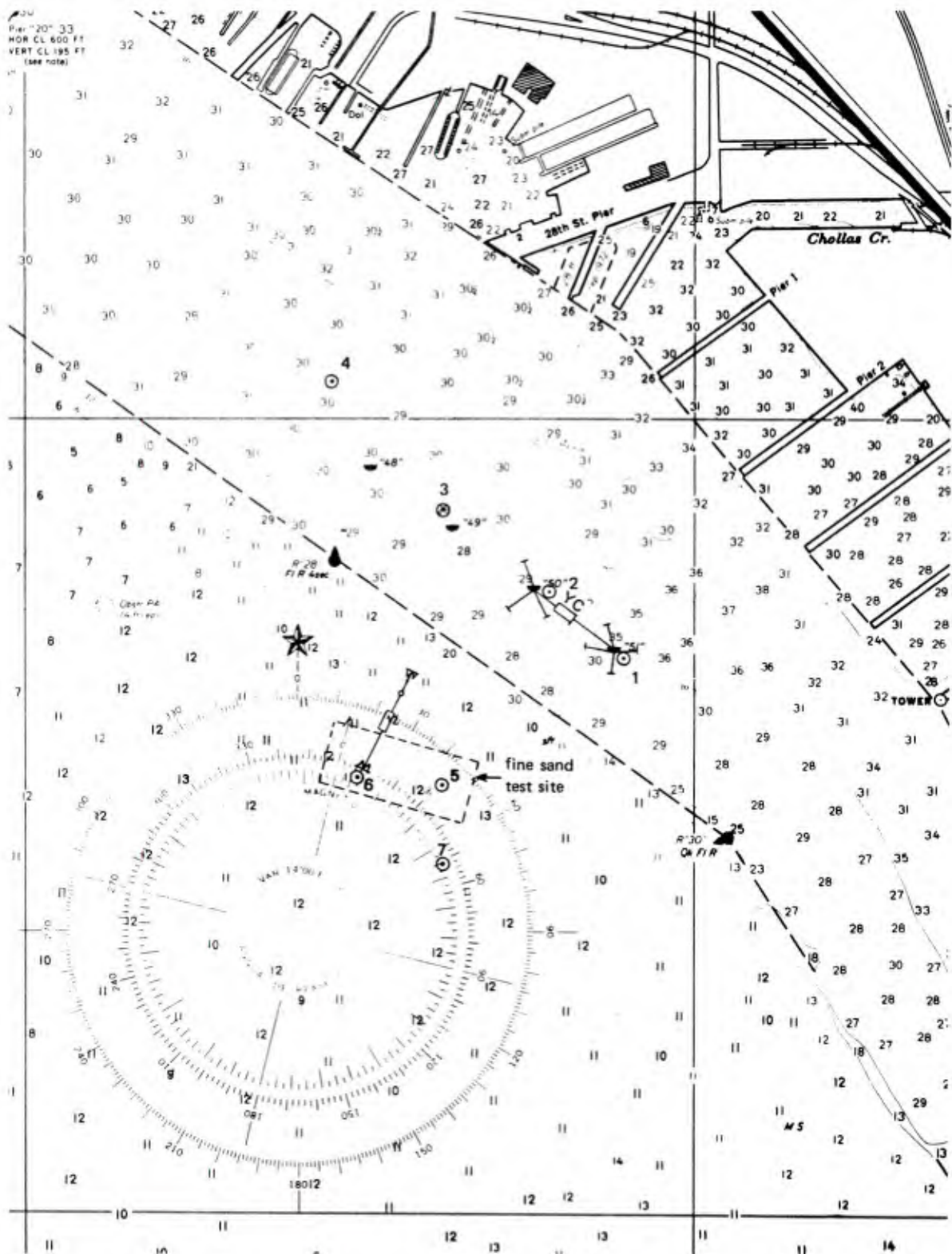


Figure 1. Test and core locations at San Diego Harbor - location 1.

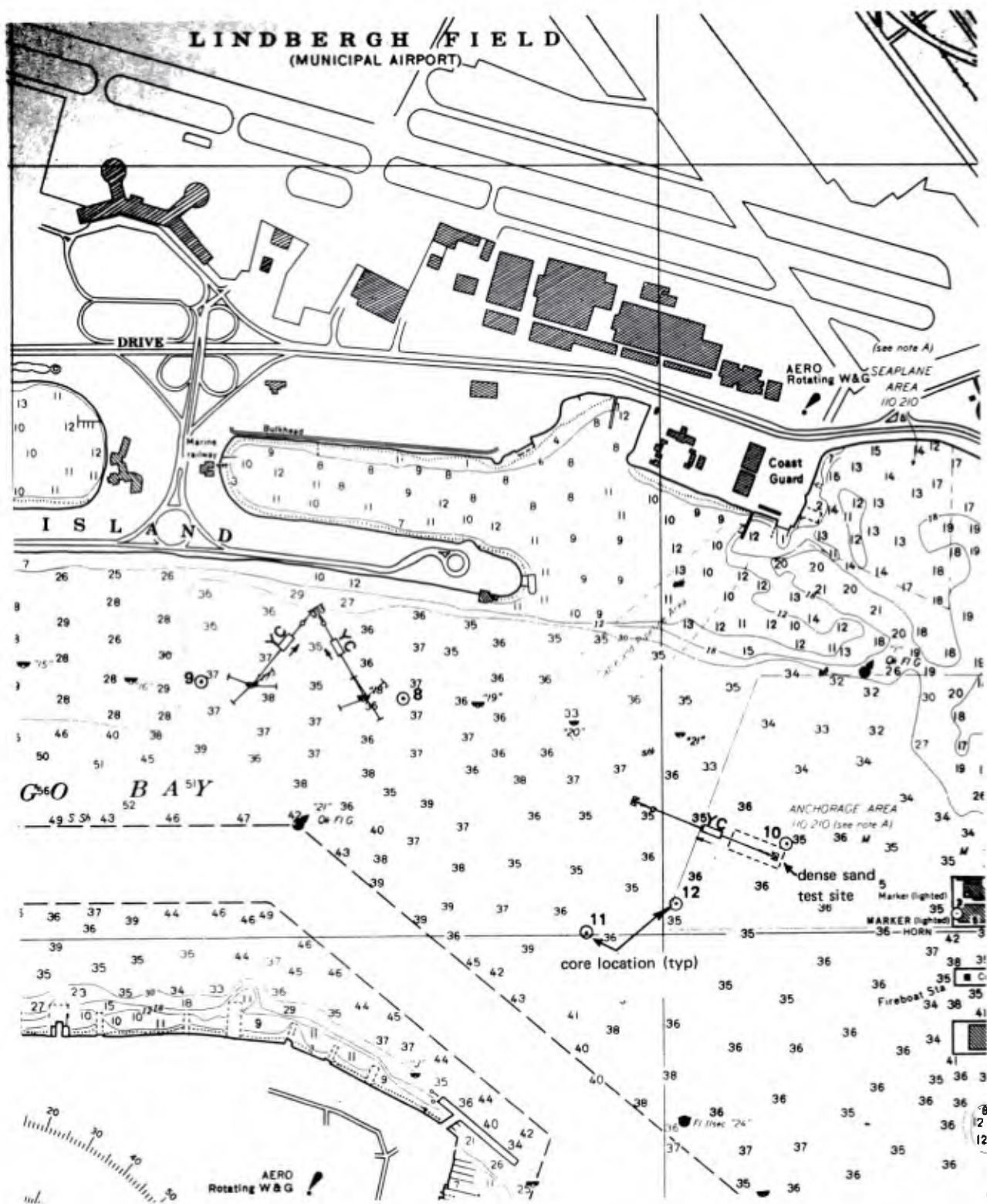


Figure 2. Test and core locations at San Diego Harbor - location 2.

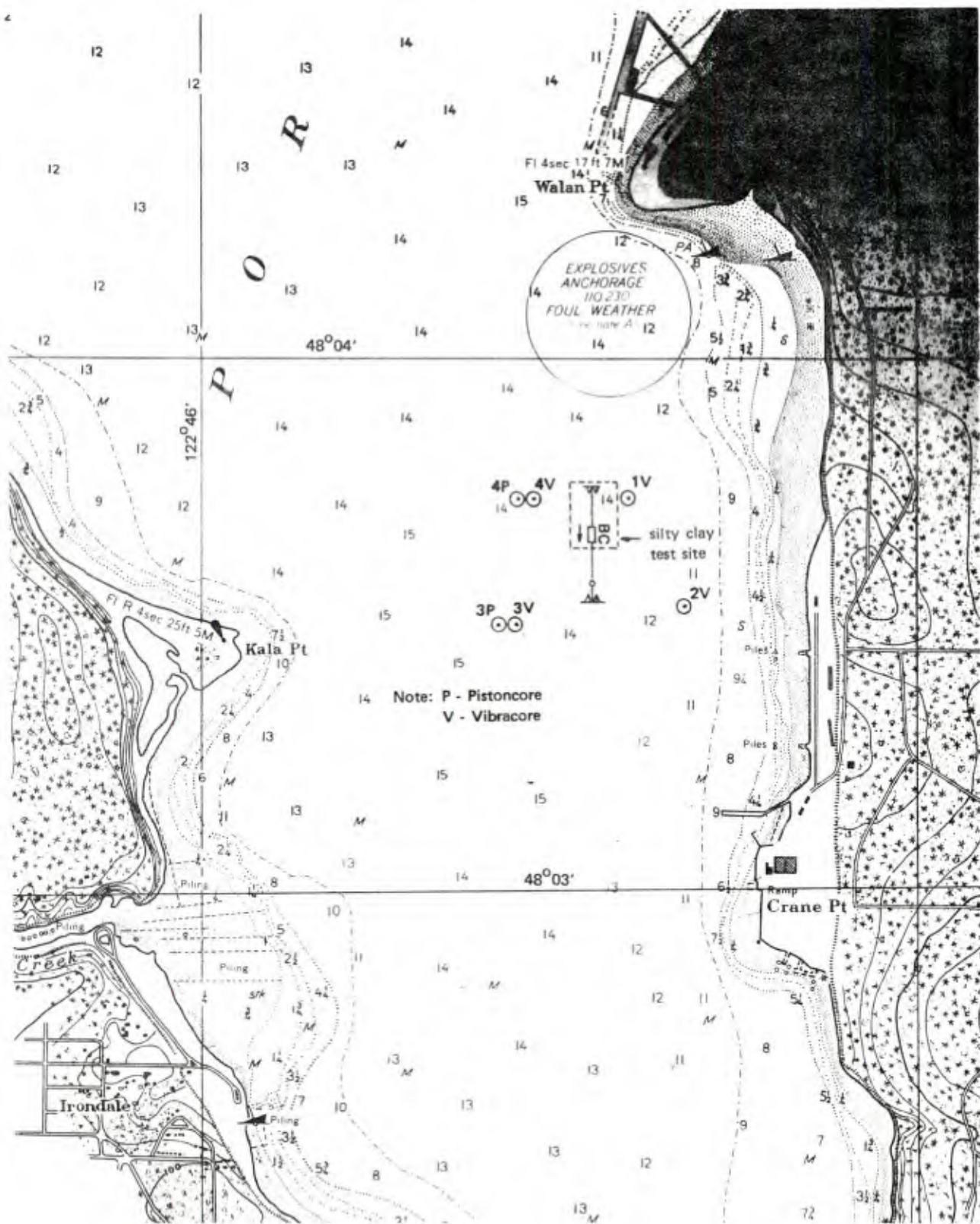


Figure 3. Test and core locations - Indian Island.

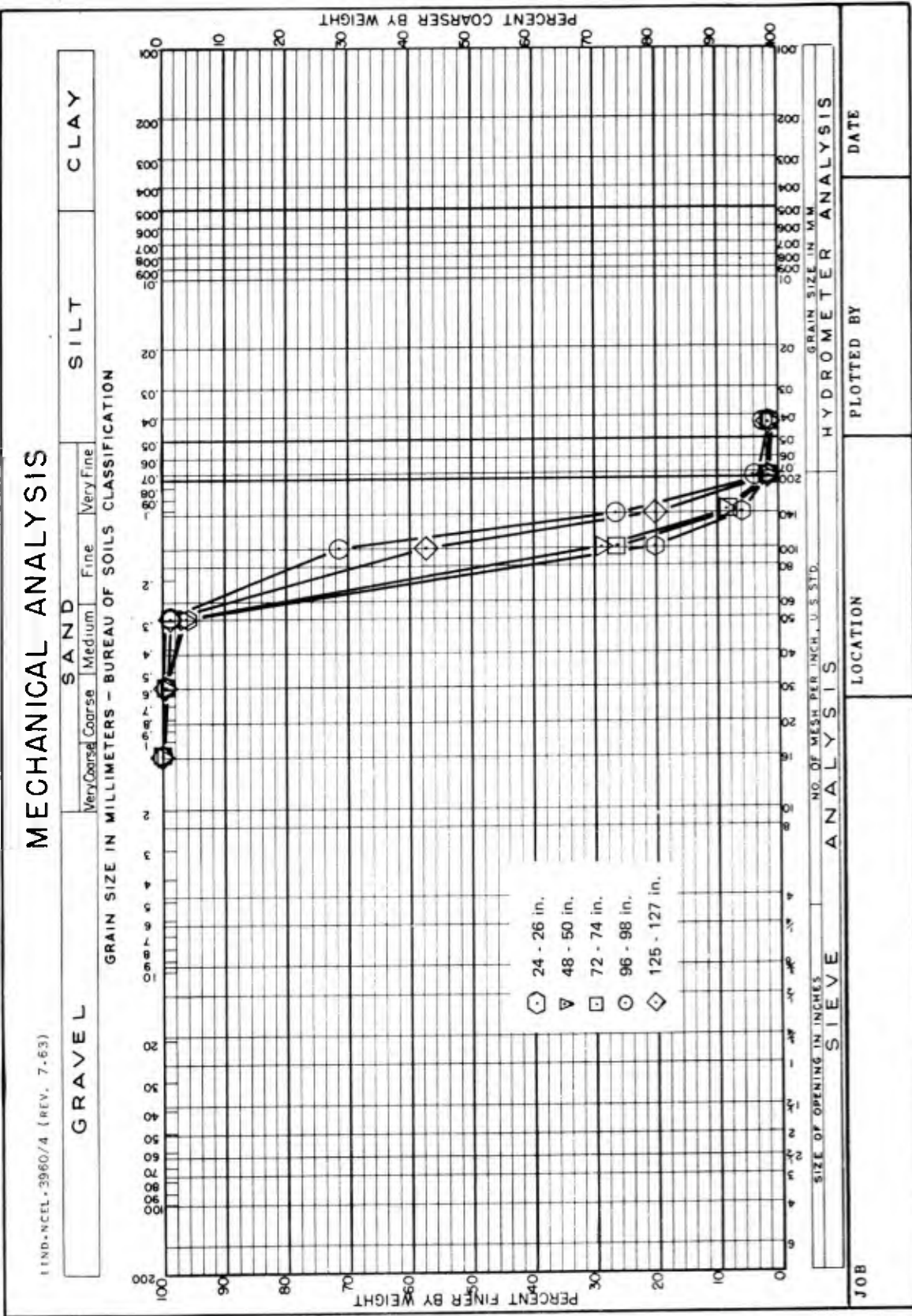


Figure 4. Grain size distribution curves for Vibracore 5 - San Diego Harbor.

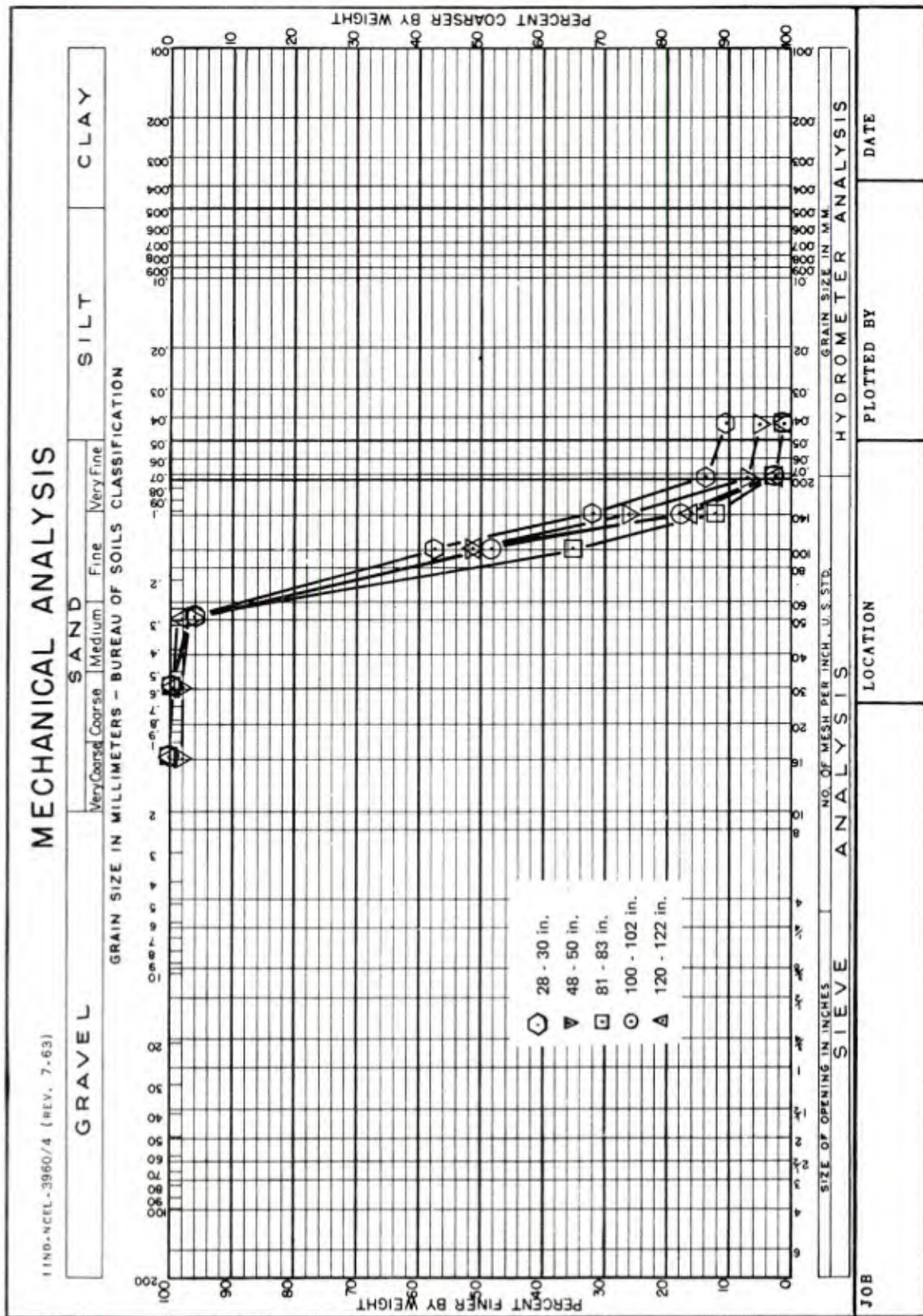


Figure 5. Grain size distribution curves for Vibracore 6 - San Diego Harbor.

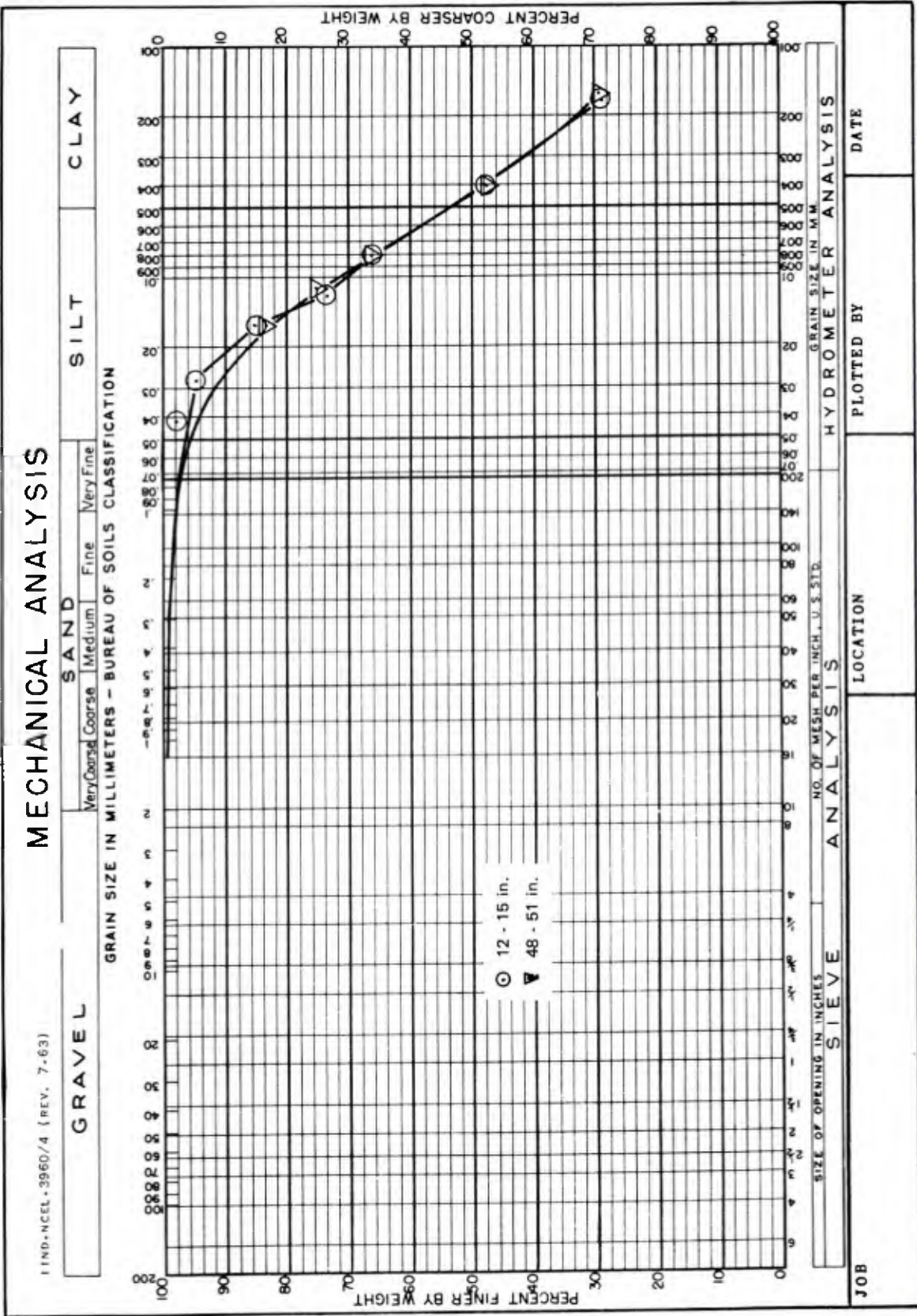


Figure 6. Grain size distribution curves for Vibracore 3 (12 to 51-inch penetration) - Indian Island.

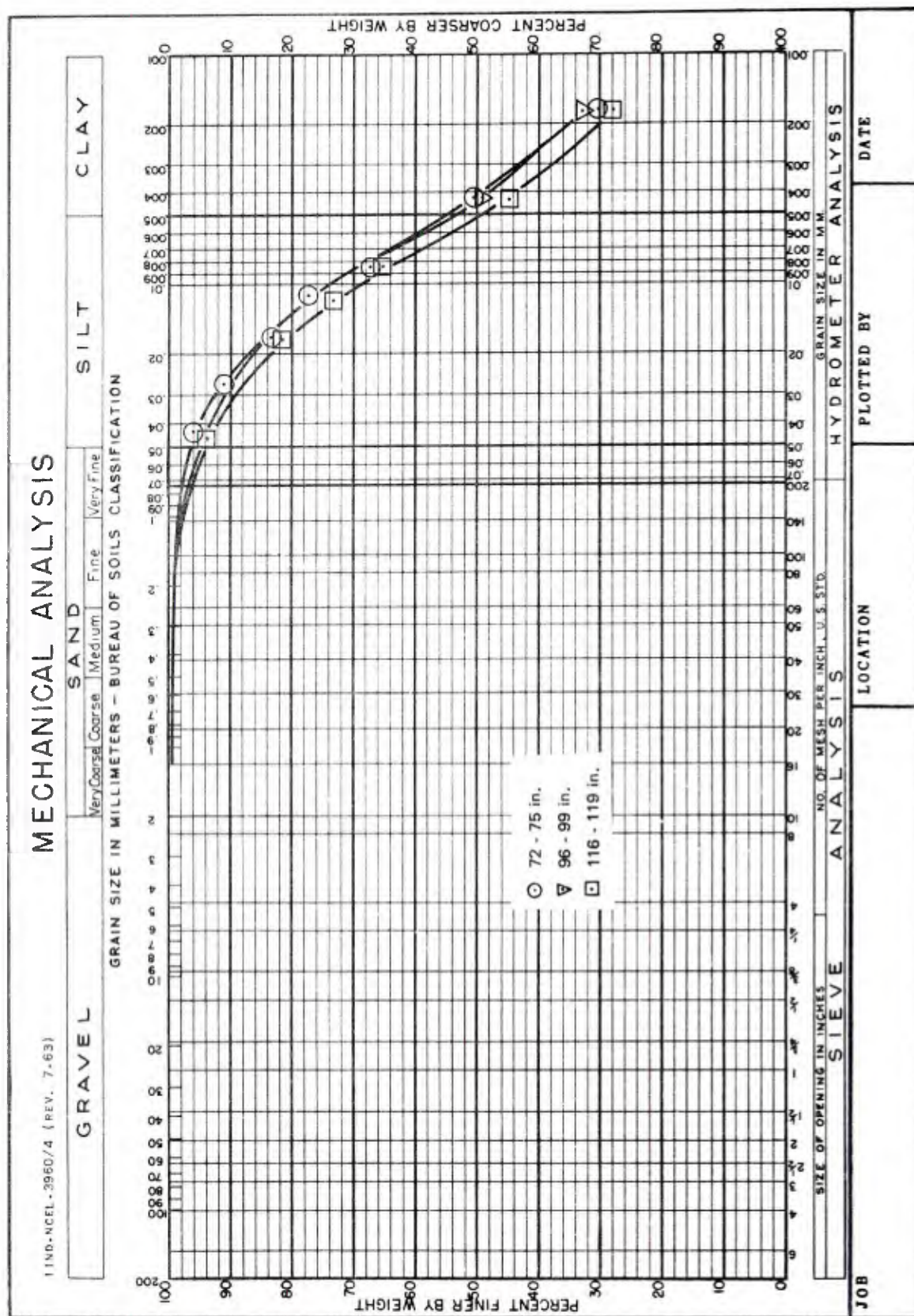
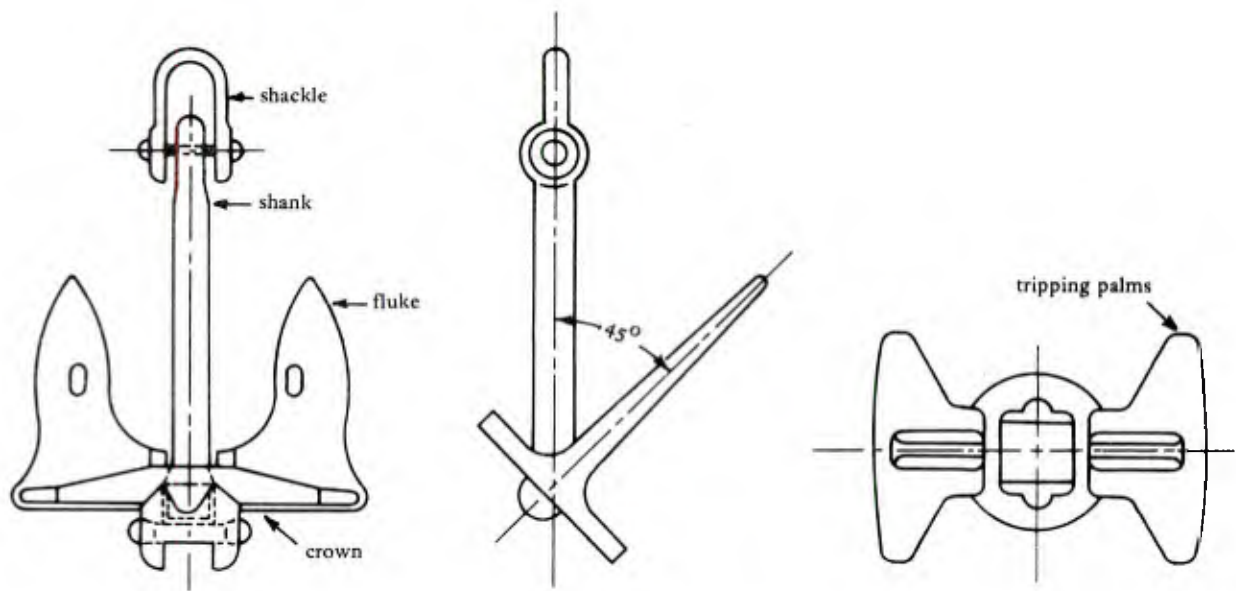


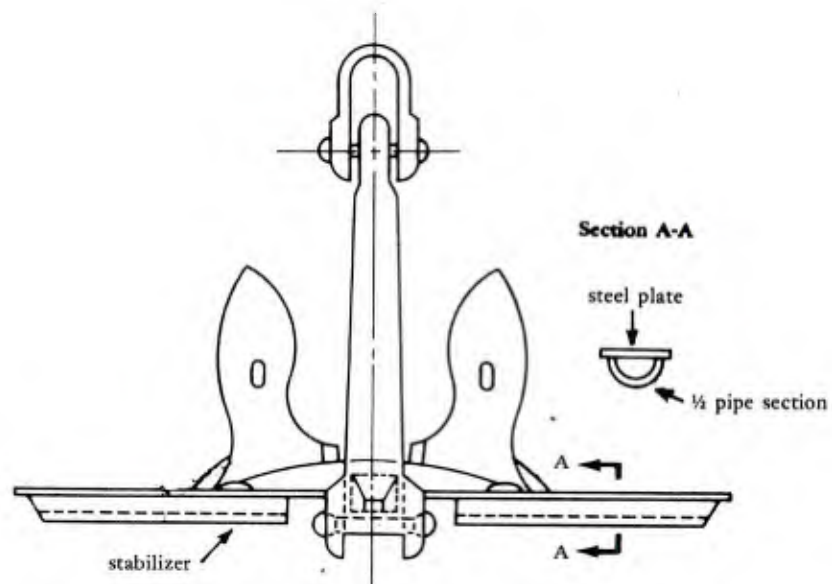
Figure 7. Grain size distribution curves for Vibracore 3 (72 to 119-inch penetration) - Indian Island.



Figure 8. Barge crane with all test anchors.



a. Navy Standard Stockless Anchor



b. Navy Stockless Anchor with Stabilizers

Figure 9. Navy Stockless anchor.



Figure 10. Navy standard Stockless anchor.

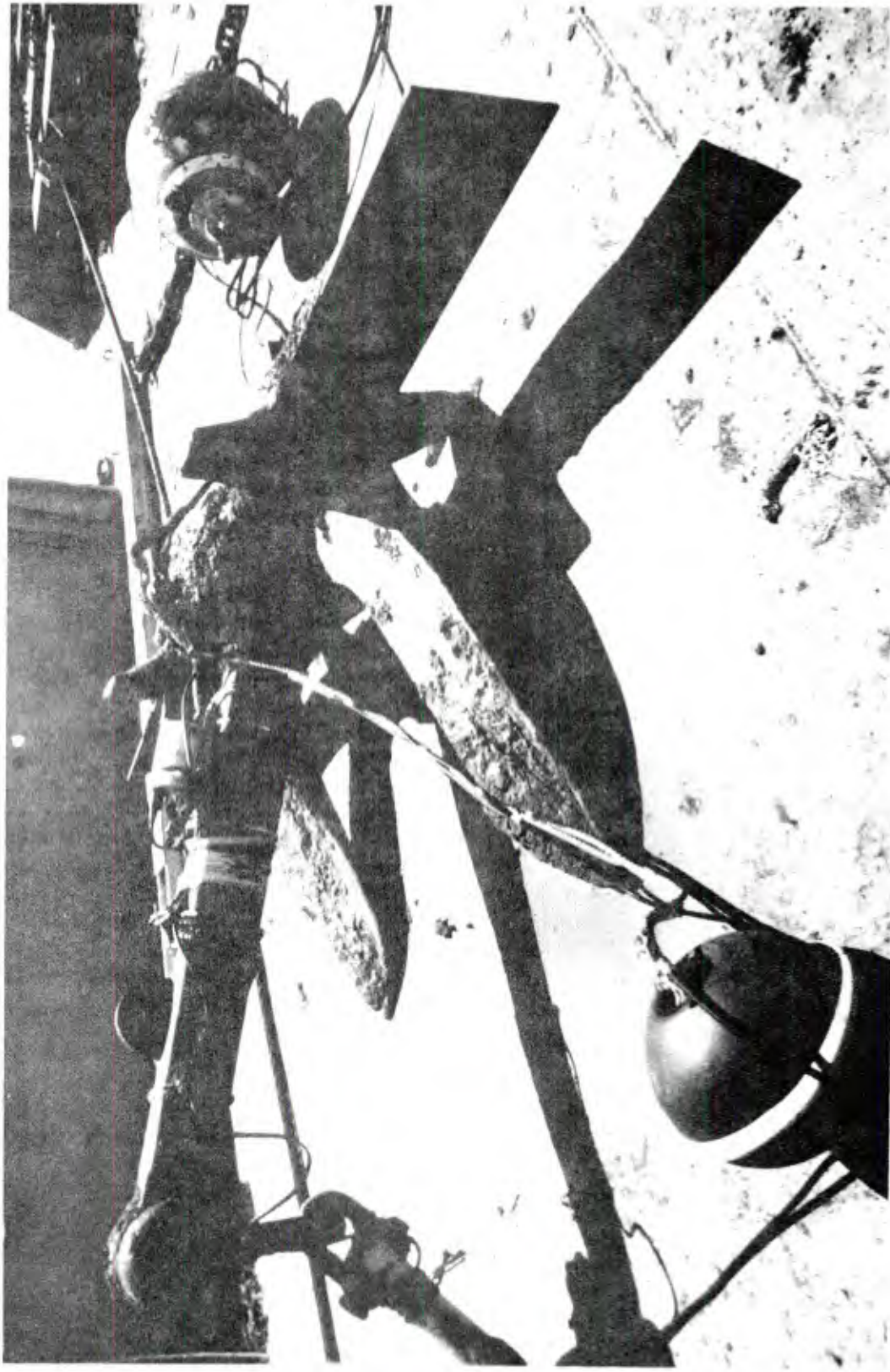


Figure 11. Navy Stockless anchor with stabilizers and welded-open flukes.

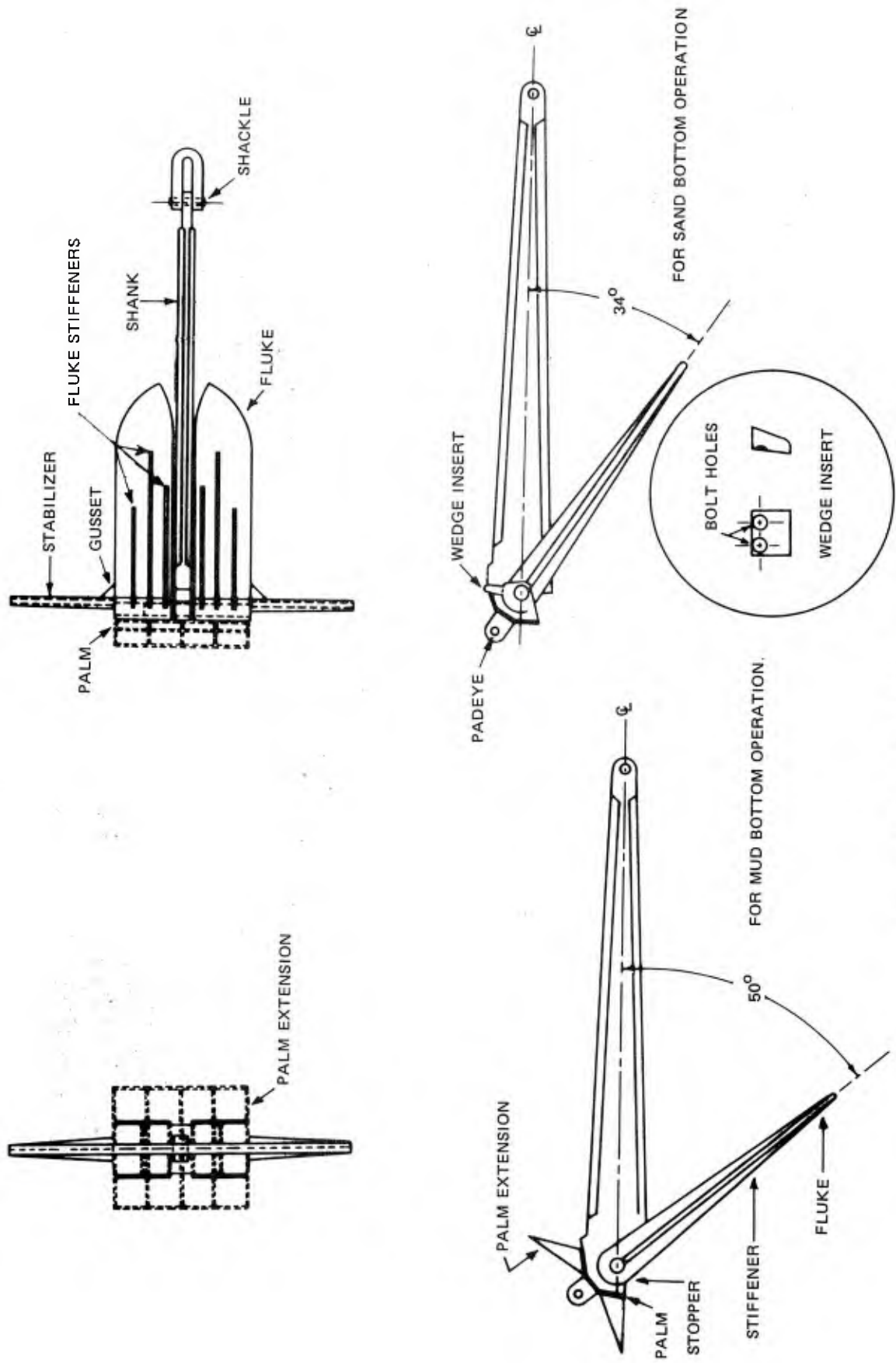


Figure 12. Navy STATO anchor.



Figure 13. Navy 6,000-pound STATO anchor.



Figure 14. Cast BRUCE anchor.

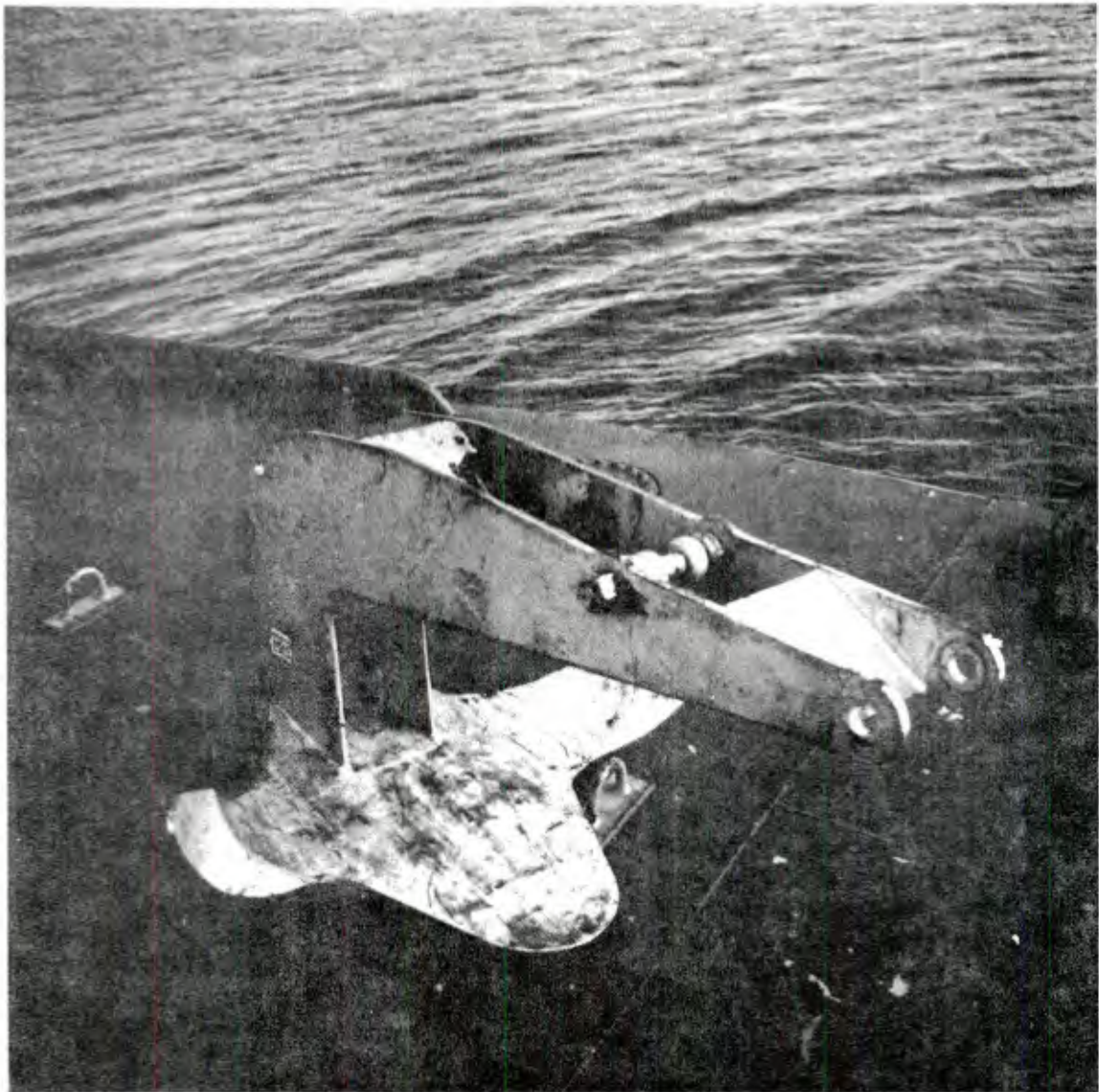


Figure 15. Welded BRUCE anchor.

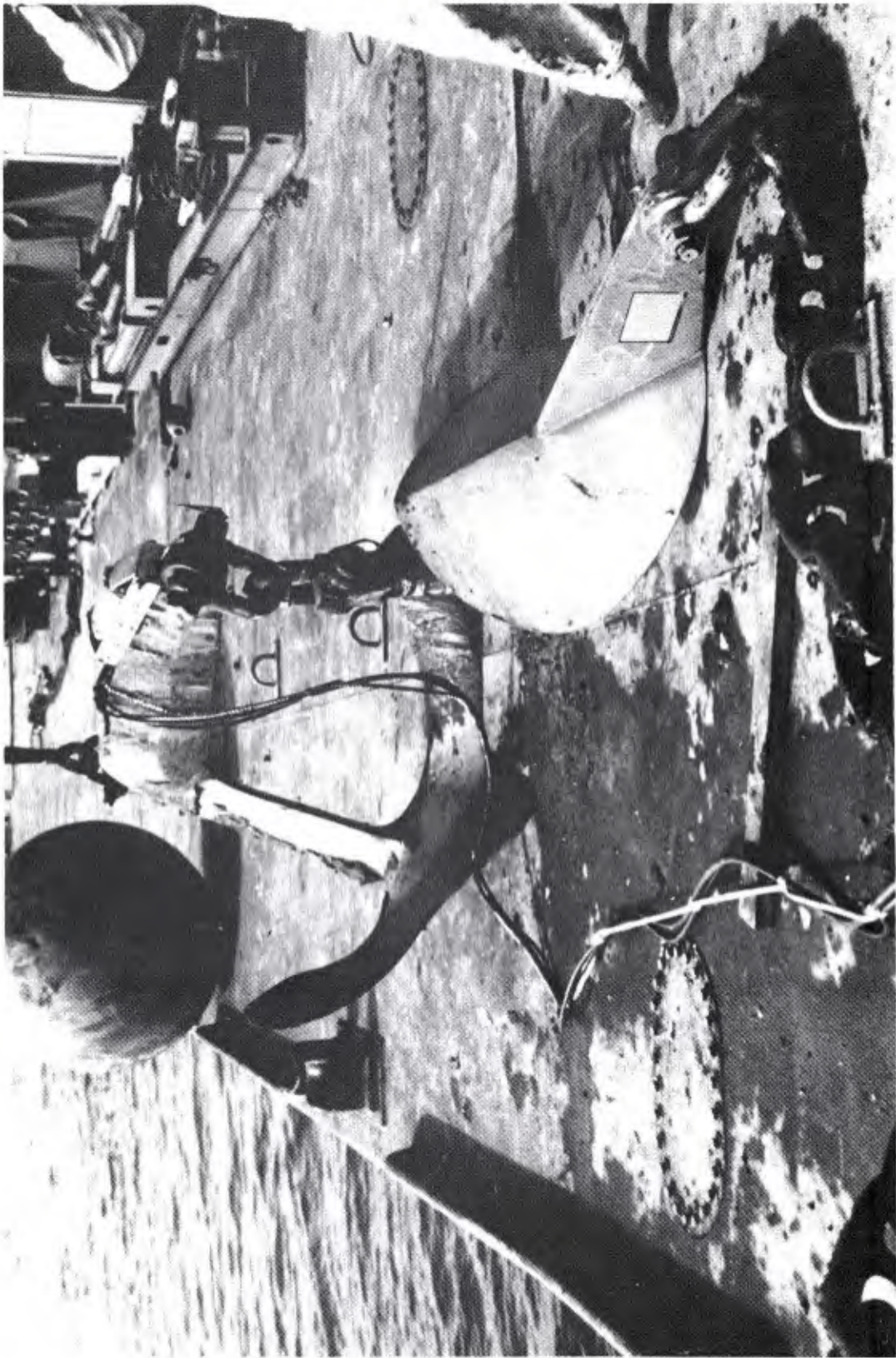


Figure 16. Cast BRUCE anchor with single cable depressor.



Figure 17. STEVDIG anchor.



Figure 18. STEVMUD anchor.



Figure 19. STEVFIX anchor without mud extensions.



Figure 20. Hook anchor.



Figure 21. Hook anchor with auxiliary flukes.

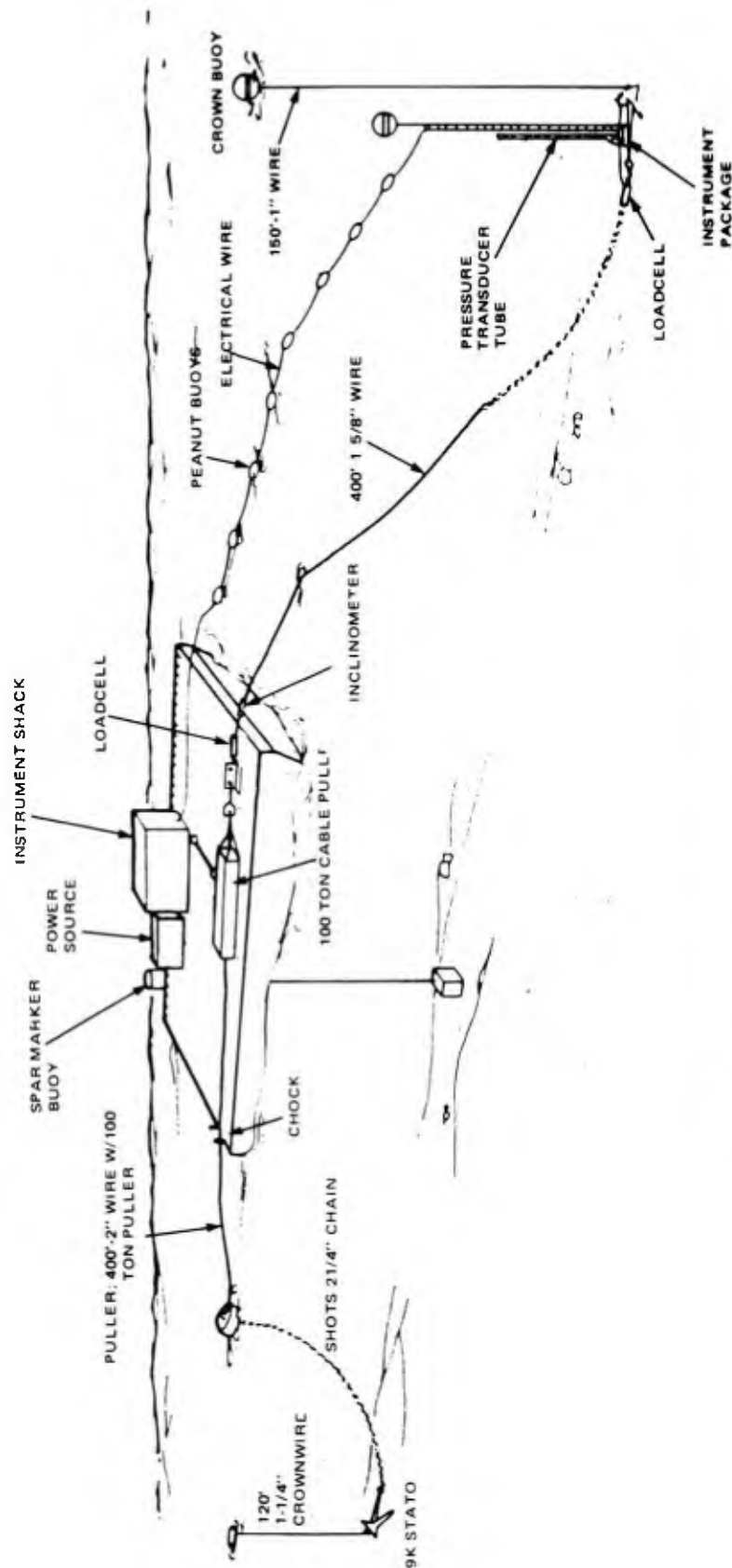


Figure 22. Anchor test setup showing major components.



Figure 23. Spar marker reference buoy.



a. San Diego System



b. Indian Island System

Figure 24. Underwater portion of test measurement system.



Figure 25. Test deck layout showing cable pulling system and prerigged test wire.

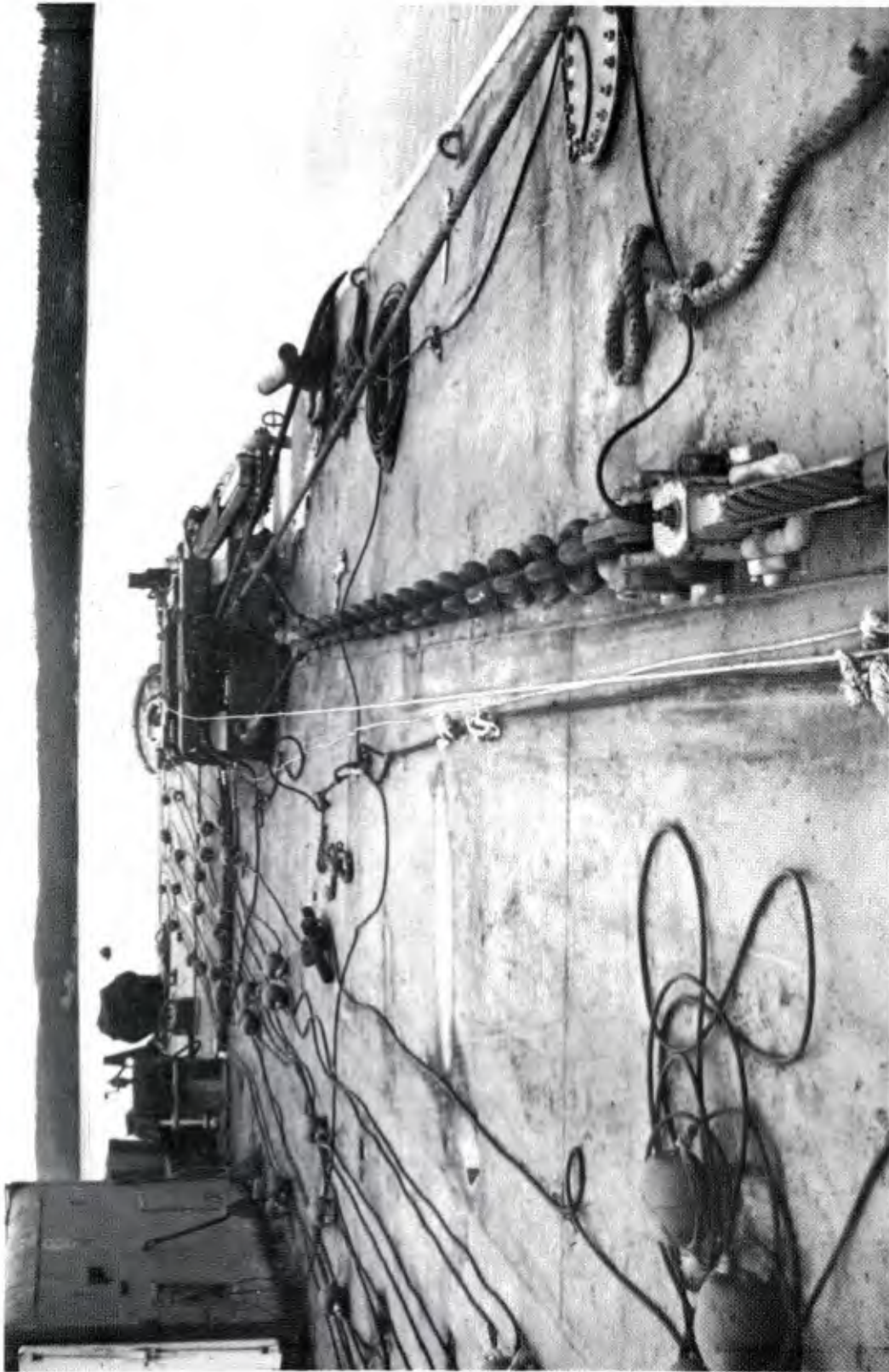


Figure 26. Test deck layout showing deck load cell, cable puller and faked electrical test wire.

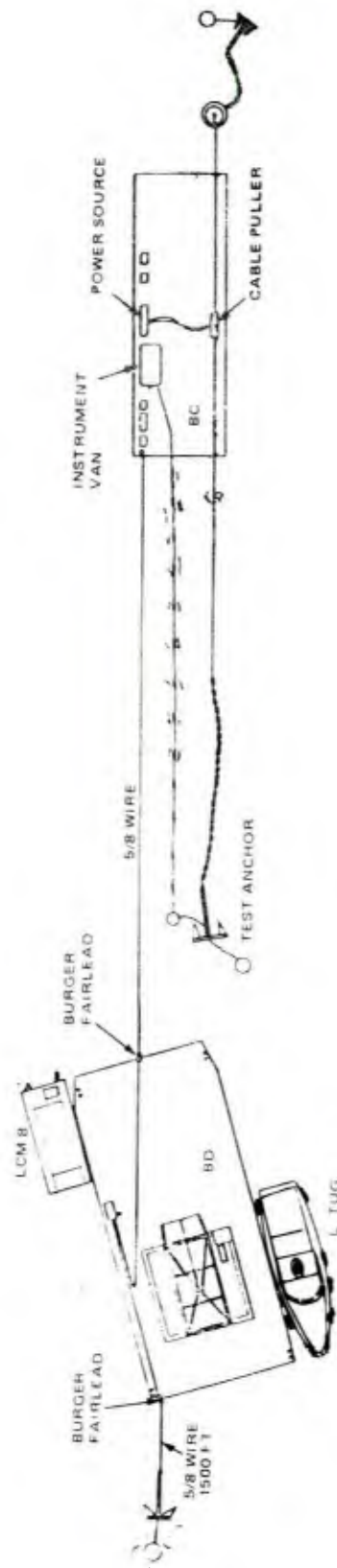


Figure 27. Overall test layout - single and tandem anchor tests.

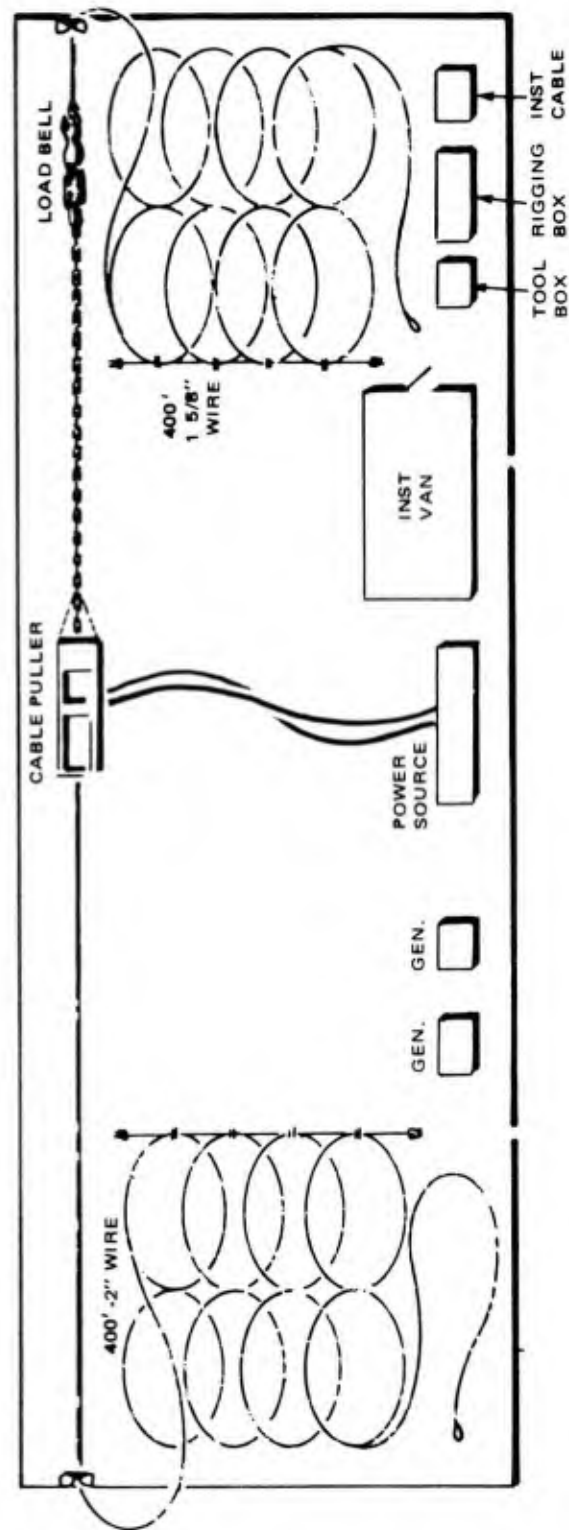


Figure 28. Barge layout for anchor test.

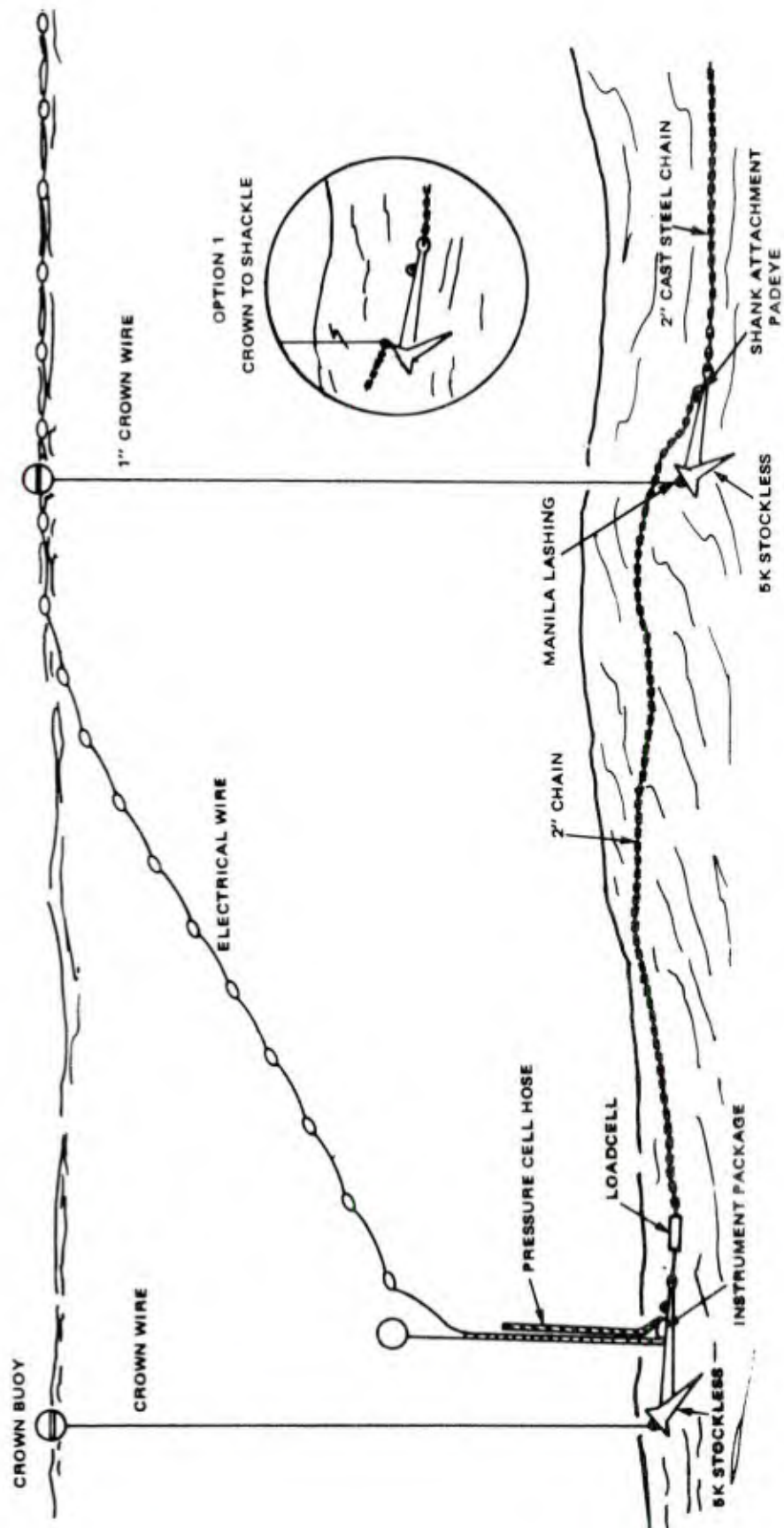


Figure 29. Tandem anchor test setup for shank-to-shackle and crown-to-shackle techniques.

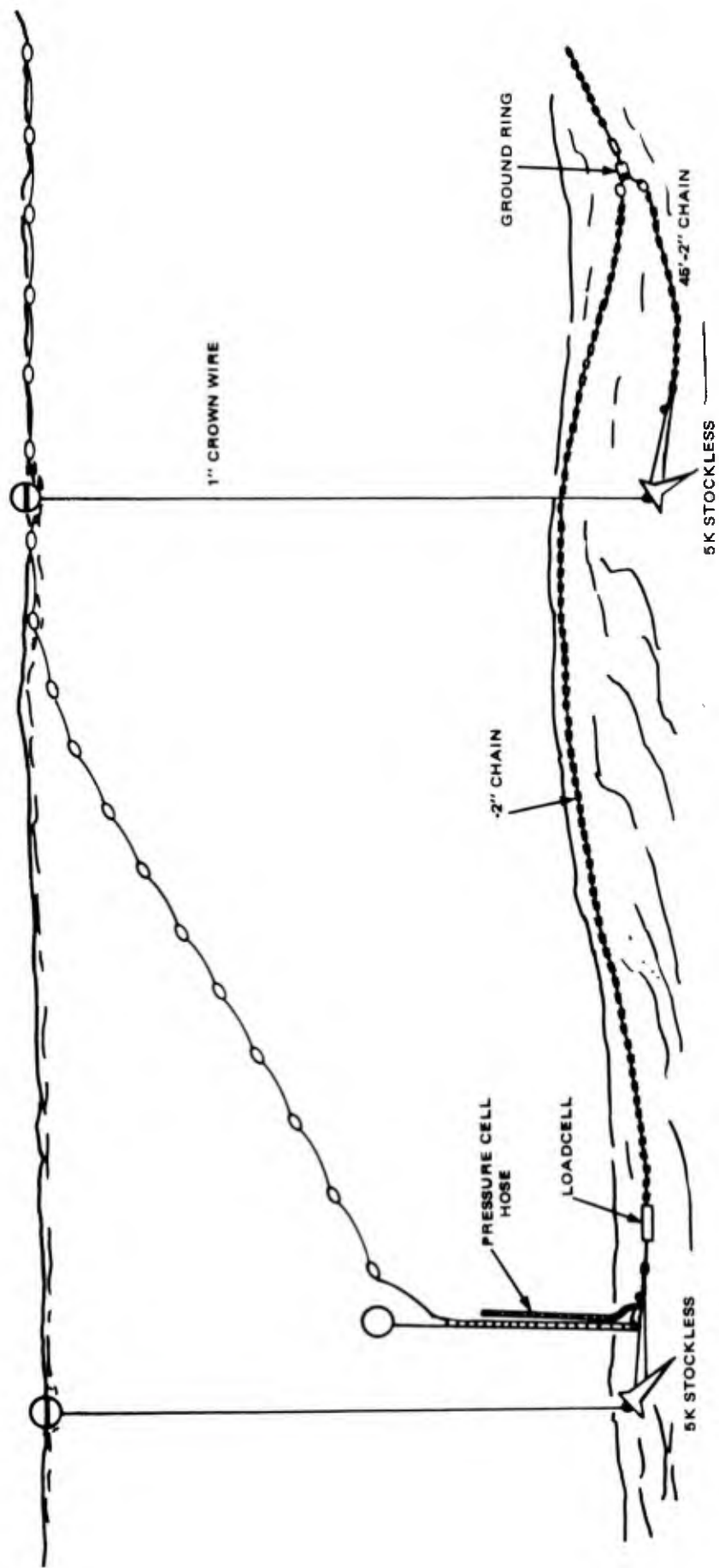
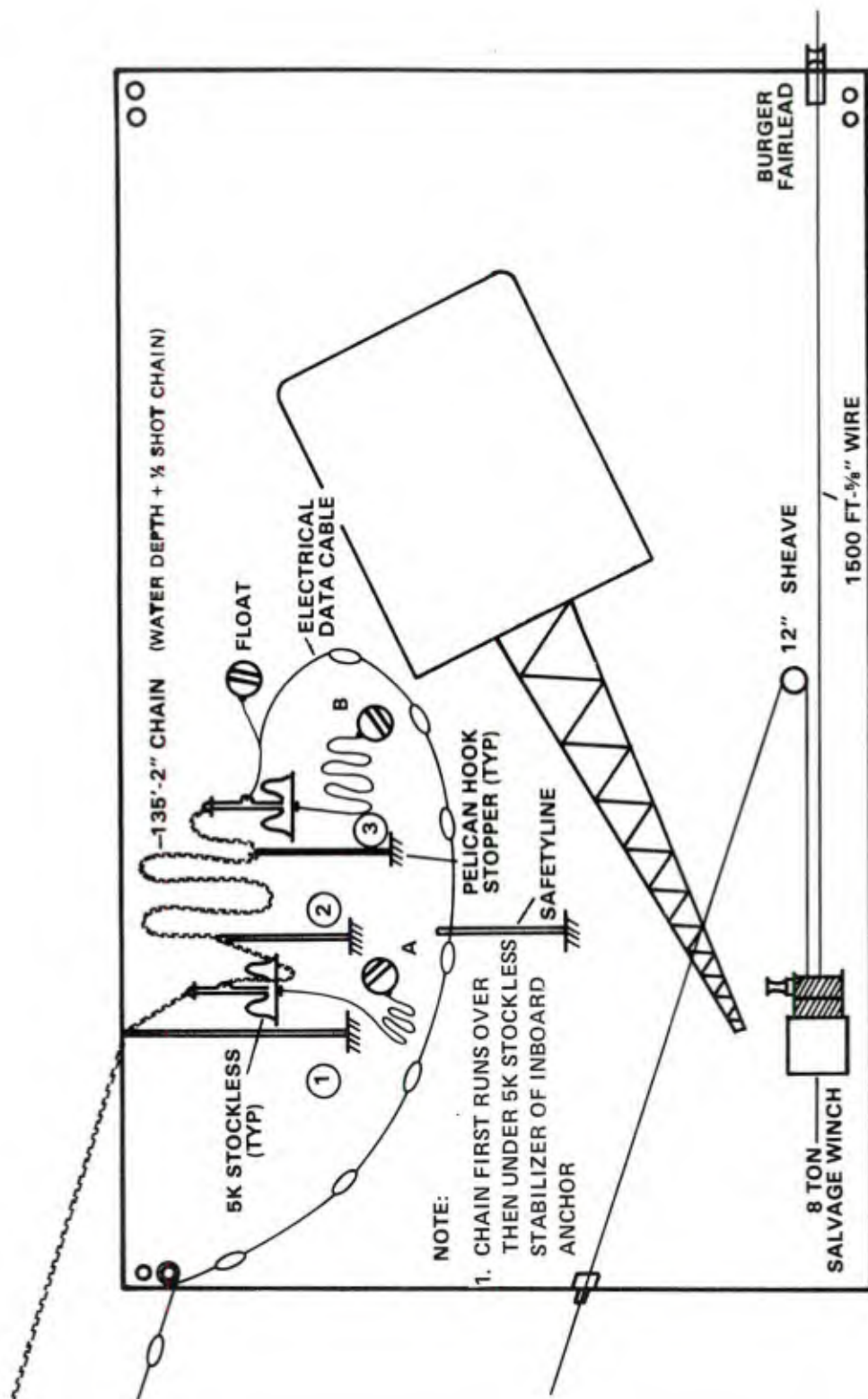


Figure 30. Tandem anchor test setup "ground ring to shackle" technique.



a. Plan view of crane barge.

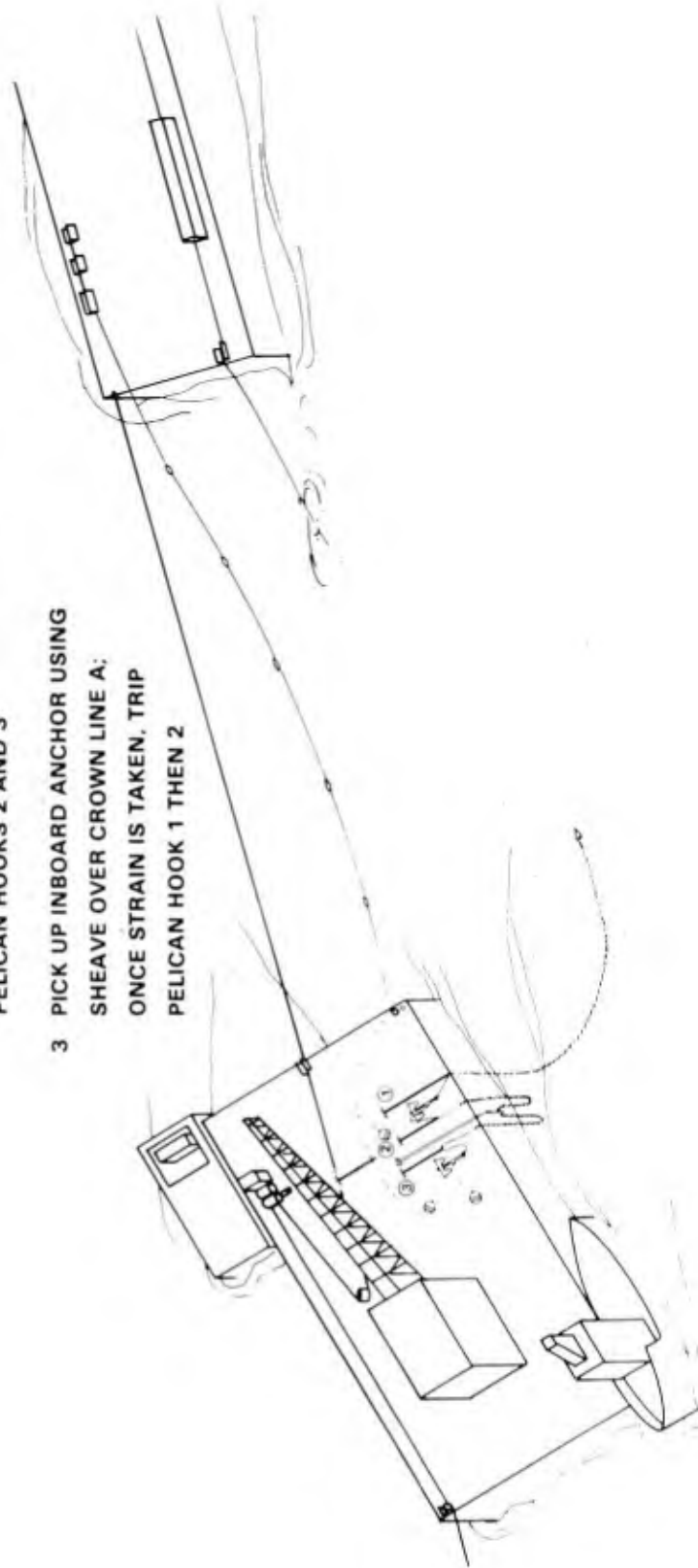
Figure 31. Tandem anchor deployment method used at Indian Island at 90-foot water depth.

2 LIFT TANDEM CHAIN USING

**2-PART SYNTHETIC THRU CHAIN AND PLACE
CHAIN OVER THE SIDE STILL STRAINED BY
PELICAN HOOKS 2 AND 3**

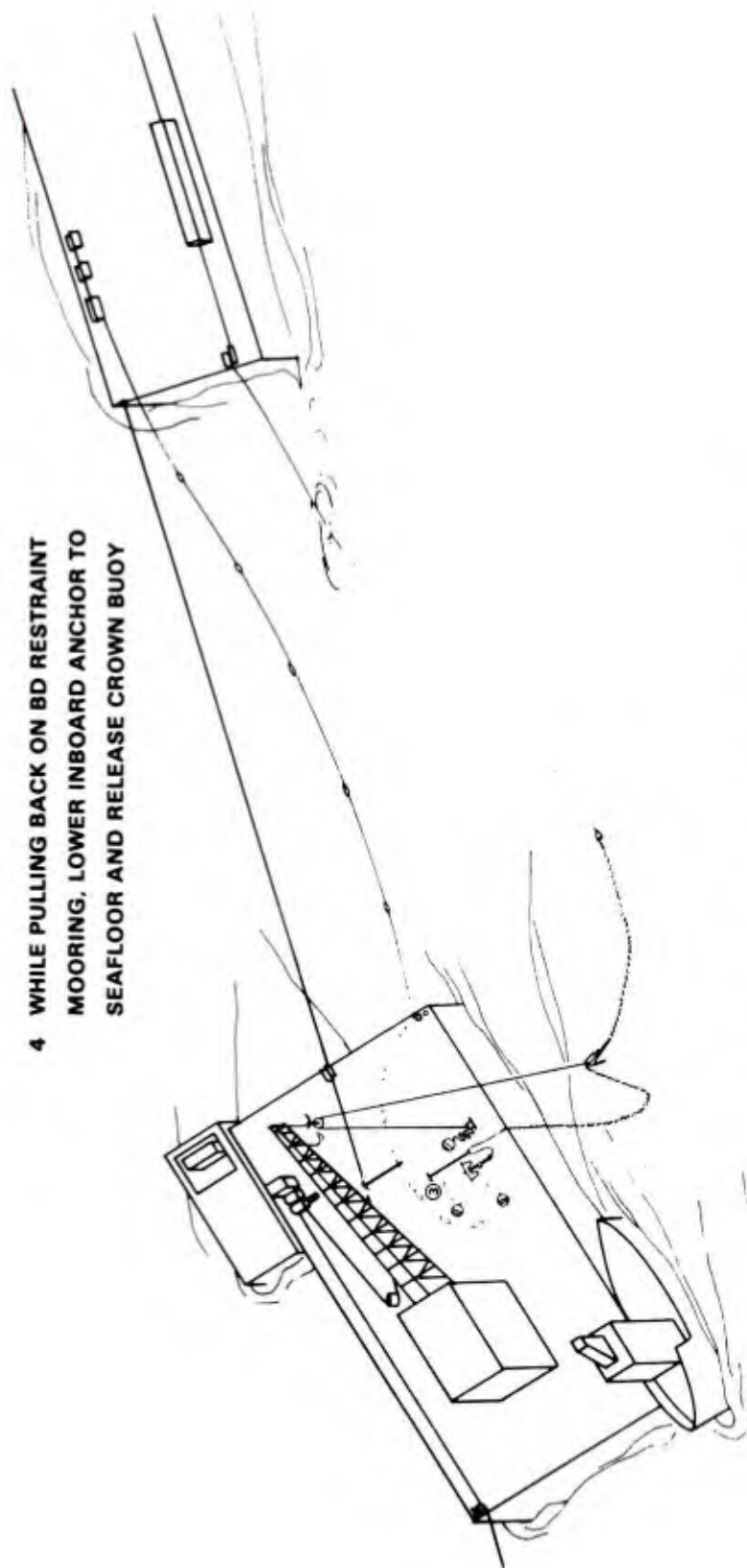
3 PICK UP INBOARD ANCHOR USING

**SHEAVE OVER CROWN LINE A;
ONCE STRAIN IS TAKEN, TRIP
PELICAN HOOK 1 THEN 2**



b. Beginning anchor deployment.

Figure 31. Continued.



4 WHILE PULLING BACK ON BD RESTRAINT
MOORING, LOWER INBOARD ANCHOR TO
SEAFLOOR AND RELEASE CROWN BUOY

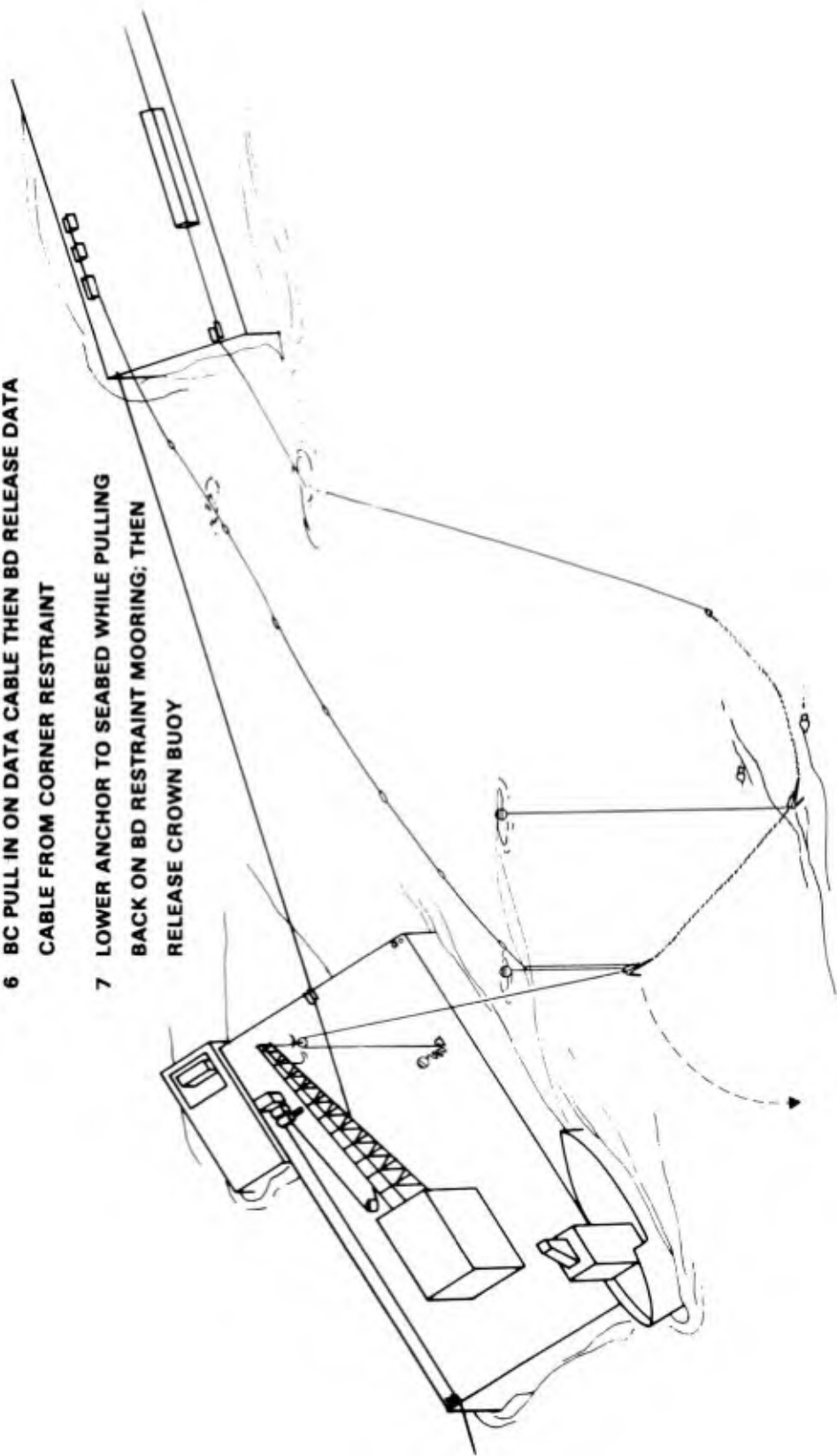
c. Lowering inboard anchor to seafloor and releasing crown buoy.

Figure 31. Continued.

**5 PICK UP ON OTHER ANCHOR USING SHEAVE OVER CROWN WIRE
THEN RELEASE PELICAN HOOK 3**

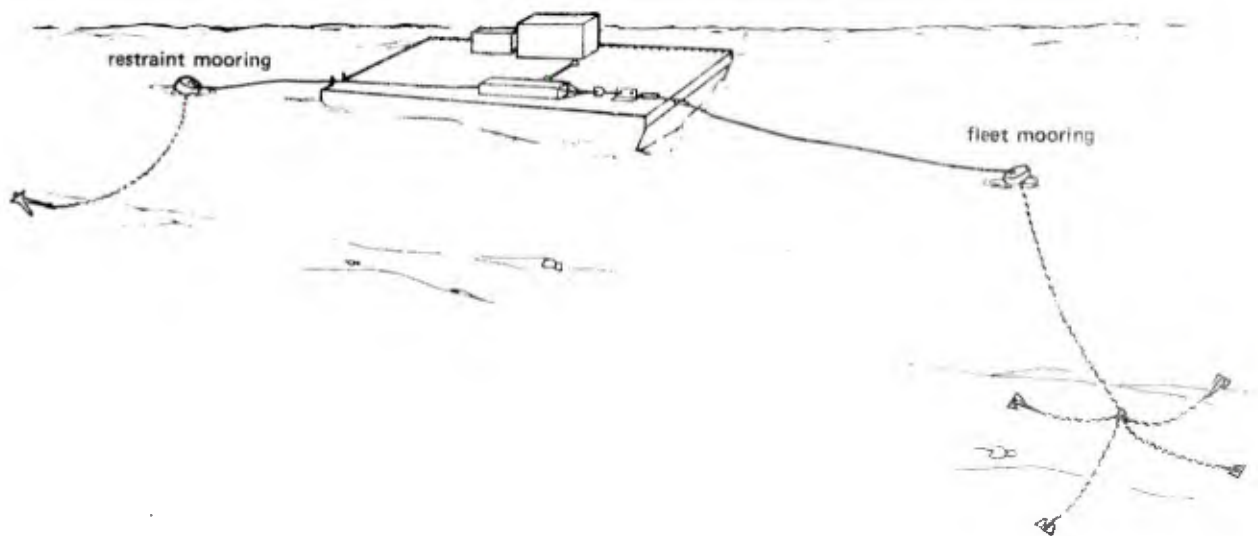
**6 BC PULL IN ON DATA CABLE THEN BD RELEASE DATA
CABLE FROM CORNER RESTRAINT**

**7 LOWER ANCHOR TO SEABED WHILE PULLING
BACK ON BD RESTRAINT MOORING; THEN
RELEASE CROWN BUOY**

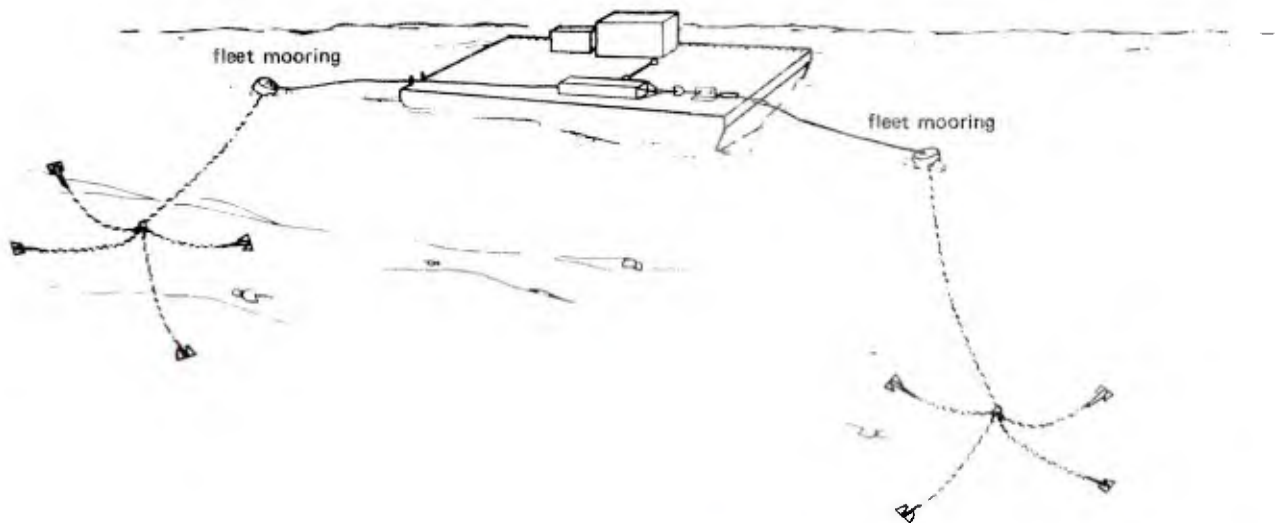


d. Completing anchor deployment.

Figure 31. Continued.



a. Single mooring test pull.



b. Dual mooring test pull.

Figure 32. Mooring test arrangements.

Day # - 176

Test No. - 23

Test Series No. - 0

INDIAN ISLAND WASHINGTON

state , 3000lbs. with 18 inch stabilizer extensions

silt

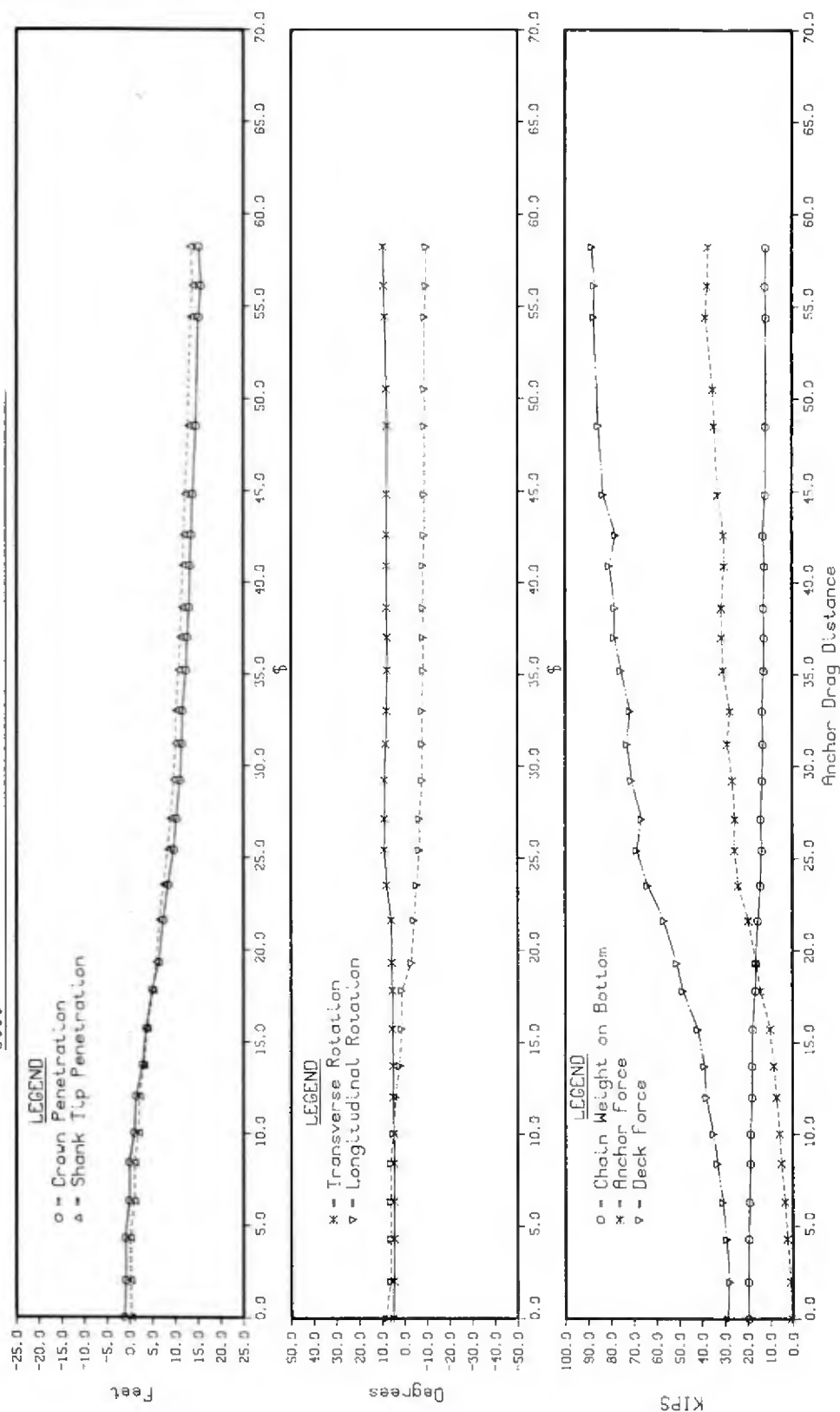


Figure 33. Typical data plot for anchor test pull.



Figure 34. STATO anchor with extended stabilizers attached (standard stabilizer on deck).



Figure 35. STATO anchor with plate addition between shank and wedge insert to reduce fluke angle to about 32 degrees.

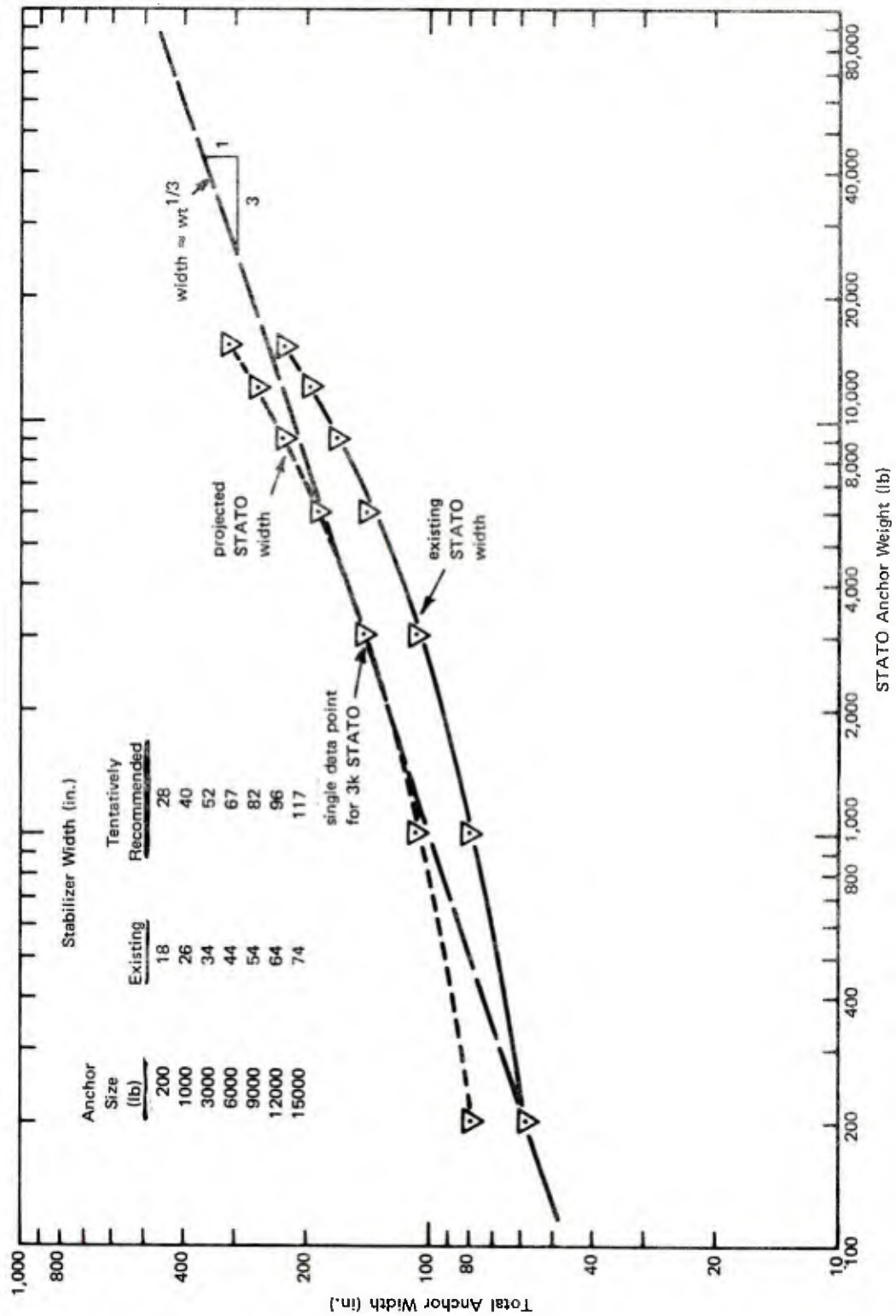


Figure 36. Recommendations for STATO anchor stabilizer lengths.

Appendix A

ADDITIONAL SAN DIEGO HARBOR SEAFLOOR PROPERTIES

Twelve vibracores were taken at San Diego. Of these, only eight cores were analyzed. Principally, San Diego Harbor consists of medium to fine sand with up to 2 to 3 feet of overlying mud in the dredged areas near the moorings (refer to Figures 1 and 2). The shallow area located primarily south of the dredge channel shown in Figure 2 is a uniform fine sand with no detectable surface mud layer. Grain size curves for cores SDV5 and SDV6 (Figures 6 and 7 in the main text) show the extremely uniform nature of the area.

Grain size curves for the remaining six cores are presented as Figures A-1 through A-6. Cores 1, 2, 3, 8, and 9 were taken near prospective moorings and typically show medium to fine sand at expected anchor fluke embedment depths. Cores 10, 11, and 12 were taken to locate an expected soft mud site; however, one was not located. Core 12 was a very uniform, fine-grained sand to 20 feet; it was not analyzed in detail. Cores 10 and 11 showed a very competent strata at 3 to 4 feet below the mud surface. This layer is practically impenetrable to standard ship anchors, yet it is classified as the anchorage area for commercial vessels. The 45- to 47-inch increment of core 10 (Figure A-6) represents the dense clayey sand.

Also provided in this section are plots of accumulative time versus vibracorer penetration depth for several apparently distinct areas (Figures A-7 through A-10). These curves are probably meaningless much below 5 to 7 feet, but they do offer insight into the variability, relative stiffnesses, and sensitivities of certain areas. In particular, Figure A-8 should be noted for cores 5, 6, and 7 at the fine sand test site. The curves are practically superimposed, lending further credence to the uniformity of the fine sand test site.

Figure A-11 provides recent vane shear data for Indian Island mud gathered with a bottom-sitting platform. Shear strength increases almost linearly from zero at the surface to 1-1/2 psi at 21 feet. Remolded shear strength readings were taken at only two depths. These data show a relatively insensitive soil where the ratio of undisturbed to disturbed strength was 1.6 at 7 feet and 2.1 at 10 feet.

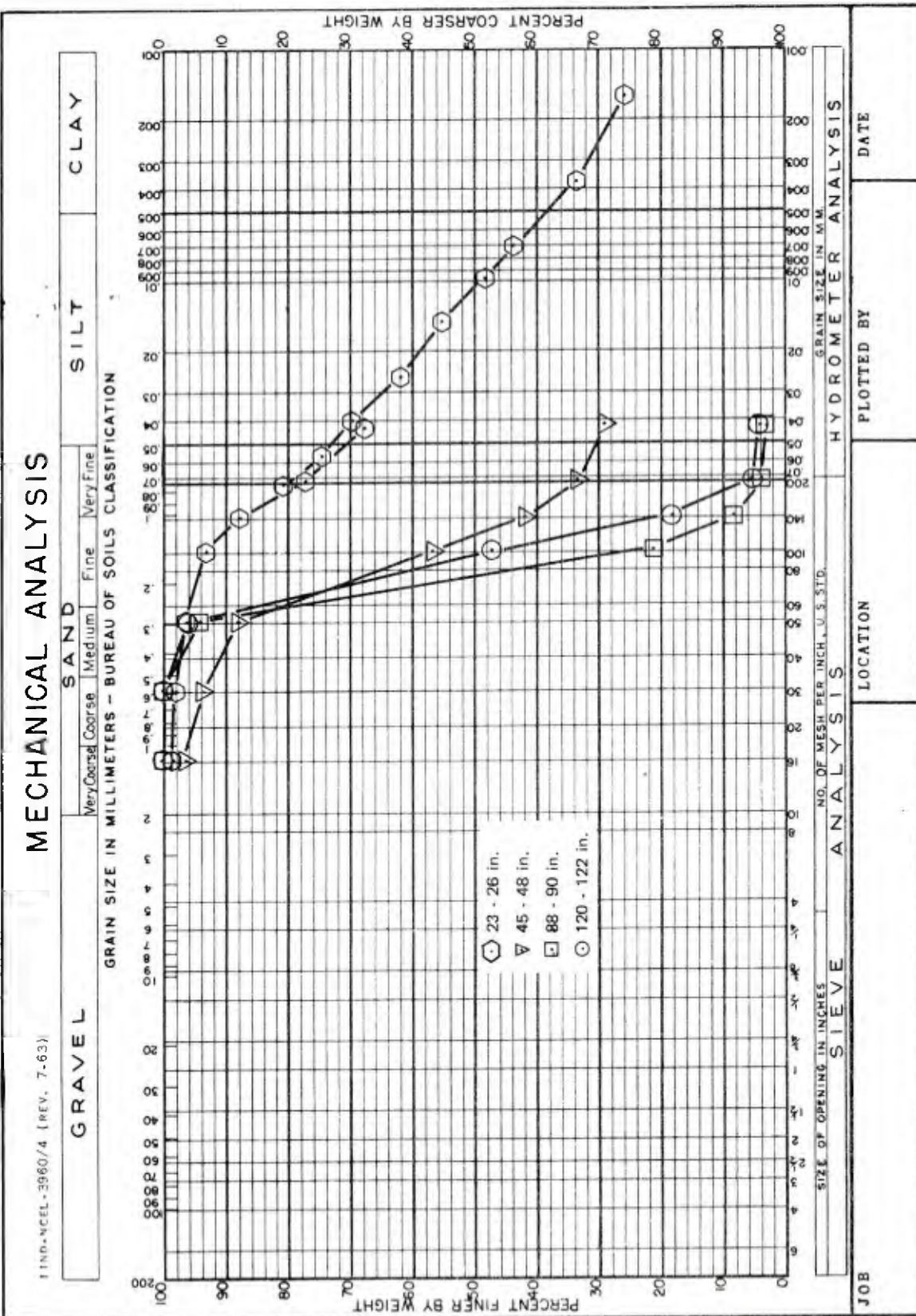


Figure A-1. Grain size distribution curves for Vibracore 1 - San Diego Harbor.

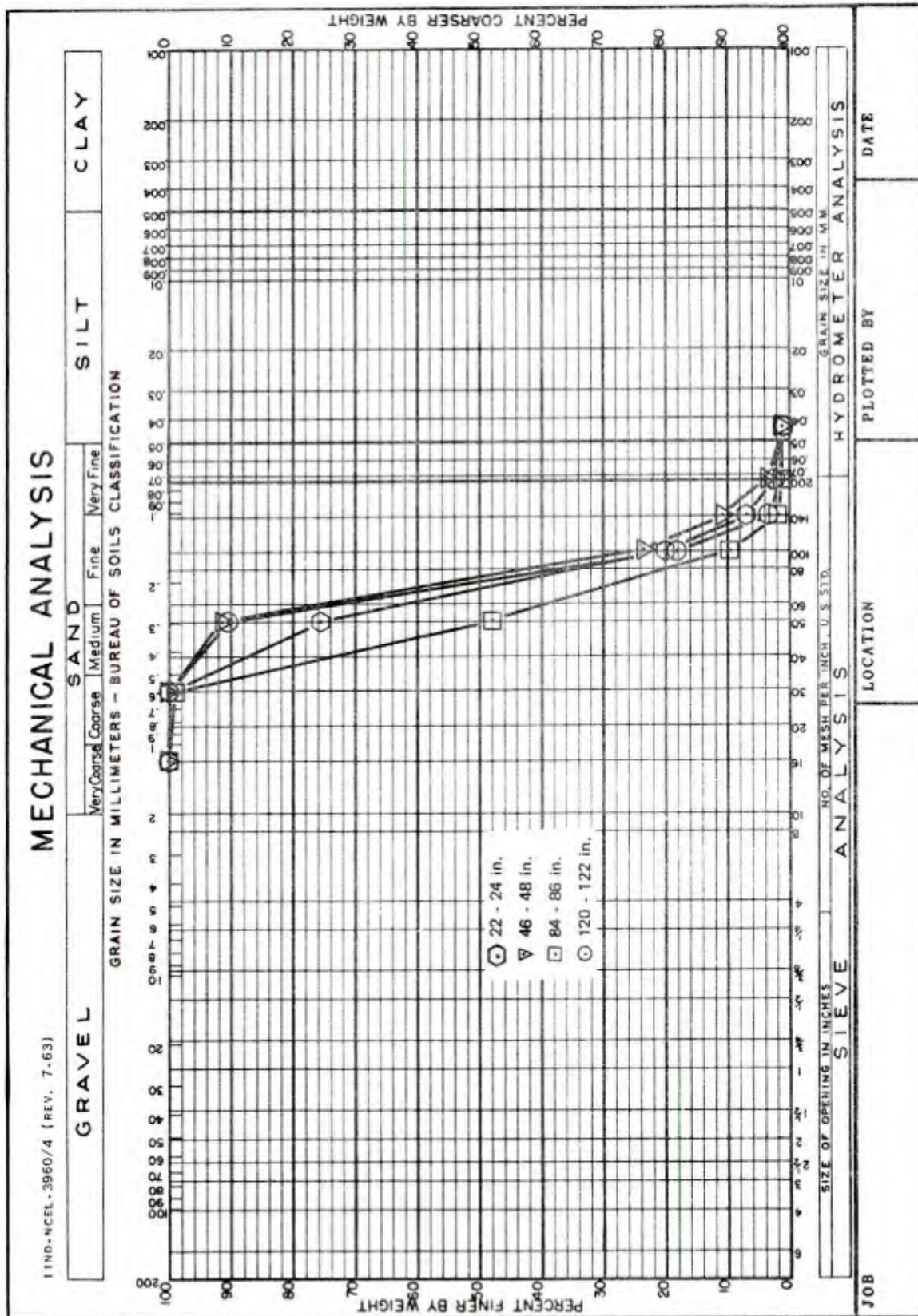


Figure A-2. Grain size distribution curves for Vibracore 2 - San Diego Harbor.

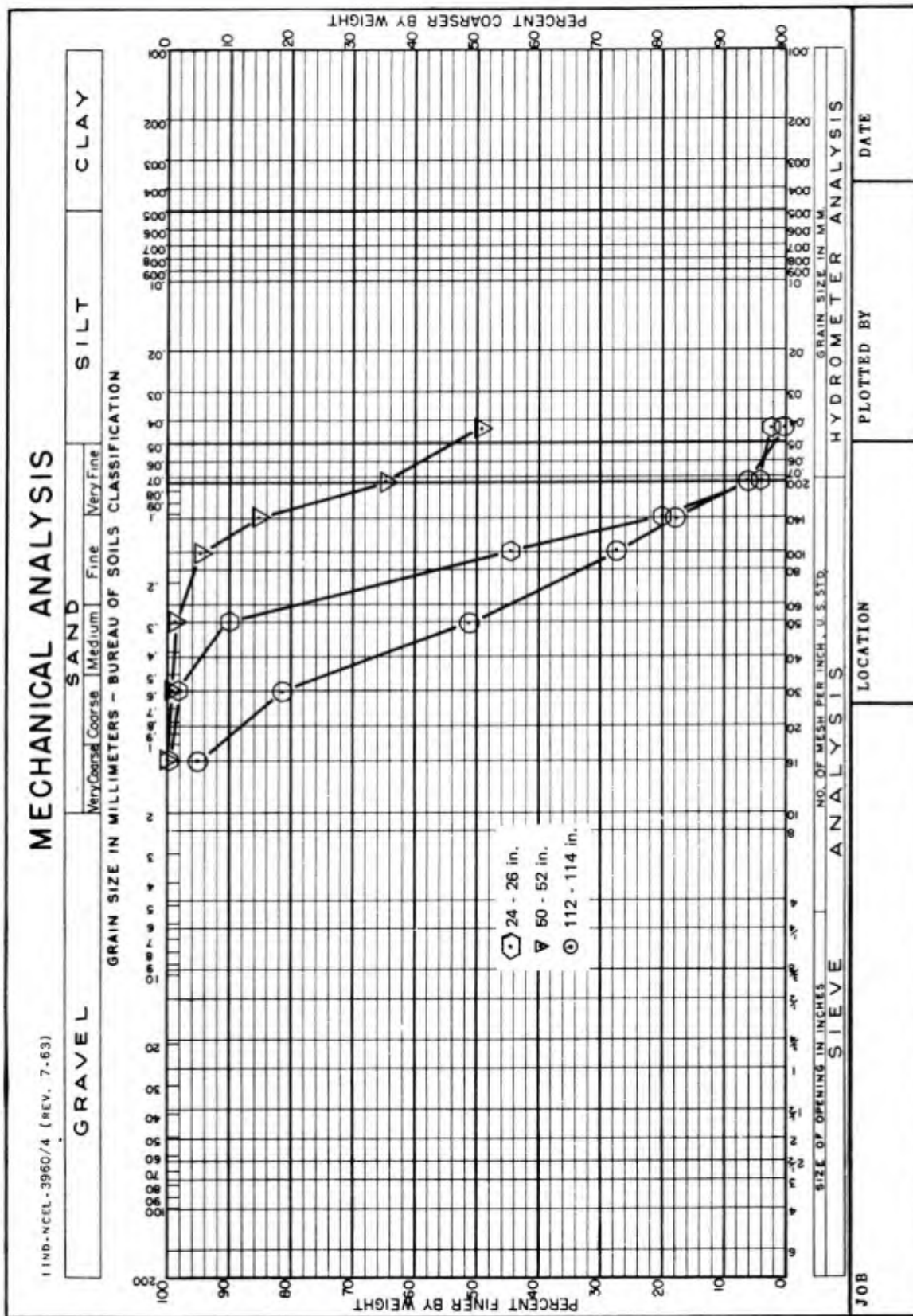
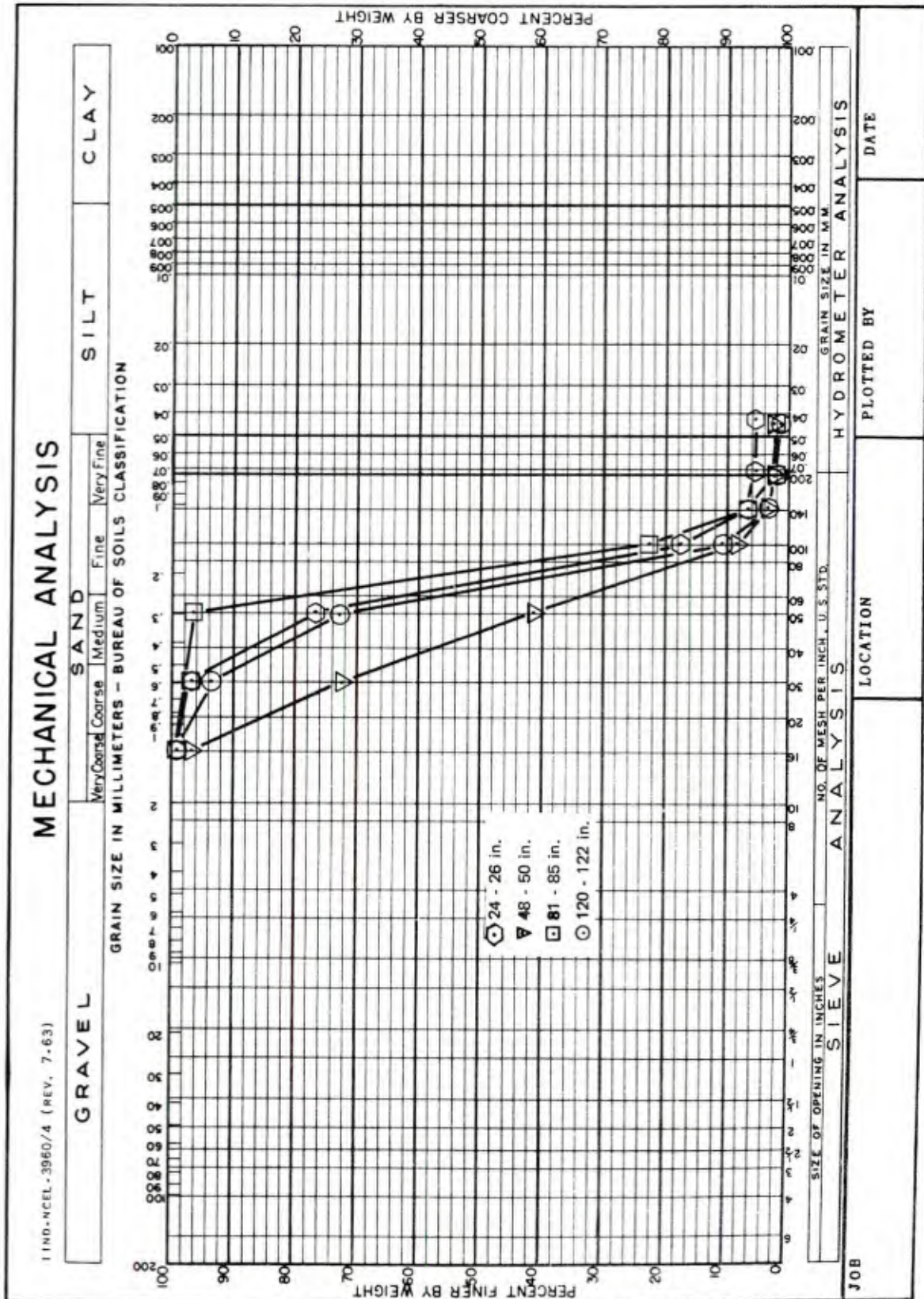


Figure A-3. Grain size distribution curves for Vibracore 3 - San Diego Harbor.



MECHANICAL ANALYSIS

GRAVEL				SAND				SILT		CLAY	
				Very Coarse	Coarse	Medium	Fine	Very Fine			

GRAIN SIZE IN MILLIMETERS - BUREAU OF SOILS CLASSIFICATION

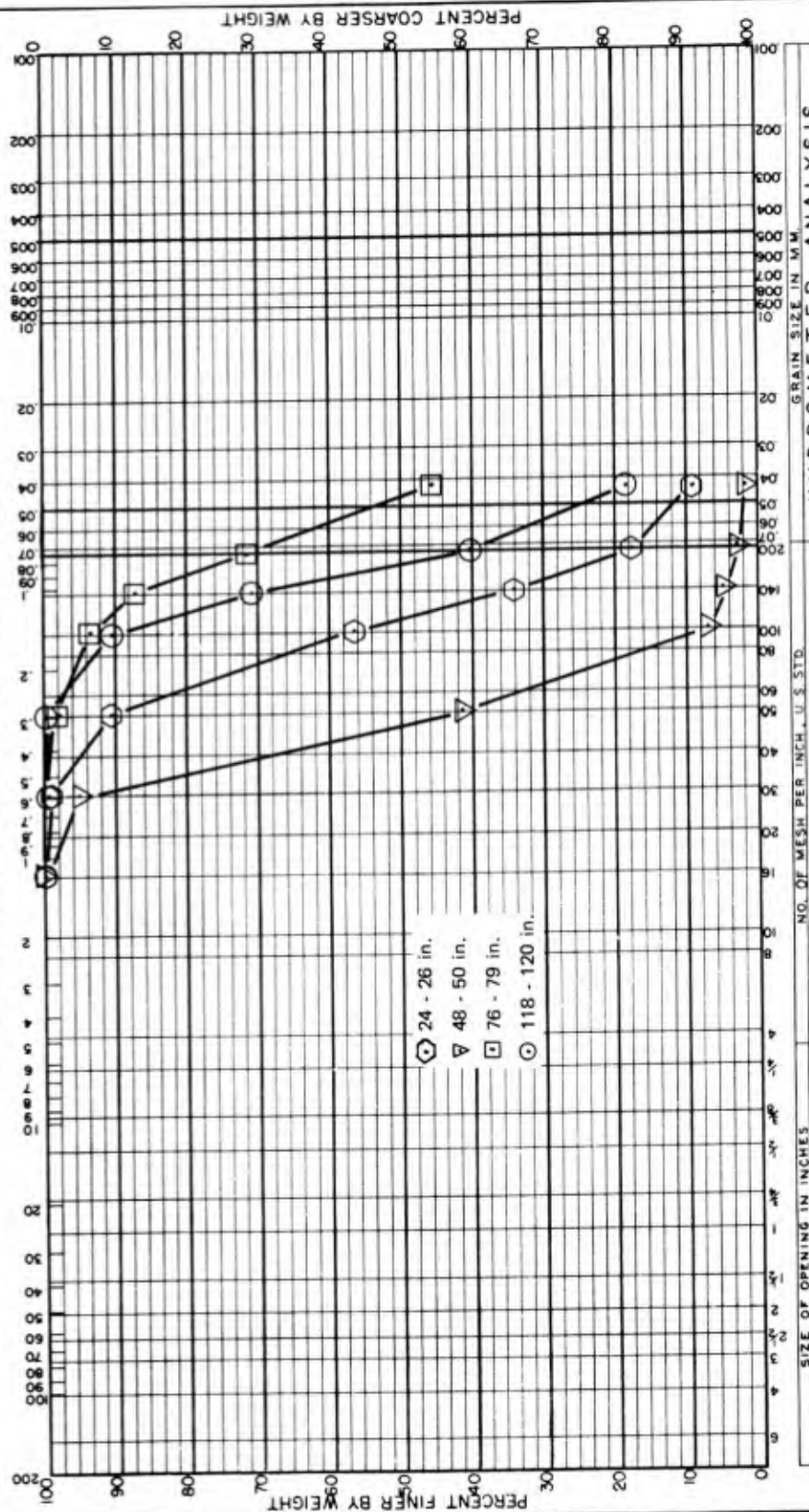
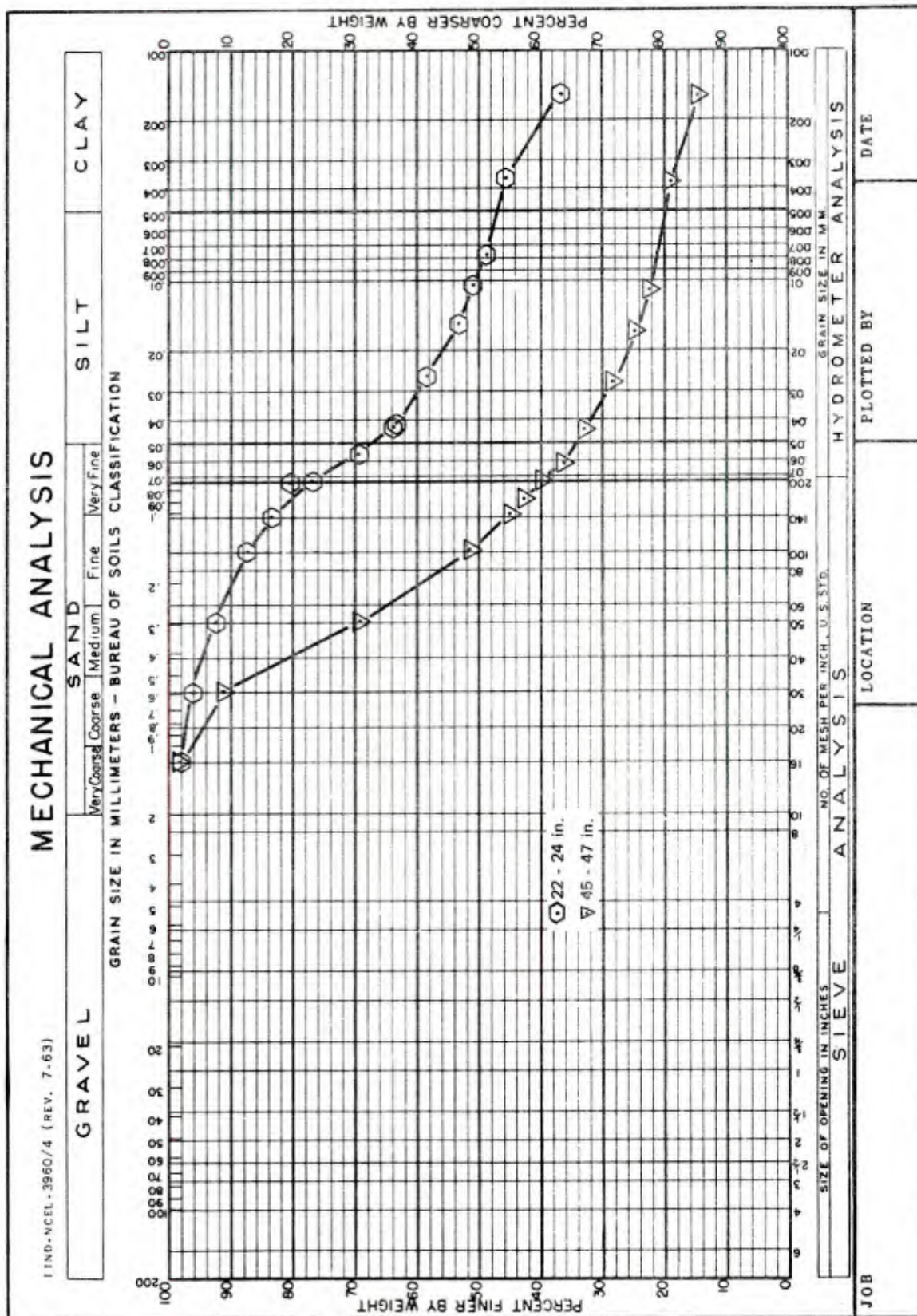


Figure A-5. Grain size distribution curves for Vibracore 9 - San Diego Harbor.



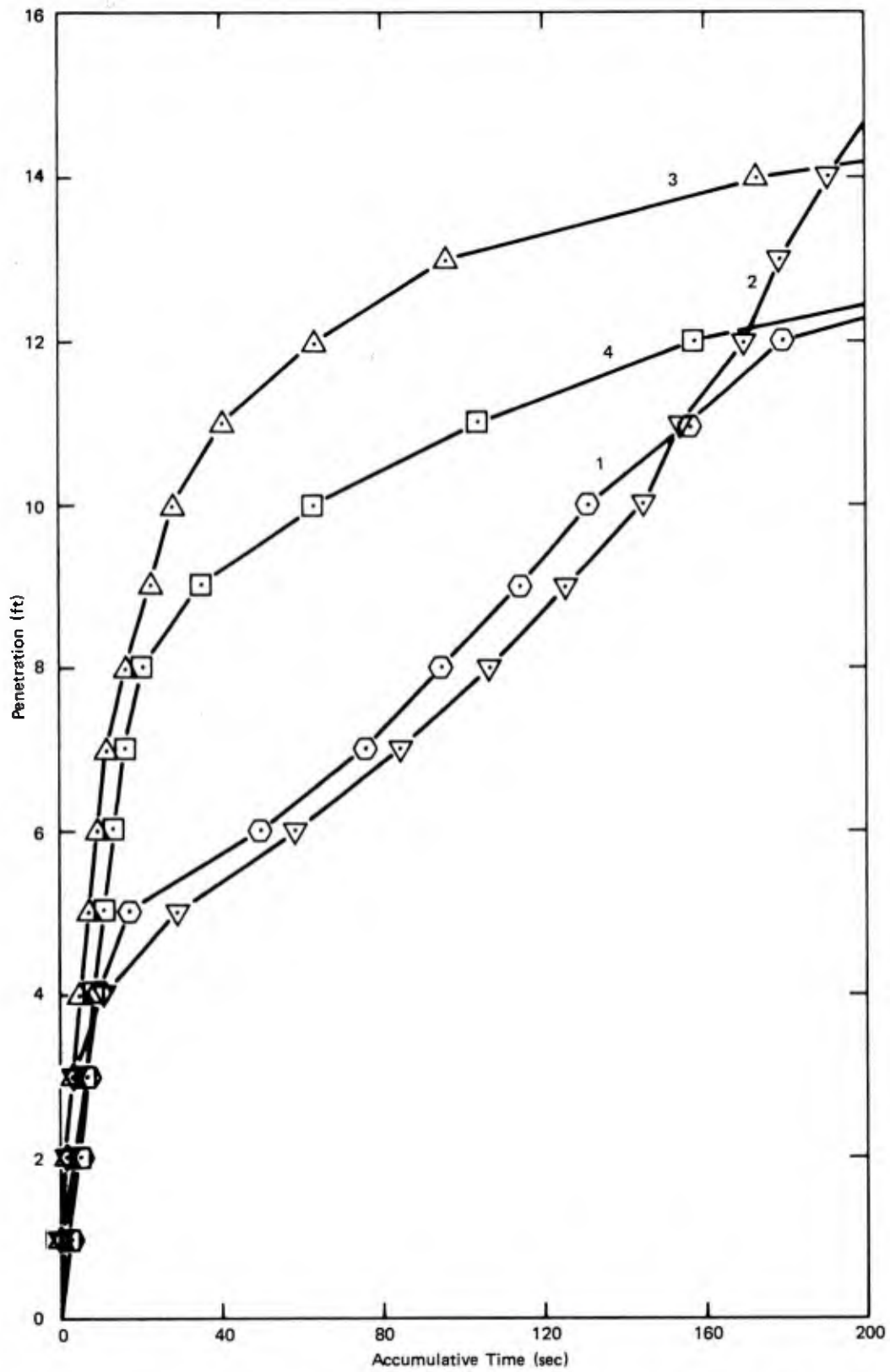


Figure A-7. Vibracorer penetration depth versus time for cores 1-4 - San Diego Harbor.

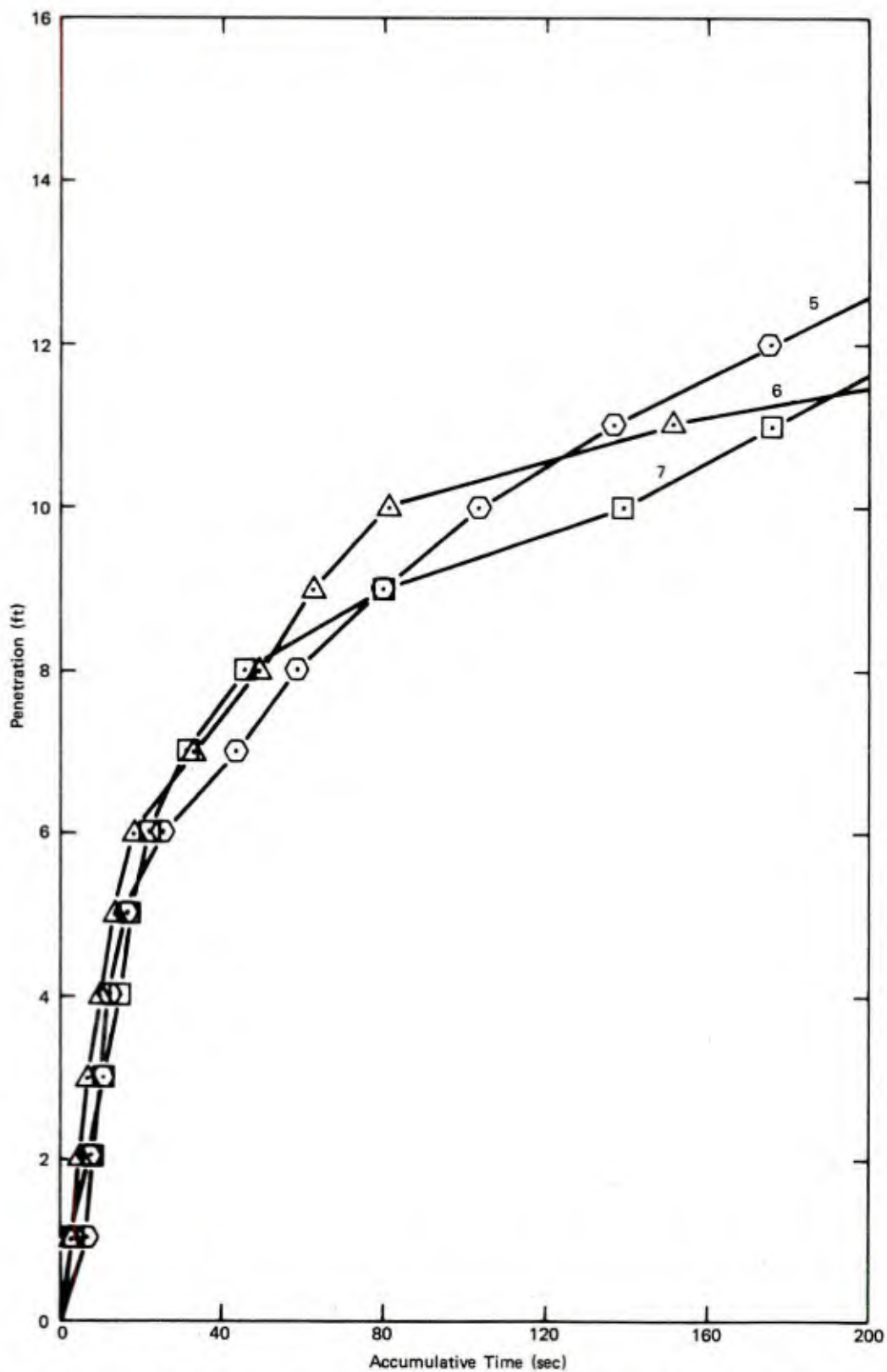


Figure A-8. Vibracorer penetration depth versus time for cores 5-7 - San Diego Harbor.

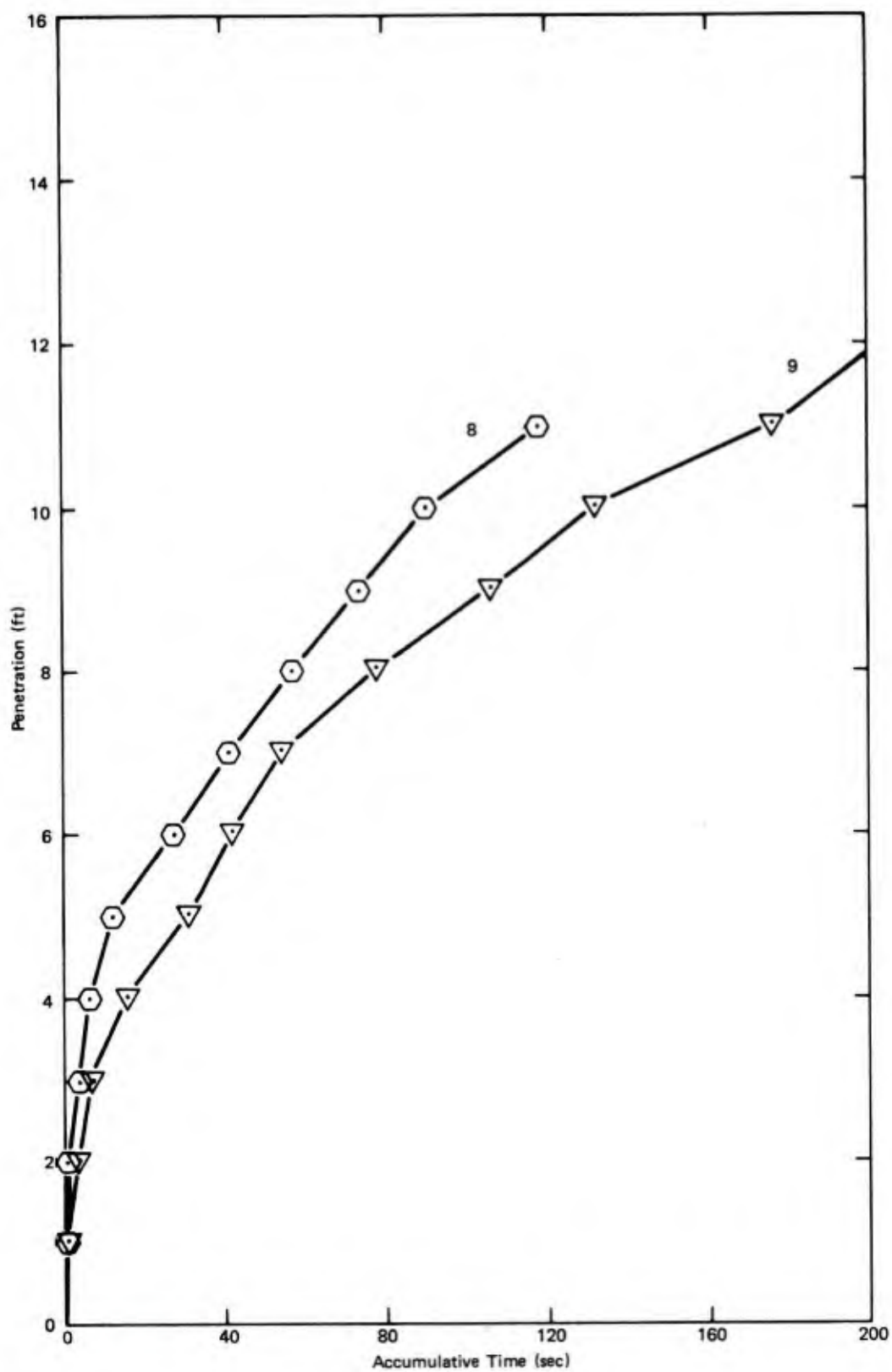


Figure A-9. Vibracorer penetration depth versus time for cores 8-9 - San Diego Harbor.

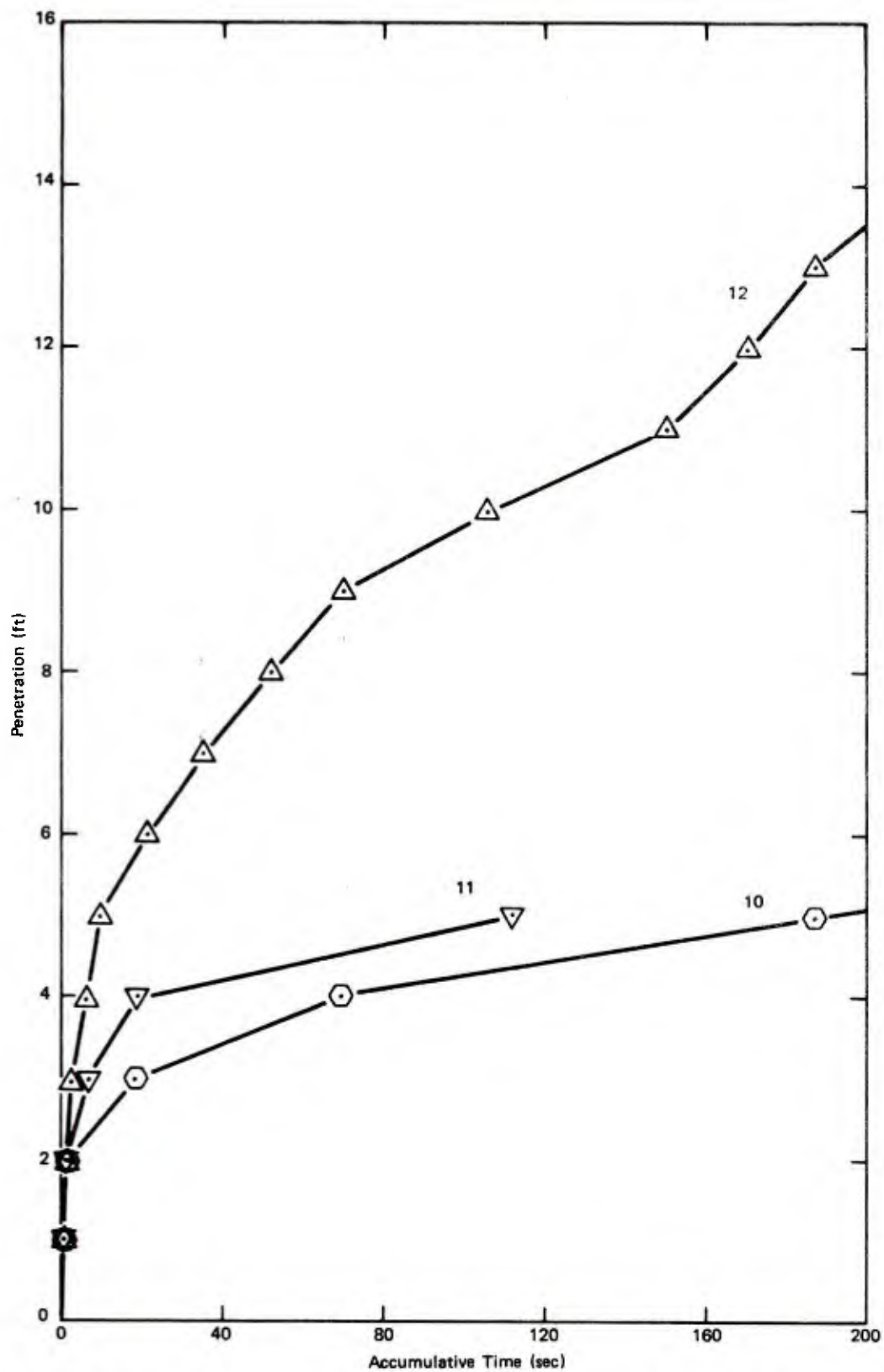


Figure A-10. Vibracorer penetration depth versus time for cores 10-12 - San Diego Harbor.

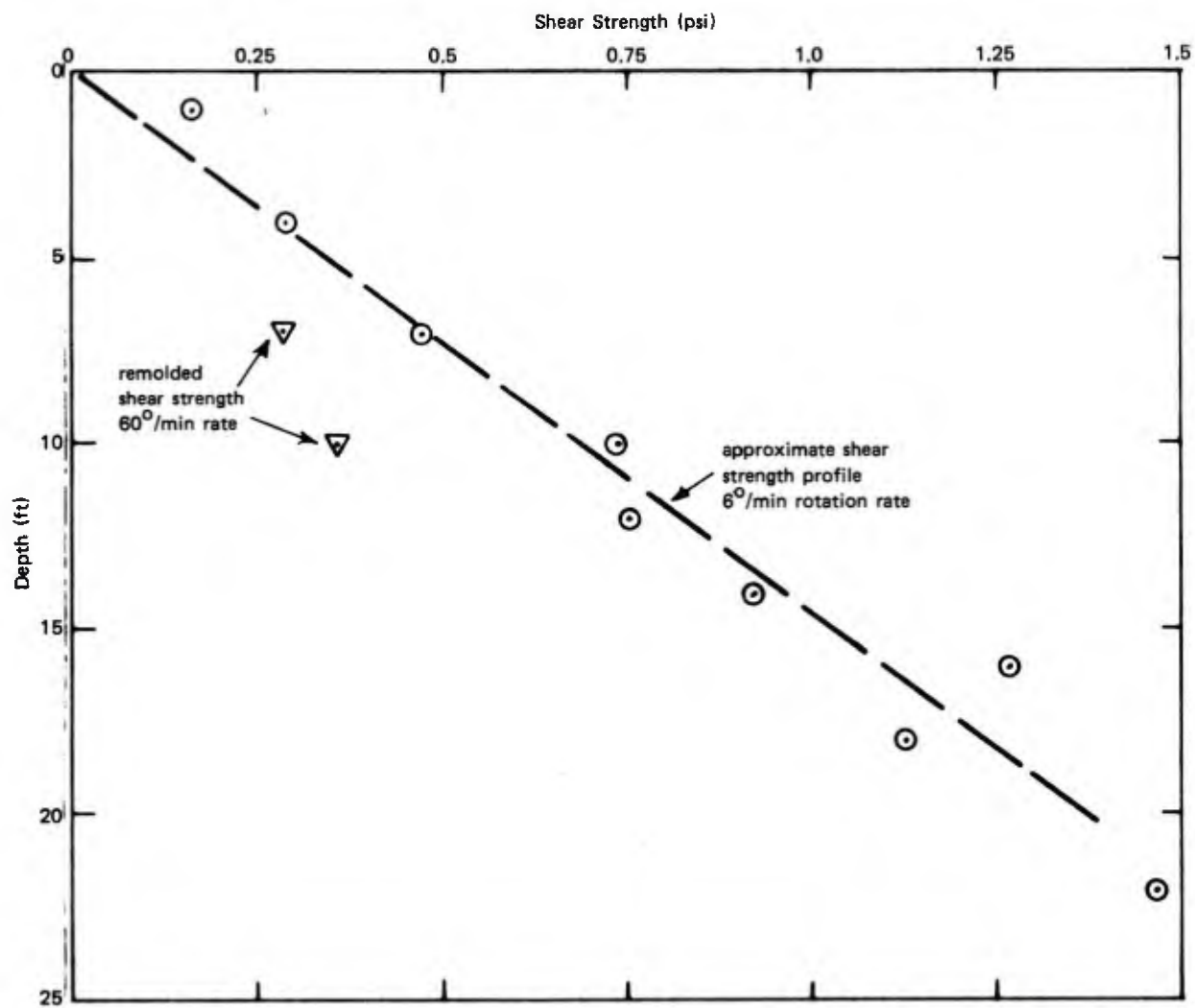


Figure A-11. Vane shear strength profile for Indian Island mud.

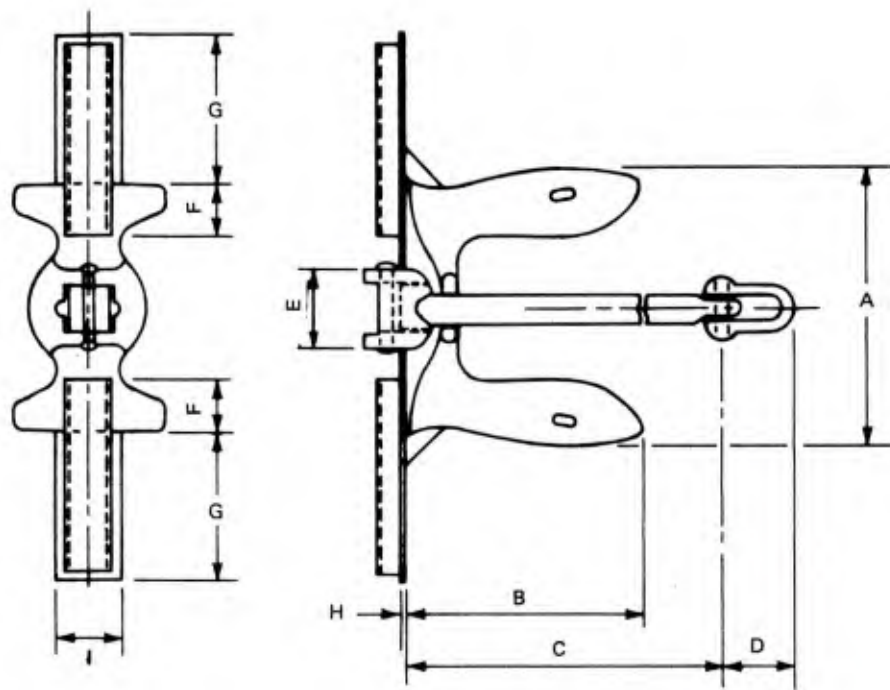
Appendix B

DIMENSIONS OF ALL TESTED ANCHORS

General dimensions of all the anchors tested are provided. Also included is a tabularized listing of the location of the instrument package on the shank relative to the shackle end of the shank.

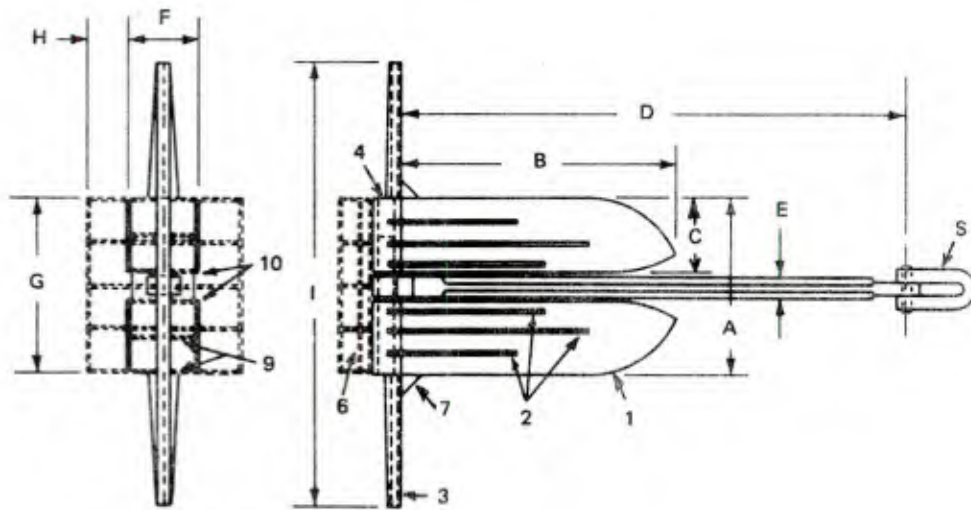
Table B-1. Location of Instrument Package on Anchor Shank

Anchor		Centerline of Package to Shank Tip, in.	
Name	Nominal Size	San Diego	Indian Island
STATO	1,000 lb	18	19-1/4
	3,000 lb	44	34
	6,000 lb	50	34
Stockless	5,000 lb	45	42-1/2
	9,000 lb	29	32
STEVFIX	640 kg	16	58
	940 kg	-	58
STEV MUD	500 kg	-	-
	1,000 kg	-	-
STEVDIG	1,000 kg	21	-
BRUCE	340 kg	-	38
	600 kg	38	33
	1,000 kg	30	18
Hook	560 kg	29	43



Nominal Weight (lb)	Anchor Dimensions (in.)								
	A	B	C	D	E	F	G	H	I
500	29-3/4	26-7/8	37-1/4	7-5/8	8-1/2	—	—	—	—
1,500	43	38-3/4	53-5/8	11	12-1/8	—	—	—	—
3,000	54-1/8	48-3/4	67-1/2	13-7/8	15-3/8	11	30	1/2	13
5,000	64-1/8	57-3/4	80-1/8	16-1/2	18-1/4	13	36	1/2	16
6,000	67-7/8	62-9/16	85-1/16	17-3/8	19-1/8	14	36	1/2	16
7,000	71-7/16	65-7/8	89-9/16	18-5/16	20-1/8	15	36	1/2	16
9,000	78-1/16	70-3/8	97-1/2	20	22-1/8	16	36	3/4	16
10,000	80-1/2	74-3/16	100-7/8	20-5/8	22-11/16	17	36	3/4	19
13,000	87-7/8	79-1/8	109-3/4	22-1/2	24-7/8	18	40	3/4	19
14,500	90-7/8	83-3/4	114	23-1/4	25-5/8	19	40	3/4	21
18,000	98-3/8	90-3/8	122-3/4	25-1/4	27-3/4	20	45	1	21
20,000	101-7/8	91-3/4	127-1/4	26-1/8	28-7/8	21	45	1	21
25,000	109-3/4	98-7/8	137-1/16	28-1/8	31-1/8	22	48	1	22
30,000	116-5/8	107-1/4	145-5/8	29-13/16	33-3/16	24	50	1	23
40,000	127-3/4	117-13/16	160-1/16	32-11/16	36	27	36	1-1/4	26

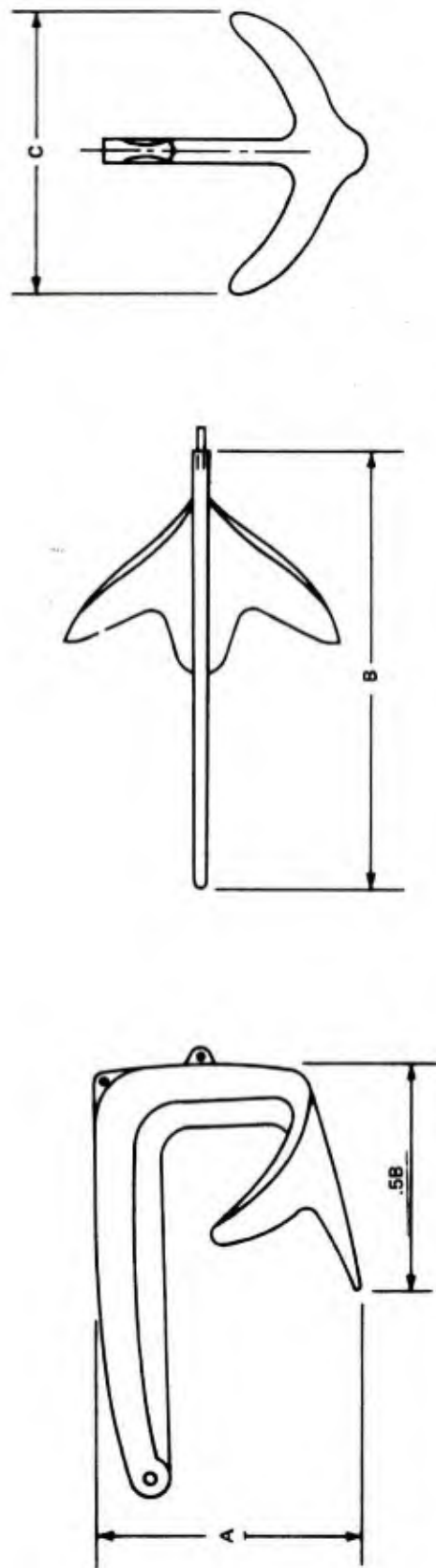
Figure B-1. Dimensions of standard Stockless anchor.



Nominal Weight (lb)	Dimensions of Anchors (in.)								
	A	B	C	D	E	F	G	H	I
200	23	25	10	42	2	9-1/2	23	6	59
1,000	28	43	75	80	—	—	28	—	80
3,000	41-1/2	69	18	129	4	19	41-1/2	13	109-1/2
6,000	55	82	24	144	5	21	55	15	143
9,000	62	96	27	160	6	27	62	16	170
12,000	69	108	30	186	7	30	69	18	197
15,000	76	121	33	205	8	32-3/8	76	20	224

Nominal Weight (lb)	Thickness of Plates (in.)									
	1	2	3	4	5	6	7	8	9	10
200	1/4	1/2	1/4	1/4	1/4	1/4	1/4	1/4 x 4	1/4	1/2
3,000	1-1/4	1	1/2	5/8	5/8	5/8	5/8	1/2 x 6	5/8	5/8
6,000	1-1/2	1	1/2	3/4	3/4	3/4	3/4	5/8 x 7	3/4	3/4
9,000	1-3/4	1-1/8	5/8	7/8	7/8	7/8	7/8	3/4 x 7	7/8	7/8
12,000	2	1-1/4	5/8	1	1	1	1	3/4 x 7	1	1
15,000	2-1/4	1-1/2	5/8	1-1/8	1-1/8	1-1/8	1-1/8	3/4 x 7-1/2	1-1/8	1-1/8

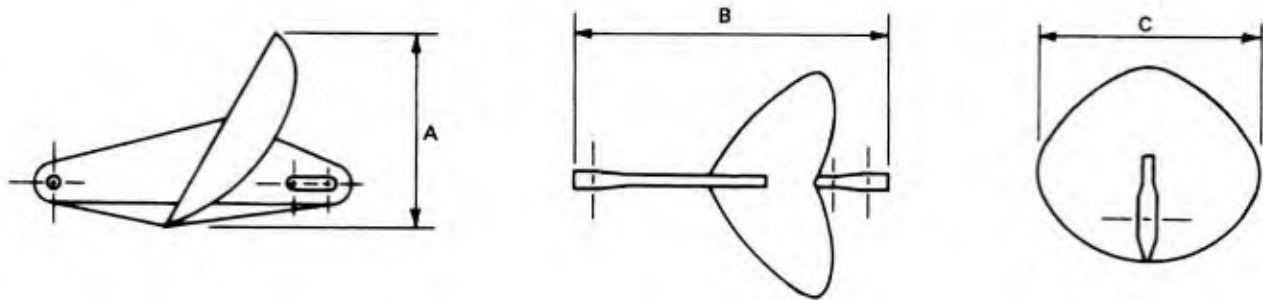
Figure B-2. Dimensions of Navy STATO anchor.



Nominal Weight		Dimensions (mm)		
kg	lb	A	B	C
*340	748	940	1930	1499
600	1320	1160	2050	1311
1000	2200	1375	2430	1554

*Note: 340 kg Bruce is welded, not cast, and has a twin plate shank separated by spacers (see Figure 15.)

Figure B-3. Dimensions of BRUCE anchor.



BRUCE ANCHOR
Nominal Weight

<u>kg</u>	<u>lb</u>
600	1320
1000	2200
3000	6600
6500	14300
9000	19800

CABLE DEPRESSOR DIMENSIONS
Nominal Weight

<u>kg</u>	<u>lb</u>	<u>A</u> <u>mm</u>	<u>B</u> <u>mm</u>	<u>C</u> <u>mm</u>
120	264	521	1061	698
200	440	720	1200	830
605	1331	1040	1735	1195
1350	2970	1355	2255	1555
1810	3982	1500	2500	1725

Figure B-4. Dimensions of BRUCE cable depressors.

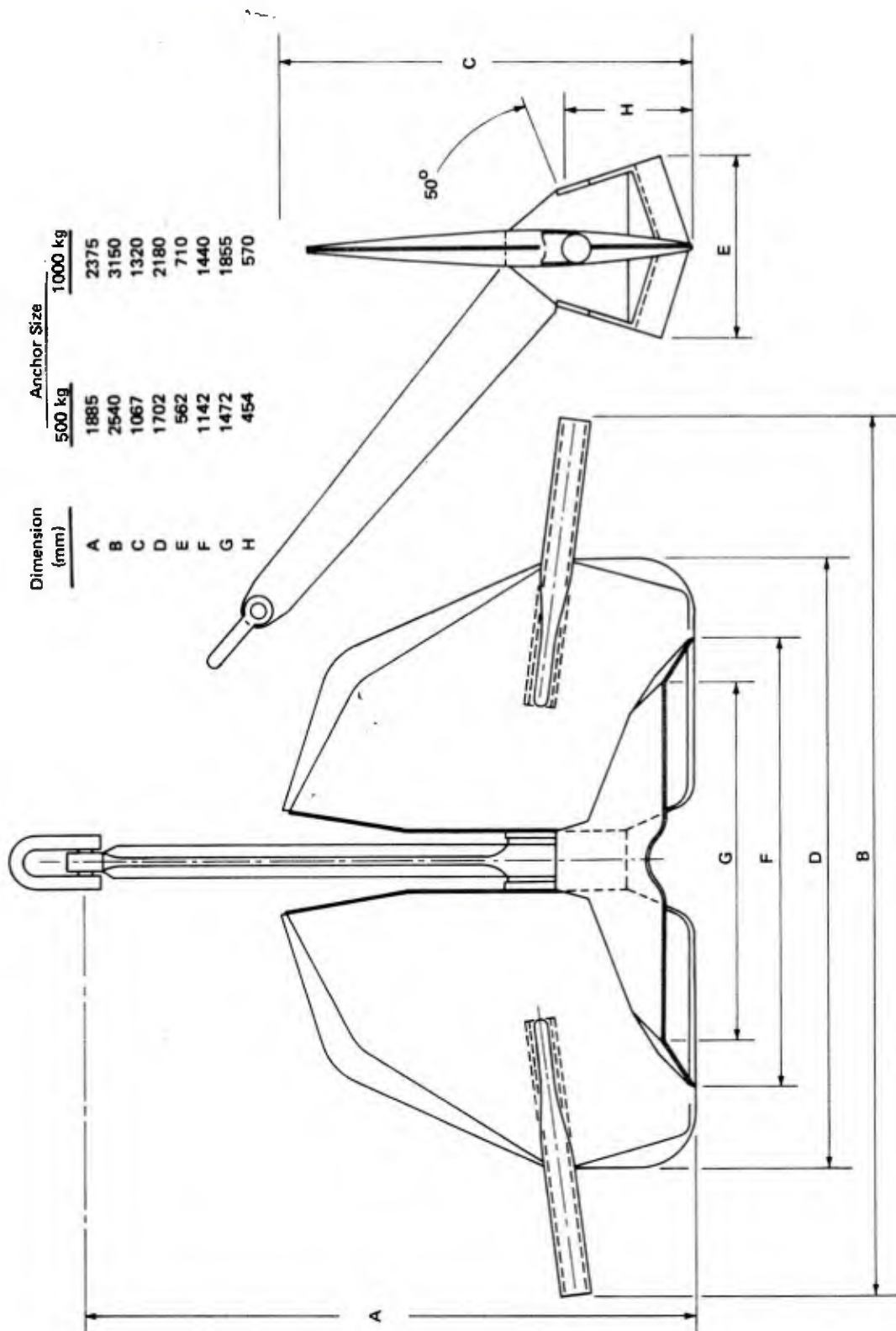


Figure B-5. Dimensions of STEVMUD® anchor.

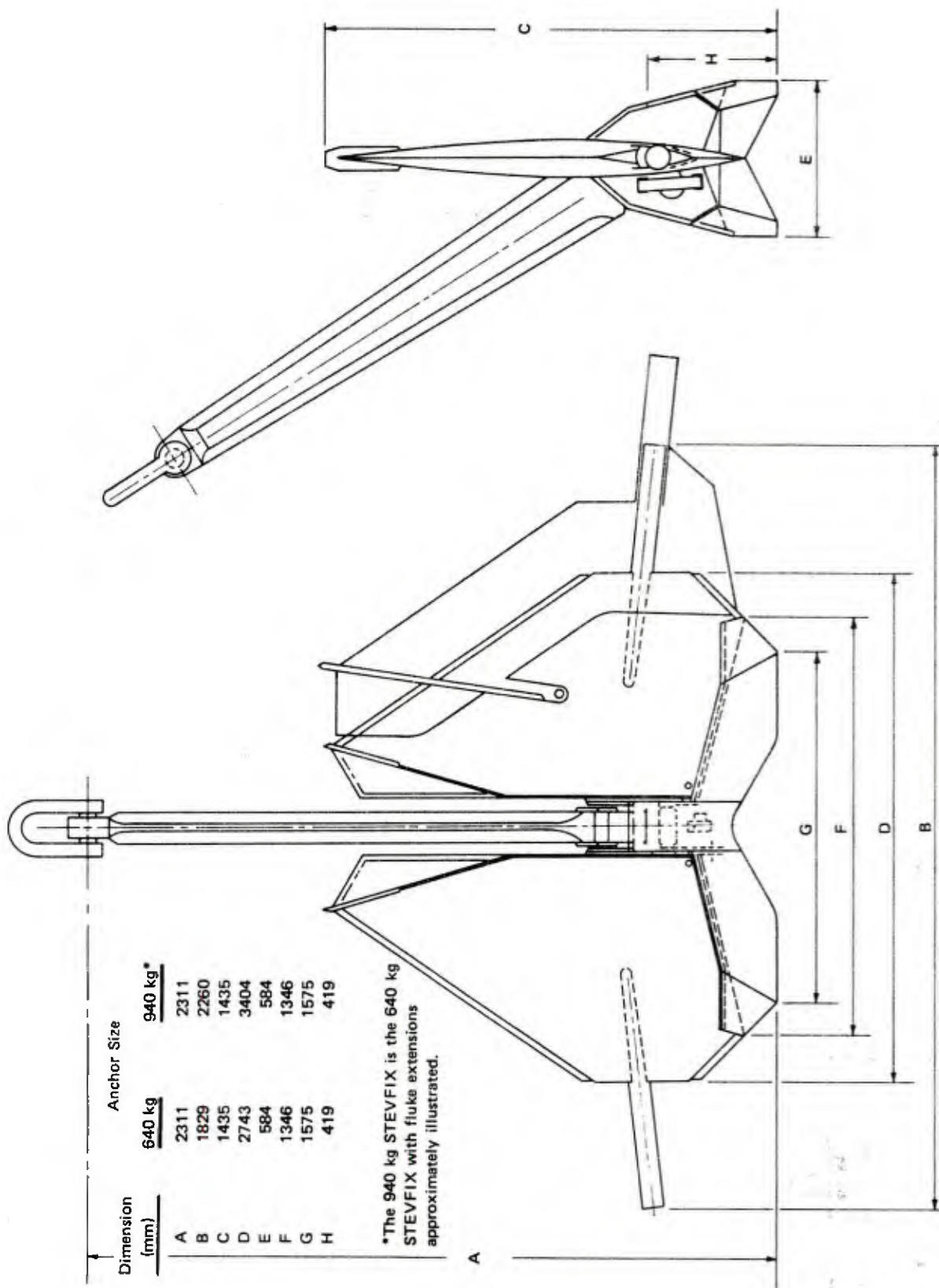


Figure B-6. Dimensions of STEVFIX® anchor.

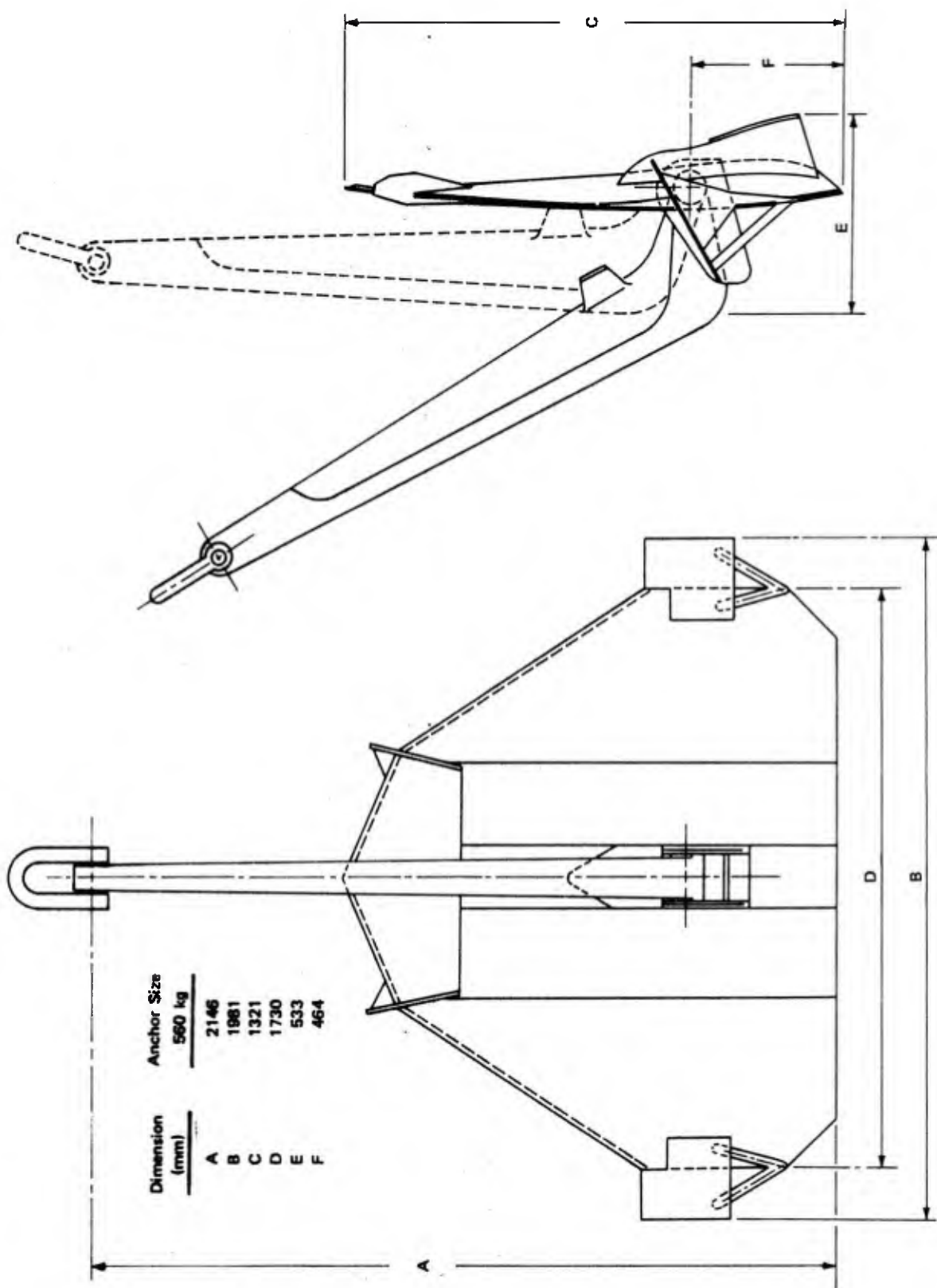


Figure B-7. Dimensions of Hook® anchor.

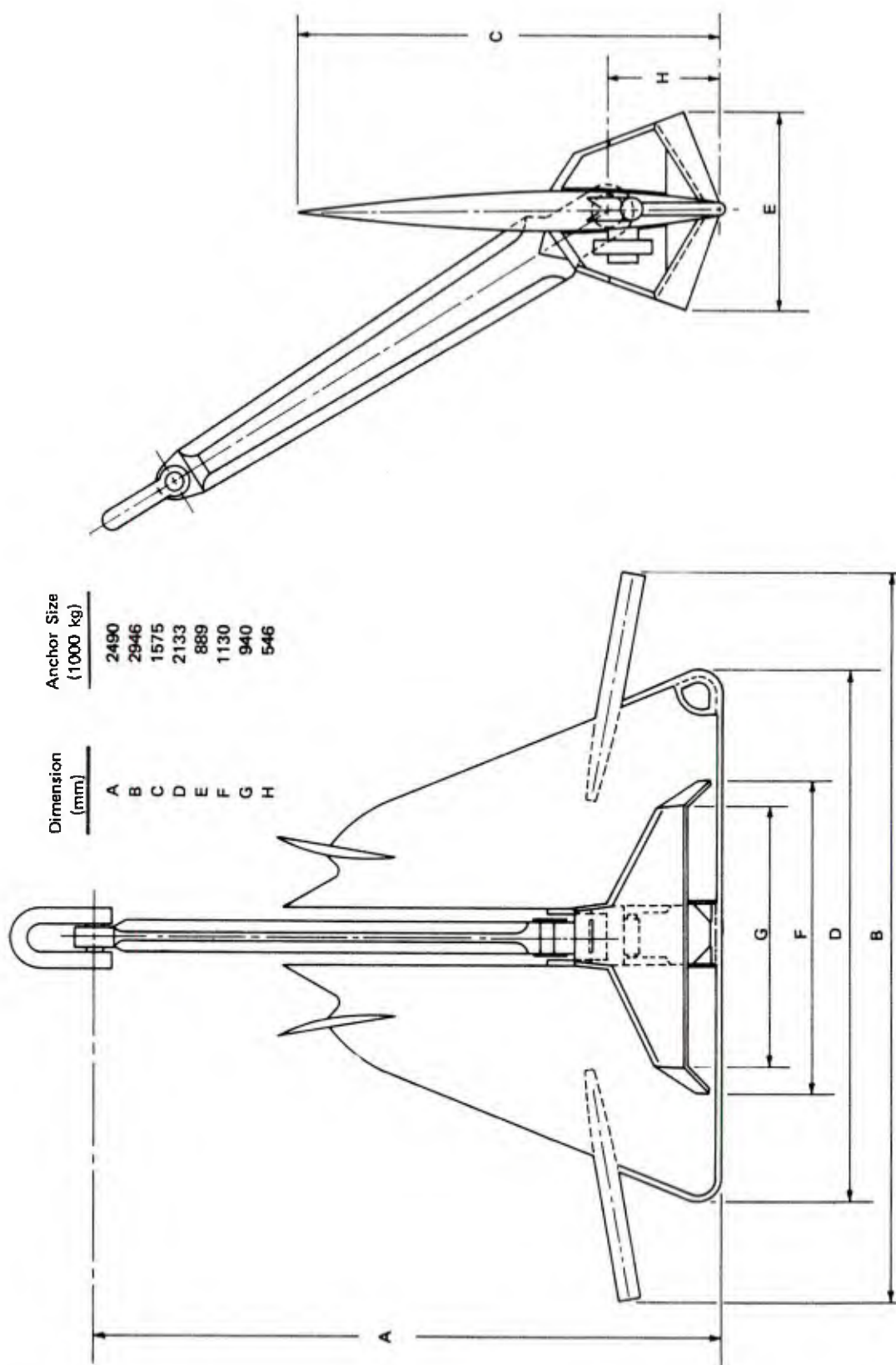


Figure B-8. Dimensions of STEVDIG® anchor.

Appendix C

STOCKLESS AND STATO ANCHOR TEST DATA

All test results for the Stockless and STATO anchors are included in this section. Anchor and deck tension, chain weight on bottom, anchor shank tip and crown penetrations, anchor shank longitudinal rotation (pitch), and anchor transverse rotation (roll) are plotted as functions of true anchor drag distance. Presented opposite each data plot is a digital listing of all plotted data plus additional descriptive data that may be useful during the eventual analysis of the data. When data were unavailable either through instrumentation difficulties or because the instrument pack was not used due to time constraints (this occurred at Indian Island), straight lines with a zero ordinate were plotted. There were several instances at San Diego where partial shorts at the load cell electrical connector occurred during testing. The anchor load cell was particularly sensitive to these shorts since its output, exclusively, was amplified at the anchor and transmitted to the vessel. When this occurred, all data but anchor load cell were recorded. At the fine sand site in San Diego Harbor, problems often occurred with the pressure transducer; these did not occur at the deeper dense clayey sand site at San Diego and at Indian Island. Apparently, partial kinking of the pressure transducer hose was sufficient to restrict water flow into the hose. For those tests where depth readings were obviously in error, columns 4, 11, 12, and 13 on the data summaries are absent. Also, anchor shank penetrations are not listed or plotted for the Stockless anchor even when package depth (column 4) is listed. An error was detected in the specification of package location on the shank. The correct location is listed in Table B-1. Shank penetrations can be calculated directly using the correct location in conjunction with anchor dimensions listed in Appendix B and anchor shank angles listed in Appendix C. Listed on most Appendix C tables is an embedment depth of the centerline of the anchor shank at the crown end of the anchor. This depth was recorded by crown wire measurement at the end of the test. This value reflects only the condition of the anchor at the end of drag and not necessarily peak anchor embedment.

SAN DIEGO

Page 1

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1715

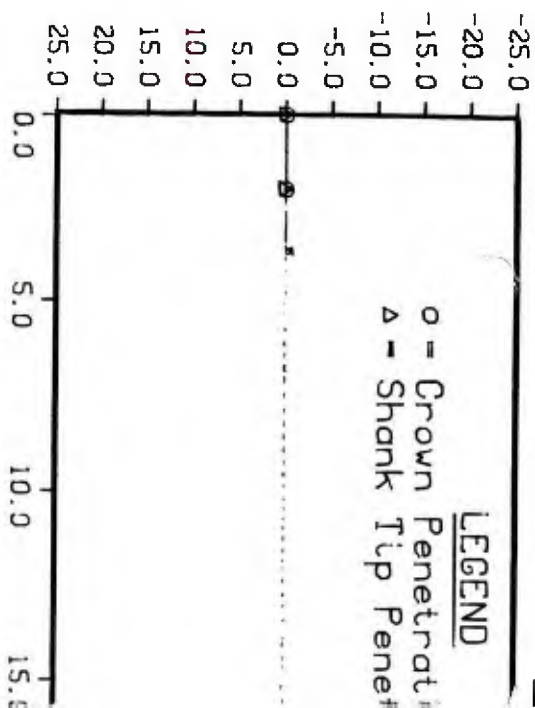
STOCKLFGG ANCHOR TFGT

```
TEST NAME
TEST NO.
TEST SCRIPTS
TEST AREA
START-END TIMES
SESSION TYPE
ANCHOR TYPE
ANCHOR WRIGHT
FILE# ANCHOR-TYPE
AUX. ANCHOR TYPE
MAIN-AUX ANCHOR SPACING
ANCHORING-ANCHOR-FILE-INITIAL
ANCHORING LINE DESCRIPTION
```

SA
1
4
EALPFC HASARDU TENDRFT. SOUTHPART OF ALINY AS
TAIN STATION. DEPTH 11-12 FT. MLV.
FLINE SANDY BOTTOM. NO STABILITZER. MOV. FLIKES
STOCKS + KNOTS P. NO STABILITZER. MOV. FLIKES
5350.00 IR. O=ENVY J=FIX
A=00 DEF. - N

NOTE - INITIAL CHARGE DEPLET TENDS TO REFLECT WEAR/END WATERDEPTH

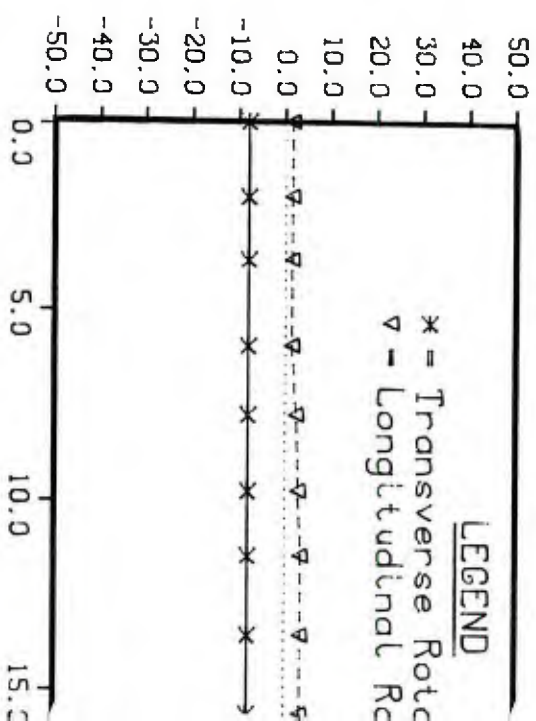
Feet



Feet

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	FFFT	WLOC	KLOC	FFET	DF	DFG	MEG	WLOC	FFET	LOC	FFFT	FFET	FFET	FFET	LOC
	0.0	29.0	0.0	0000	-0.0	1.5	8.1	21.8	23.2	6171.0					
	2.0	24.5	2.5	0000	-0.0	1.5	8.0	24.2	22.6	5166.1					
	3.7	24.6	2.5	0000	-0.0	1.5	7.7	25.4	23.4	5694.1					
	4.0	14.0	2.5	0000	-0.0	1.5	7.7	20.7	20.4	5694.2					
	7.2	31.0	4.0	0000	-0.0	1.5	7.6	30.7	22.7	6171.8					
	9.0	14.0	4.0	0000	-0.0	1.5	7.6	21.7	21.6	5693.5					
	11.5	24.5	2.0	0000	-0.0	1.5	7.6	25.4	24.2	6171.6					
	11.6	24.0	1.0	0000	-0.0	1.5	7.6	25.4	24.2	5693.0					
	15.7	27.0	4.0	0000	-0.0	1.5	7.6	24.8	23.0	5694.1					
	17.6	27.5	14.0	0000	-0.5	1.5	7.6	24.8	23.0	5700.8					
	19.9	44.5	14.0	0000	-0.5	20.7	7.1	44.2	15.7	3171.4					
	21.7	47.0	20.0	0000	-0.5	20.7	7.1	44.2	15.7	3171.4					
	23.4	47.0	15.0	0000	-0.5	20.7	7.1	44.2	15.7	3171.4					
	25.1	47.0	15.0	0000	-0.5	20.7	7.1	44.2	15.7	3171.4					
	27.1	47.0	15.0	12.0	-0.5	24.0	6.1	36.8	27.1	4193.7					
	29.0	47.0	15.0	12.0	-0.5	24.0	6.1	36.8	27.1	4193.7					
	31.5	47.0	15.0	12.0	-0.5	24.0	6.1	36.8	27.1	4193.7					
	33.3	34.5	10.0	12.1	-0.0	24.5	6.6	40.7	29.2	4659.4					
	35.3	34.5	9.0	12.2	-0.0	24.5	6.6	40.7	29.2	4659.4					
	37.6	41.0	12.0	11.0	-4.0	25.5	6.7	40.7	30.1	4659.4					
	39.4	35.0	10.0	12.0	-6.0	25.5	6.7	40.7	30.1	4659.4					
	41.7	47.0	16.0	12.5	-6.0	27.5	6.7	46.7	35.2	5180.2					
	43.6	47.0	14.0	12.1	-6.0	27.5	6.7	46.7	35.2	5180.2					
	45.6	44.0	13.0	12.7	-5.0	28.0	6.8	43.7	31.3	4739.4					
	47.3	35.0	9.0	12.9	-5.0	28.0	6.8	43.7	31.3	4739.4					
	49.5	44.0	14.0	12.1	-5.0	27.5	6.5	43.7	28.0	4739.4					

Degrees



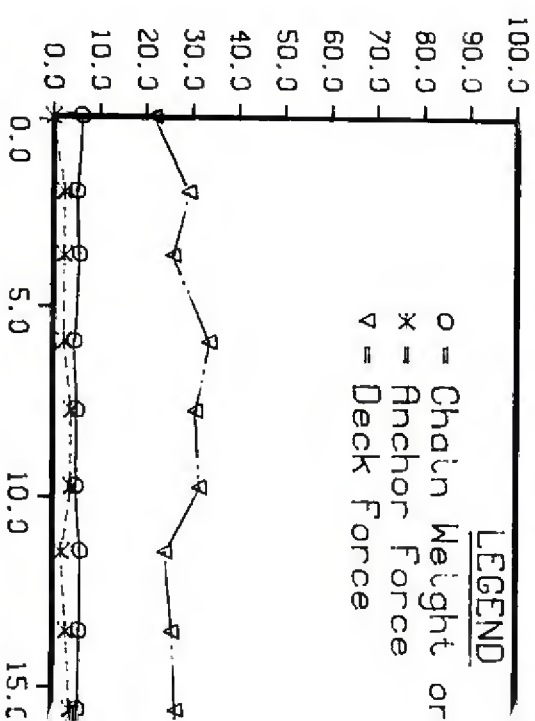
Degrees

```

DISTANCE AARGF TRAVELLED      50.0
DISTANCE ANCHOR TRAVELLED     49.5

```

KIPS



KIPS

Day # - 88

SAN DIEGO HARBOR 1500FT. SOUTHEAST OF BUOY 49

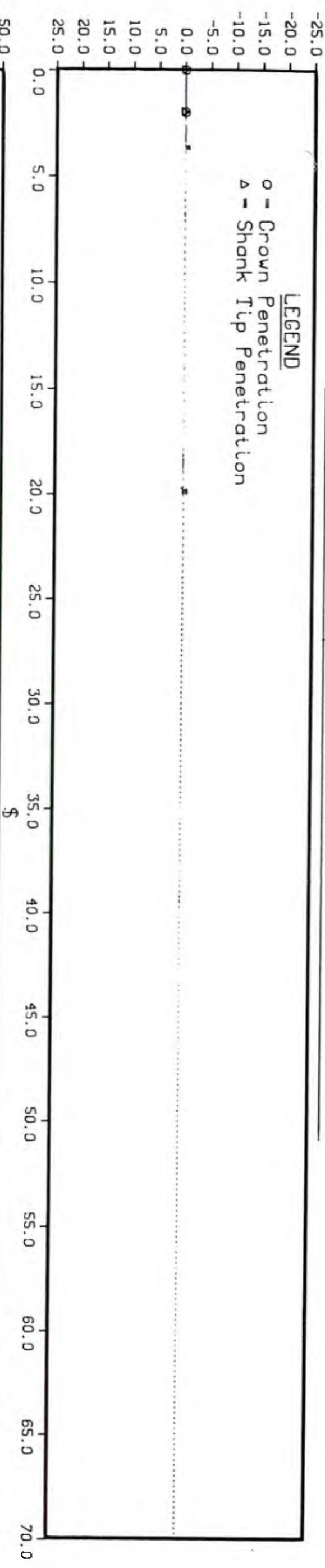
Test No. - 1

stockless, 5000lb. no stabilizers 48 deg. mov. flukes

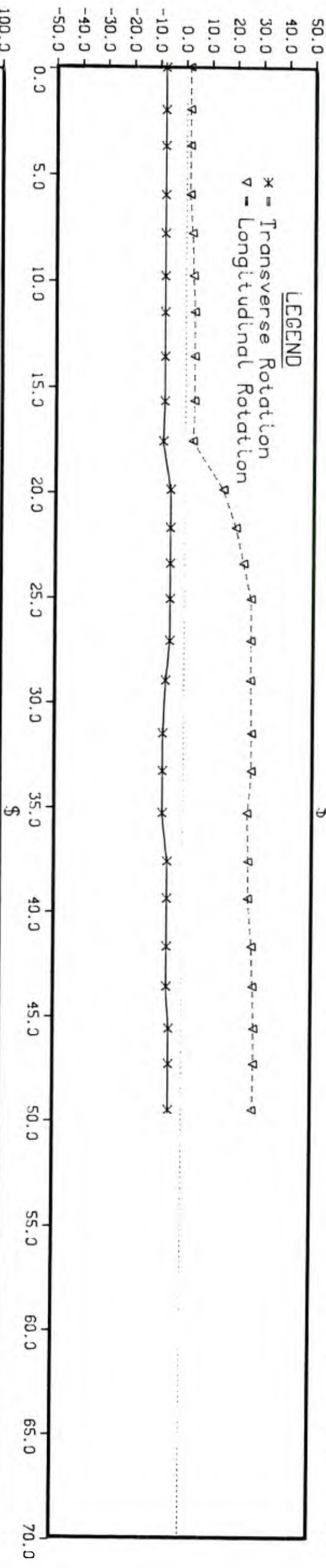
Test Series No. - 4

fine sand bottom. depth 11-12 ft. mllw

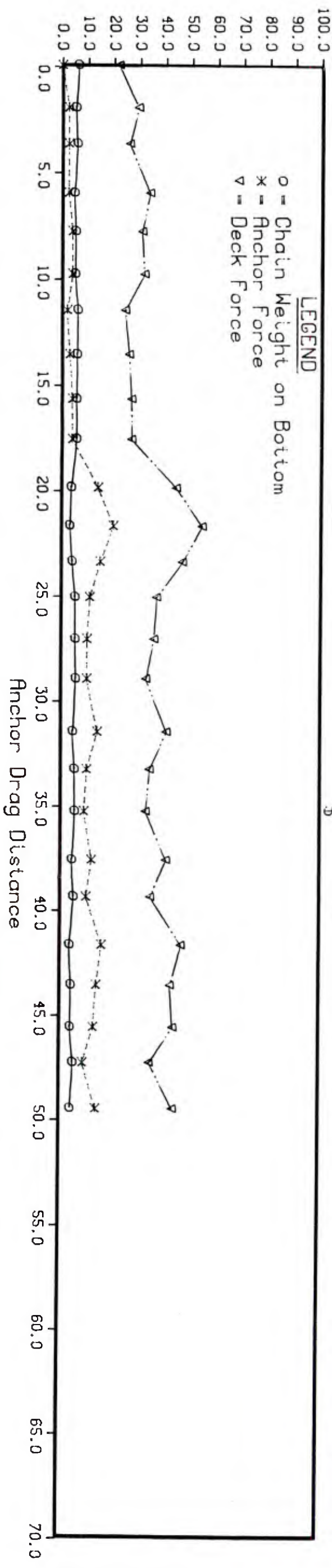
Feet



Degrees



KIPS



Day # - 88
Test No. - 2
Test Series No. - 4

[illegible]

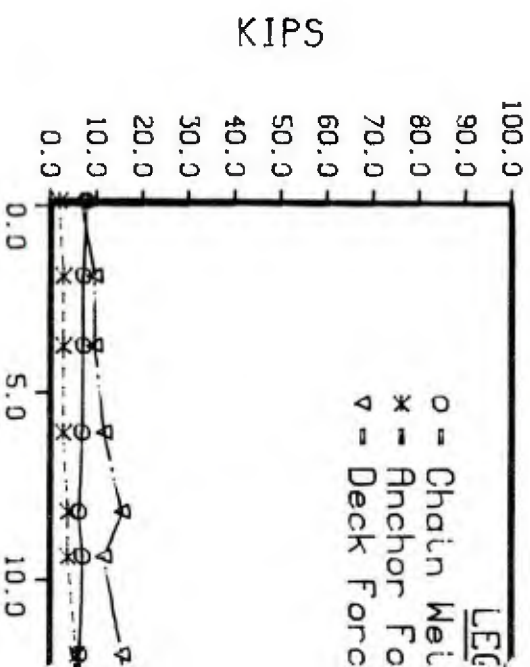
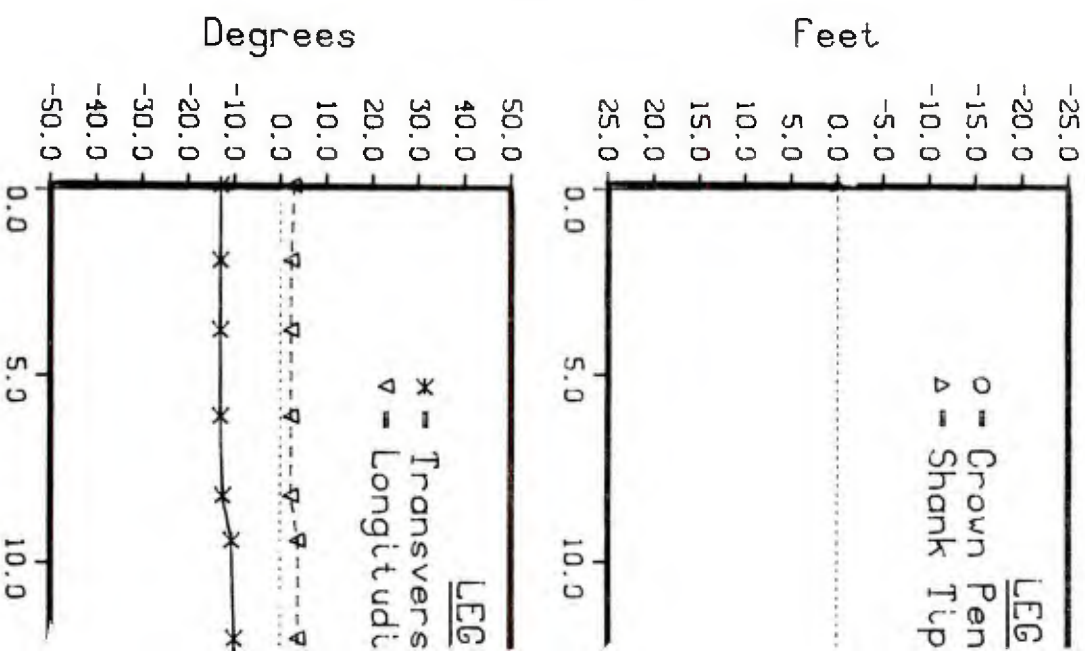
ANCHOR TO GWT 1.125 IN, PILEUCK CHAIN TO GWT 2.0 IN STUD-
LINK CHAIN TO GWT 2 IN, WIP GDS

1. DRAG DISTANCE	5. ROTATION ANGLE	9. CHAIN LENGTH ON BOTTOM	13. ANCHOR FLUXUS TIP HEIGHT
2. TIECK TENSION	6. SHANK ANGLE	10. CHAIN WEIGHT ON BOTTOM	14. WATER DEPTH
3. ANCHOR TENSION	7. WIDE DECK ANGLE	11. ANCHOR DOWN DEPTH	15. TOTAL BOTTOM WEIGHT
4. DRAGAGE DEPTH	8. DECK HEIGHT	12. ANCHOR SHANK TIP DEPTH	

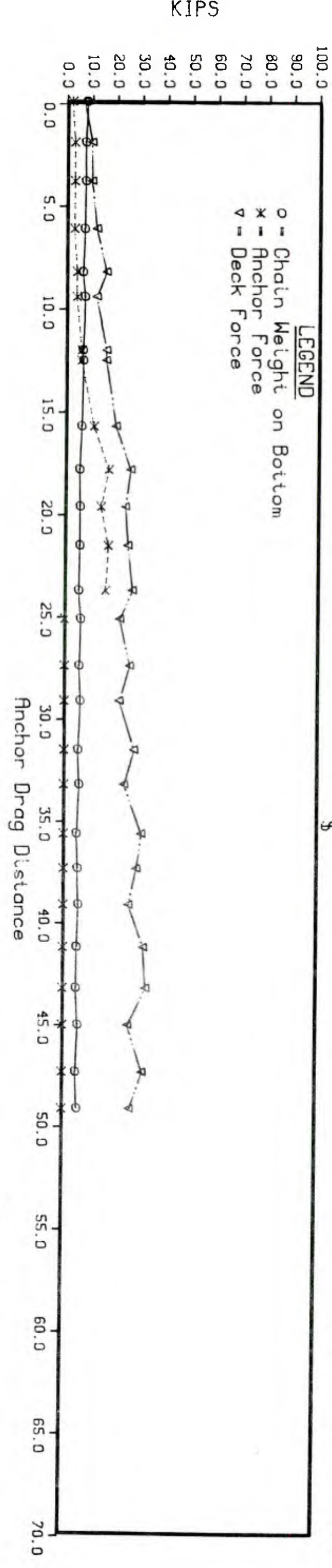
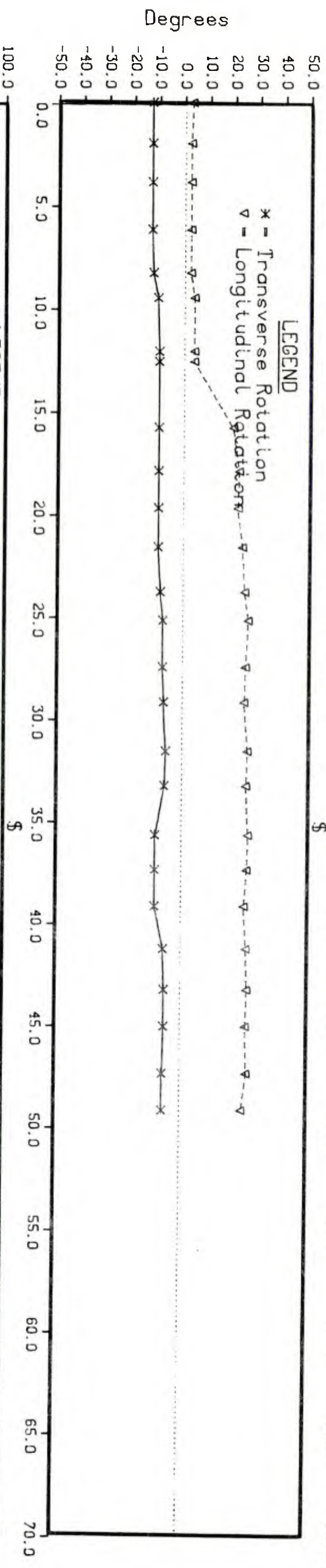
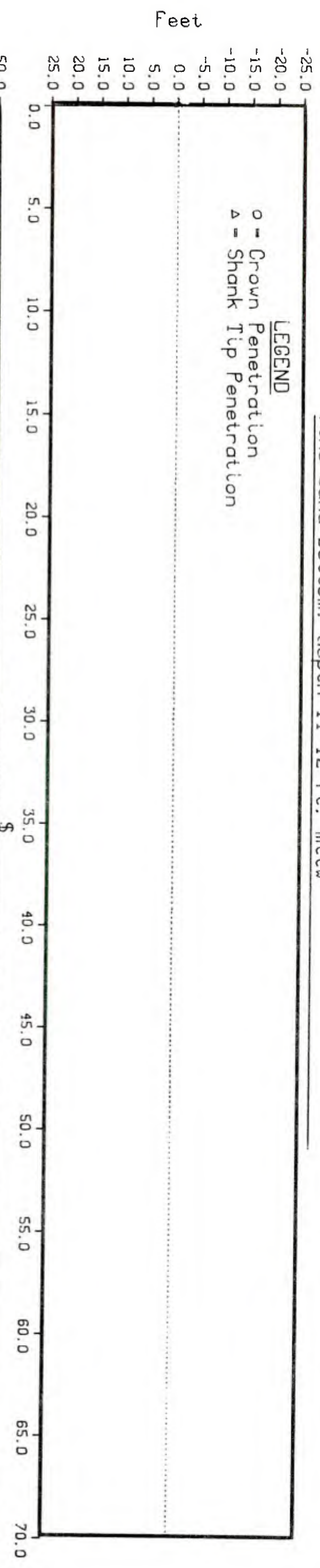
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	FERT	KLMS	KLMS	FERT	DEG	DEG	KLMS	FERT	KLMS	DEG	FERT	KLMS	FERT	KLMS
1	0.0	7.0	7.0	0.0	-13.0	2.0	11.9	6.8	444.4	726.3	0.0	0.0	0.0	0.0
2	0.0	10.0	3.0	0.0	-13.0	2.6	11.6	9.8	458.3	728.9	0.0	0.0	0.0	0.0
3	0.0	10.0	3.0	0.0	-13.0	2.6	11.6	9.8	458.3	728.9	0.0	0.0	0.0	0.0
4	0.0	10.0	3.0	0.0	-13.0	2.6	11.6	9.8	458.3	728.9	0.0	0.0	0.0	0.0
5	0.0	10.0	3.0	0.0	-13.0	2.6	11.6	9.8	458.3	728.9	0.0	0.0	0.0	0.0
6	0.0	10.0	3.0	0.0	-13.0	2.6	11.6	9.8	458.3	728.9	0.0	0.0	0.0	0.0
7	0.0	10.0	3.0	0.0	-13.0	2.6	11.6	9.8	458.3	728.9	0.0	0.0	0.0	0.0
8	0.0	10.0	3.0	0.0	-13.0	2.6	11.6	9.8	458.3	728.9	0.0	0.0	0.0	0.0
9	0.0	10.0	3.0	0.0	-13.0	2.6	11.6	9.8	458.3	728.9	0.0	0.0	0.0	0.0
10	0.0	10.0	3.0	0.0	-13.0	2.6	11.6	9.8	458.3	728.9	0.0	0.0	0.0	0.0
11	0.0	10.0	3.0	0.0	-13.0	2.6	11.6	9.8	458.3	728.9	0.0	0.0	0.0	0.0
12	0.0	10.0	3.0	0.0	-13.0	2.6	11.6	9.8	458.3	728.9	0.0	0.0	0.0	0.0
13	0.0	10.0	3.0	0.0	-13.0	2.6	11.6	9.8	458.3	728.9	0.0	0.0	0.0	0.0
14	0.0	10.0	3.0	0.0	-13.0	2.6	11.6	9.8	458.3	728.9	0.0	0.0	0.0	0.0

17.9	25.0	17.0	-10.0	22.6	6.4	25.7	231.2	5473.5	11.6
19.7	24.0	14.0	11.3	22.5	8.3	23.7	241.2	5407.2	11.6
21.6	27.0	17.0	11.2	-10.0	23.6	8.0	241.2	4792.4	11.6
21.6	27.0	17.0	10.4	-9.0	24.6	26.7	229.6	4520.7	11.0
22.0	16.0	10.0	10.6	-8.0	24.5	7.7	214.4	4324.4	11.0
22.2	22.0	10.0	10.9	-9.0	24.9	7.7	214.4	4278.1	11.0
22.5	25.0	10.0	10.9	-9.0	25.0	7.7	214.4	4241.1	11.0
22.5	25.0	10.0	10.7	-7.5	25.0	7.7	214.4	4204.0	11.0
23.2	26.0	10.0	10.7	-7.5	25.0	7.7	214.4	4167.0	11.0
23.3	26.0	10.0	10.7	-7.0	25.4	7.7	213.8	4130.5	11.0
23.7	31.0	11.2	-10.5	25.3	7.7	20.7	223.0	4084.1	11.0
23.7	29.0	11.2	-10.5	25.4	7.3	28.4	223.0	4046.6	11.0
24.3	33.6	11.5	-7.0	25.9	7.0	31.6	226.0	4010.9	11.0
24.3	33.6	11.5	-7.0	25.9	7.0	32.8	226.2	3975.1	11.0
24.3	33.6	10.7	-6.5	25.9	7.1	25.8	246.6	4058.1	11.0
24.9	37.0	11.1	-7.0	26.3	7.2	31.7	228.5	4021.0	11.0
24.9	37.0	10.9	-7.0	26.4	7.1	26.6	245.7	4034.5	11.0
25.0	47.0	11.0	-7.0	26.4	7.1	26.6	245.7	4034.5	11.0

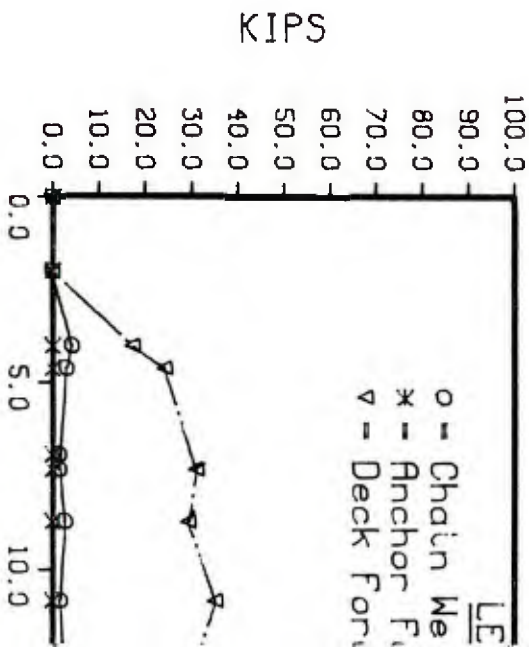
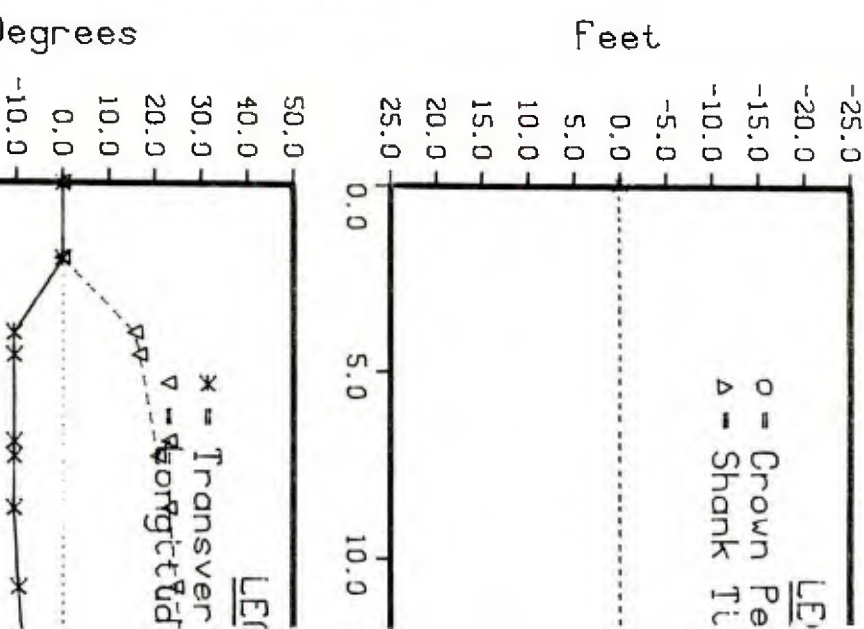
DISTANCE RANGE TRAVELLED 50.0
 DISTANCE ANCHOR TRAVELLED 49.0
 NOTE - POSITIVE CHAIN
 ANGLE INDICATES
 CHAIN TIP REL IN
 FROM



Day # - 88
 Test No. - 2
 Test Series No. - 4
 SAN DIEGO HARBOR 1500 FT. SOUTHEAST OF BUOY 49
 stockless, 5000lb. no stabilizers 48 deg. mov. flukes
 fine sand bottom. depth 11-12 ft. mllv

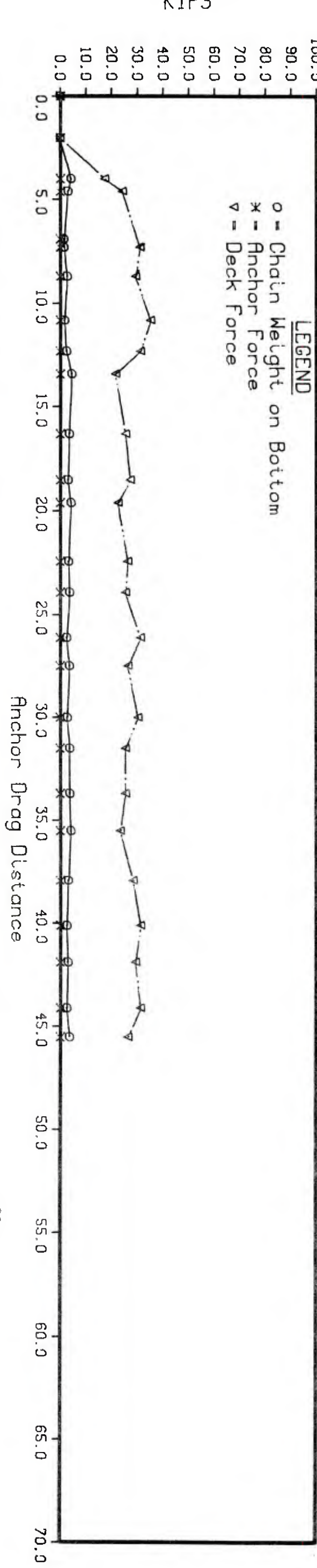
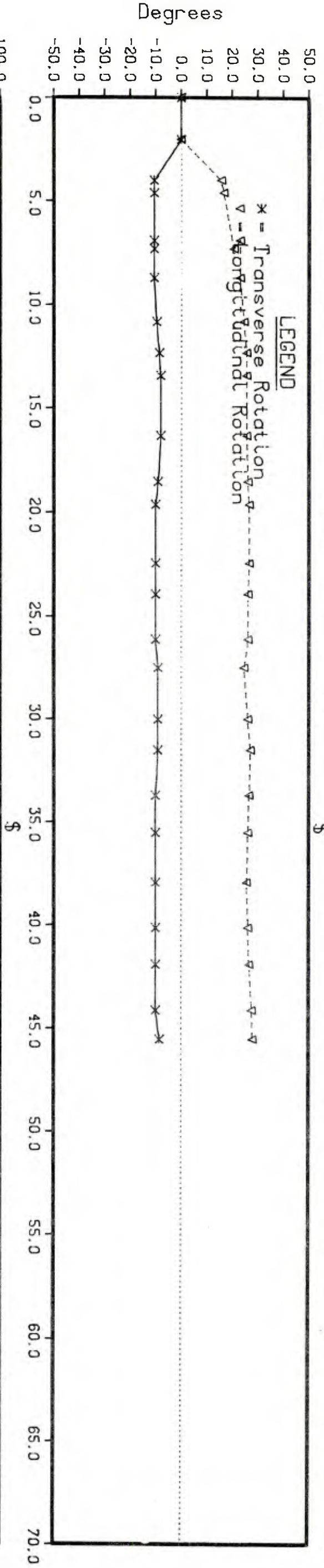
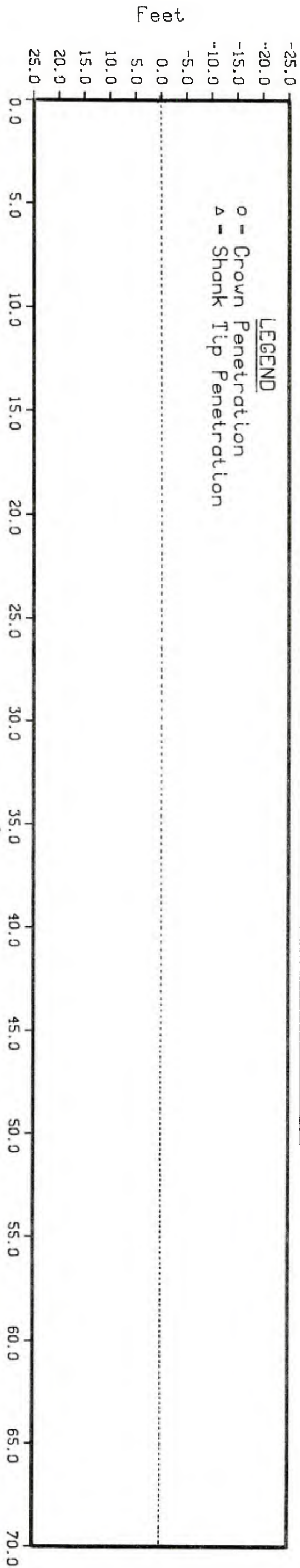


SAN DIE

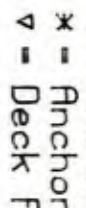
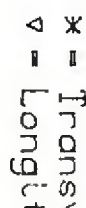
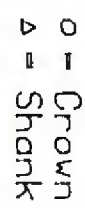


SAN DIEGO HARBOR 1500 FT. SOUTHEAST OF BUOY 49

Day # - 88
Test No. - 3
Test Series No. - 4
stockless, 5000lb. no stabilizers 48 deg. mov. flukes
fine sand bottom. depth 11-12 ft. mlw



SAN DI

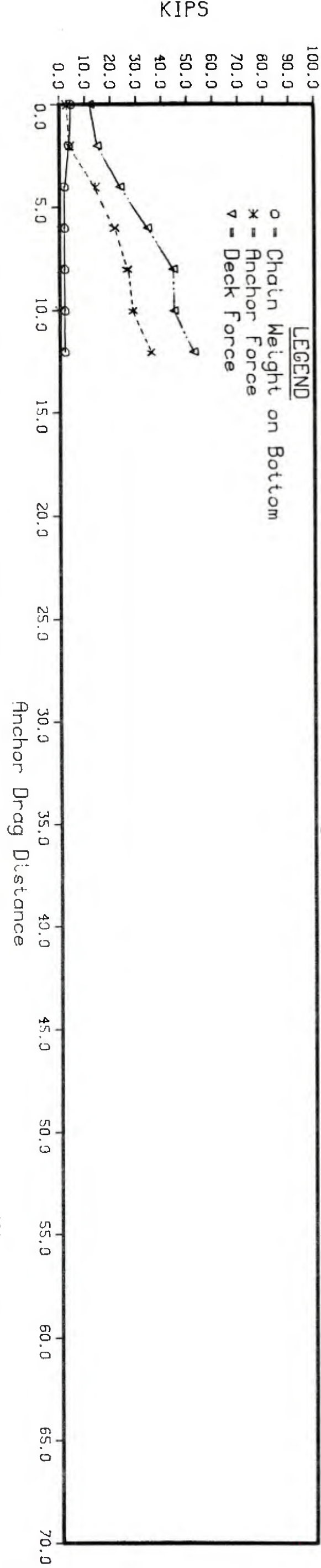
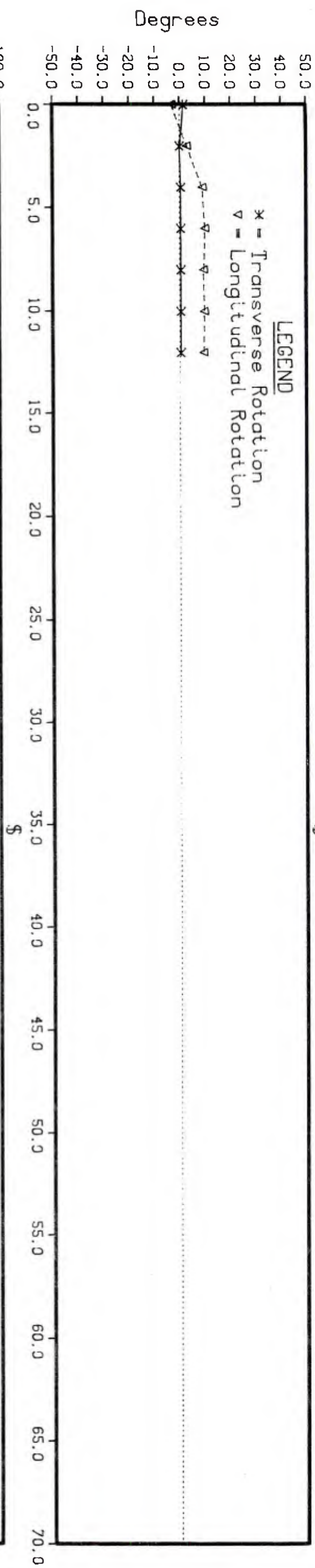
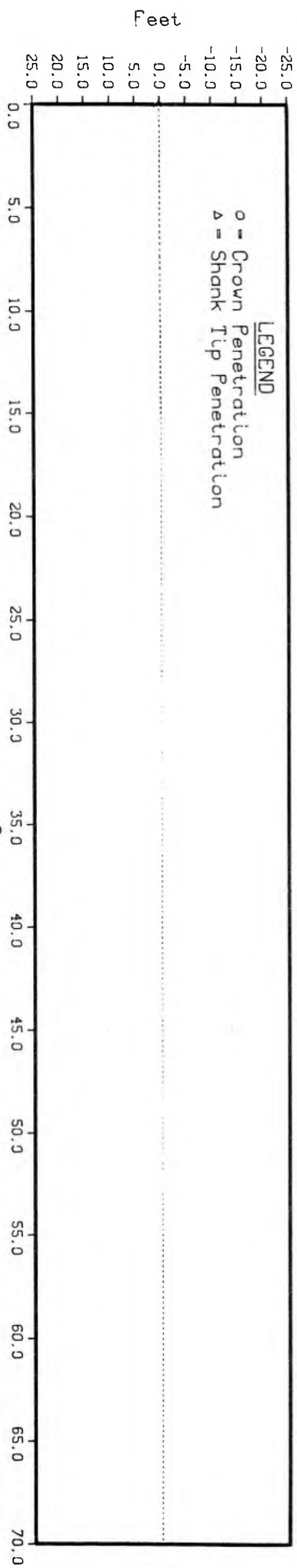


Day # = 89

SAN DIEGO HARBOR 1500 FT. SOUTHEAST OF BUOY 49

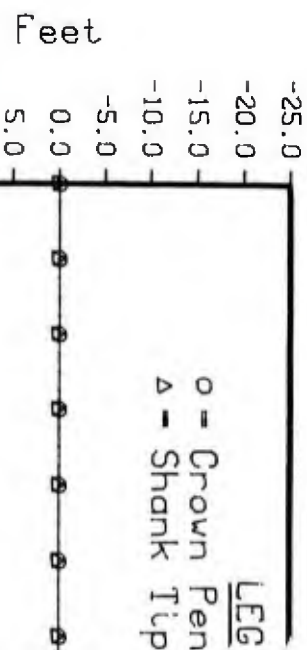
Test No. = 1

Test Series No. = 5 stockless, 5000lb. stabilizers-600lb. /pr. 35 deg. fx. fluke
fine sand bottom. depth 11-12 ft. mltw



Day # - 89
Test No. - 2
Test Series No. - 5

SAN DIEGO



CRITICAL CHECK DEPTH FROM IN DEFECT MEASUREMENT INFORMATION

TEST DATE
TEST NO. 2
TEST NO. 175
TEST AREA
STAIR-END TIME
SEAFLOR TYPE
ANCHOR TYPE
ANCHOR WEIGHT
FLUX AND/E-TEMP.
AUX. ANCHOR TYPE
AUX. ANCHOR TYPE
WAT-ANX ANCHOR SEPARATION
NEEDLEPS-VN-W/F. FACT-TRIAL WT.
WINDING LINE DESCRIPTION

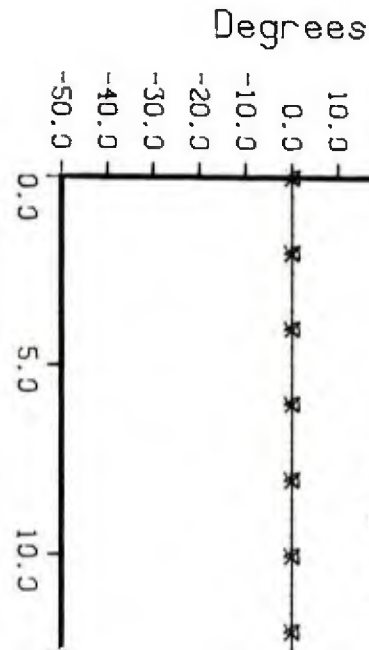
P9
5
SAN DIEGO HARBOR 1500 FT. SOUTHEAST OF BUOY 49
144 - 103
FINE SAND BOTTOM, DEPTH 11-12 FT., MLLW
STOCKLESS, 4000 LB. STABILIZER-6000 LB./90, 75 NPS, FR., FLUX
3500, 100 1A
35.00 00C, - 1 0240V 1=FIX
0.00 1B,
0.0 0FFV
0.0 - 0.0 1B,
ANCHOR TO LAIFT PIV, STABILIZER PLAIN TO LAIFT PIV, W/OF ONDP

0.0 FREE
N = 0.0 = N-1 LE.
SUCHOS TO LAST PIN, STITCH FOR CHAIN TO LAST PIN, W/ST END

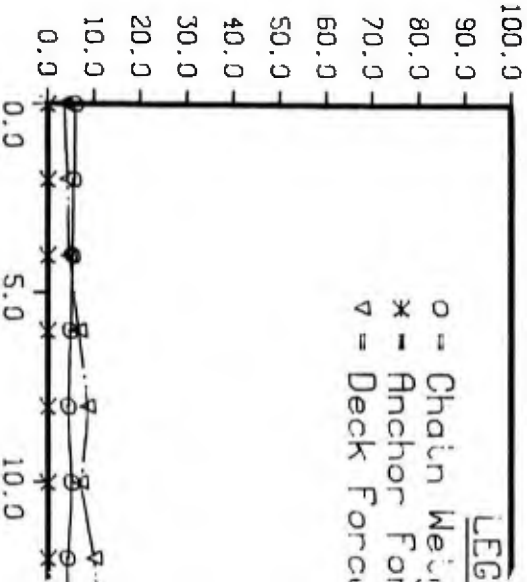
1. ANCHOR TENSION
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97. ANCHOR TENSION
98. ANCHOR TENSION
99. ANCHOR TENSION
100. ANCHOR TENSION

DISTANCE	MARGE TRAVELLED	56.0
DISTANCE	ANCHOR TRAVELLED	33.7

NOTE - POSITIVE CHANGE
AND A NEGATIVE
CHANGE TO THE
FORM.



Degrees



KIPS

Day # - 89

SAN DIEGO HARBOR 1500 FT. SOUTHEAST OF BUOY 49

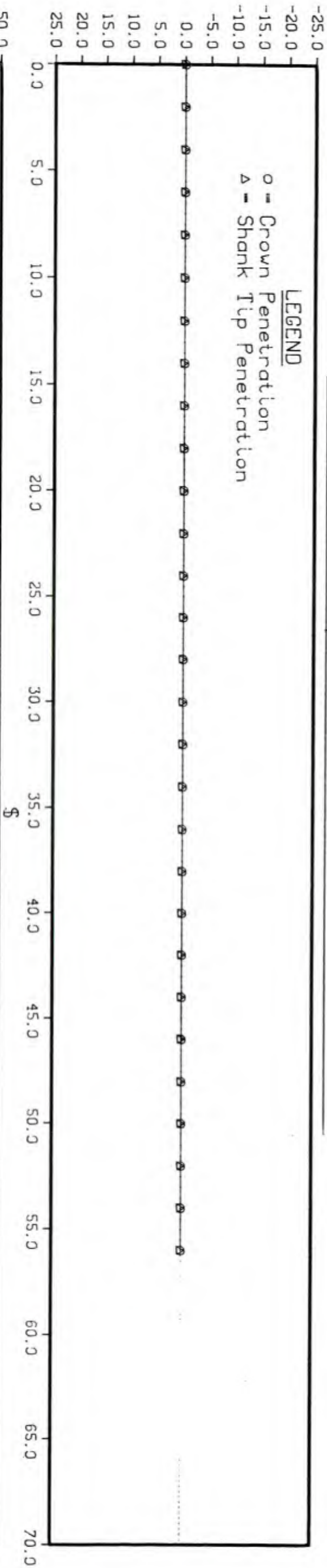
Test No. - 2

stockless .5000lb. stabilizers-600lb. /pr. 35 deg. fx. fluke

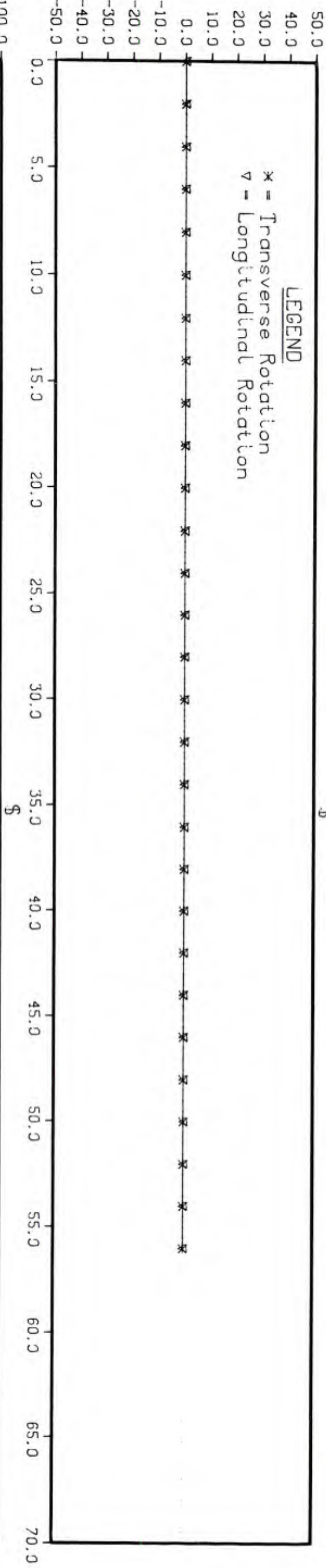
Test Series No. - 5

fine sand bottom. depth 11-12 ft. mllw

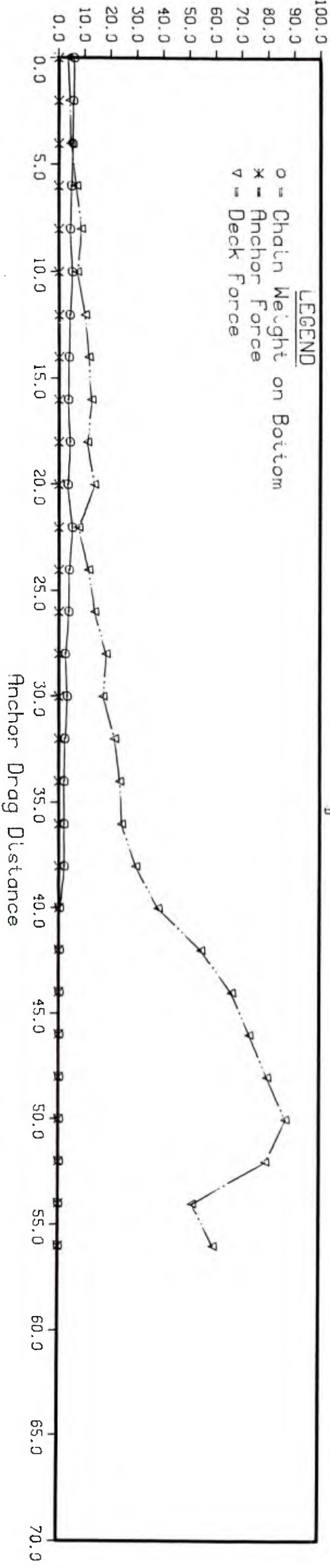
Feet



Degrees



KIPS



Day # - 92
 Test No. - 3
 Test Series No. - 5

SAN DIEGO

STUCKLES ANCHOR TEST

TEST DATE 92
 TEST NO. 3
 TEST SCOPE 5
 TEST AREA 1001 - 1013
 STATION TYPE SAN DIEGO HARBOUR 1500 FT. SOUTHEAST OF BUOY 40
 STATION TYPE FINE SAND BOTTOM, DEPTH 11-12 FT. ALLY
 ANCHOR TYPE STOCKLESS, 55000 LB. STABLE 17FPS-600LB. 700. 75 DEG. FX, FLUXE
 ANCHOR WEIGHT 50500.00 LB.
 FLUXE ANGLE F-TYPE 75.00 DEG., -1 02MOV 15FTX
 ALLY ANCHOR TYPE 75.00 DEG., -1 02MOV 15FTX
 ALLY ANCHOR WEIGHT 50500.00 LB.
 MAIN-ALLY ANCHOR SEPARATION 0.00 1 P.
 OFF-SCANS-IN-WT-FRM-TOTAL WT. 0.00 FEET - 0.00 LB.
 MONITORING LINE DESCRIPTION ANCHOR TO 100FT 210, STICK LNK CHAIN TO 400FT 210, WIDE DOOR

NOTE - INITIAL CHAIN DEPTH 77000 TO OFFSET MEASUREMENT WATERDEPTH

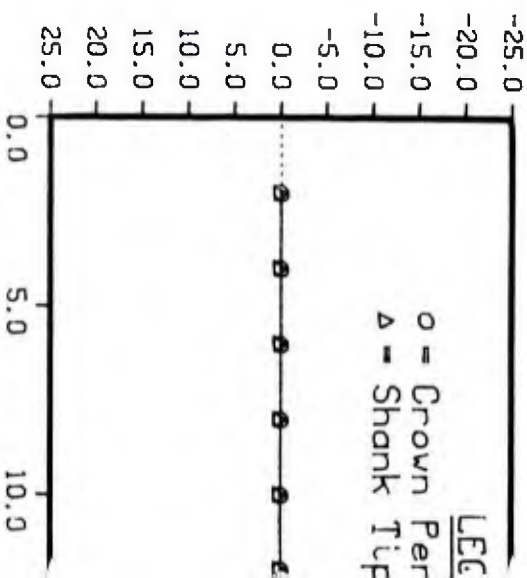
1. DEAG DISTANCE	2. DECV TENSION	3. ANCHOR TENSION	4. DECADE DEPTH	5. ROTATION ANGLE	6. SHAKE ANGLE	7. WIDE DOOR ANGLE	8. DECV MOVIZ. PROOF	9. CHAIN LENGTH ON BOTTOM	10. CHAIN WEIGHT ON BOTTOM	11. ANCHOR FROM DEPTH	12. ANCHOR CHAIN TIP DEPTH	13. ANCHOR FLUXE TIP DEPTH	14. WATER DEPTH	15. TOTAL BOTTOM WEIGHT
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
FEET	WLOC	WLOC	FEET	DEG.	DEG.	DEG.	WLOC	FEET	LB.	FEET	FEET	FEET	FEET	LB.
2.0	7.1	0.0	0.000	0.0	0.0	23.4	4.5	172.1	5475.5	0.000	0.000	0.000	15.0	11500.0
4.0	12.2	0.0	0.000	0.0	0.0	22.4	11.5	115.0	3459.4	0.000	0.000	0.000	15.0	6800.0
6.0	20.2	0.0	0.000	0.0	0.0	18.2	19.2	61.7	1963.8	0.000	0.000	0.000	15.0	7013.8
8.0	27.4	0.0	0.000	0.0	0.0	16.0	26.3	23.7	752.7	0.000	0.000	0.000	15.0	4703.7
10.0	24.3	0.0	0.000	0.0	0.0	15.3	25.4	42.2	1741.0	0.000	0.000	0.000	15.0	7201.0
12.0	31.4	0.0	0.000	0.0	0.0	13.3	30.6	32.5	1067.4	0.000	0.000	0.000	15.0	7017.4
14.0	41.5	0.0	0.000	0.0	0.0	12.8	40.5	0.0	1067.4	0.000	0.000	0.000	15.0	7017.4
NOTE - ALL PULL LINE AND CHAIN IS OFF BOTTOM AT 13.0 FEET														
16.0	46.6	0.0	0.000	0.0	0.0	12.5	45.5	0.0	1067.4	0.000	0.000	0.000	15.0	7017.4
NOTE - ALL PULL LINE AND CHAIN IS OFF BOTTOM AT 12.5														
18.0	42.8	0.0	0.000	0.0	0.0	10.8	41.7	0.0	1067.4	0.000	0.000	0.000	15.0	7017.4
NOTE - ALL PULL LINE AND CHAIN IS OFF BOTTOM AT 10.8														
20.0	46.1	0.0	0.000	0.0	0.0	10.5	42.7	0.0	1067.4	0.000	0.000	0.000	15.0	7017.4
NOTE - ALL PULL LINE AND CHAIN IS OFF BOTTOM AT 10.5														
22.0	40.1	0.0	0.000	0.0	0.0	0.0	20.5	FEET	0.0	1067.4	0.000	0.000	15.0	7017.4
NOTE - ALL PULL LINE AND CHAIN IS OFF BOTTOM AT 20.5														
24.0	55.7	0.0	0.000	0.0	0.0	0.0	22.5	FEET	0.0	1067.4	0.000	0.000	15.0	7017.4
NOTE - ALL PULL LINE AND CHAIN IS OFF BOTTOM AT 22.5														
26.0	57.7	0.0	0.000	0.0	0.0	0.0	24.0	FEET	0.0	1067.4	0.000	0.000	15.0	7017.4
NOTE - ALL PULL LINE AND CHAIN IS OFF BOTTOM AT 24.0														
28.0	47.9	0.0	0.000	0.0	0.0	10.8	44.7	0.0	1067.4	0.000	0.000	0.000	15.0	7017.4
NOTE - ALL PULL LINE AND CHAIN IS OFF BOTTOM AT 10.8														
30.0	51.7	0.0	0.000	0.0	0.0	10.8	50.7	0.0	1067.4	0.000	0.000	0.000	15.0	7017.4
NOTE - ALL PULL LINE AND CHAIN IS OFF BOTTOM AT 10.8														

DISTANCE RANGE TRAVELLED 28.0
 DISTANCE ANCHOR TRAVELLED 30.6

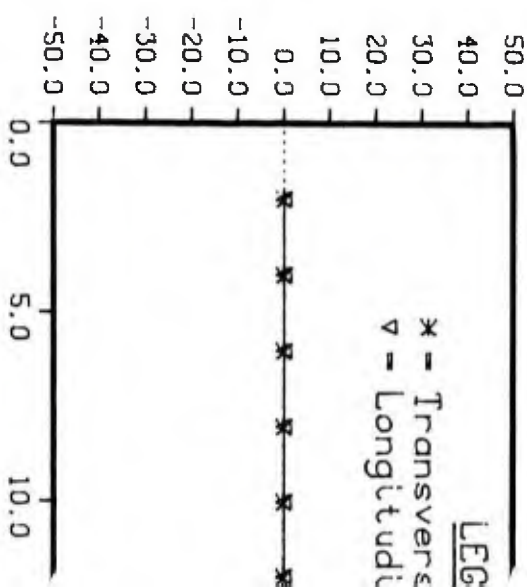
Note: Anchor depth at end
 of drag measured -
 centerline of shank at
 anchor crown = 34 inches.

NOTE - POSITIVE SHAKE
 ANGLE F-TYPE
 CHAIN TIP DEPTH
 (DEPTH)

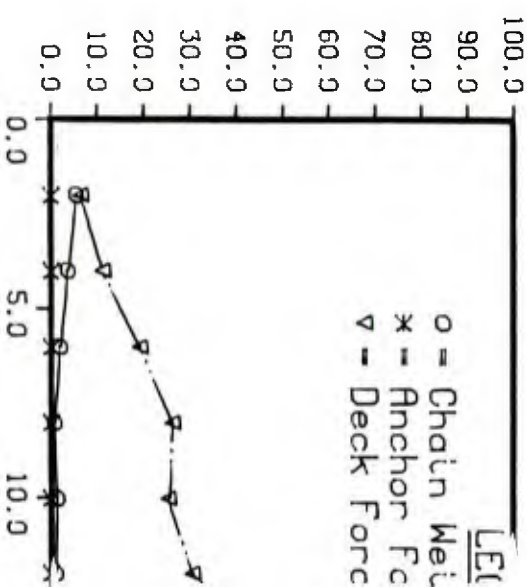
Feet



Degrees



KIPS



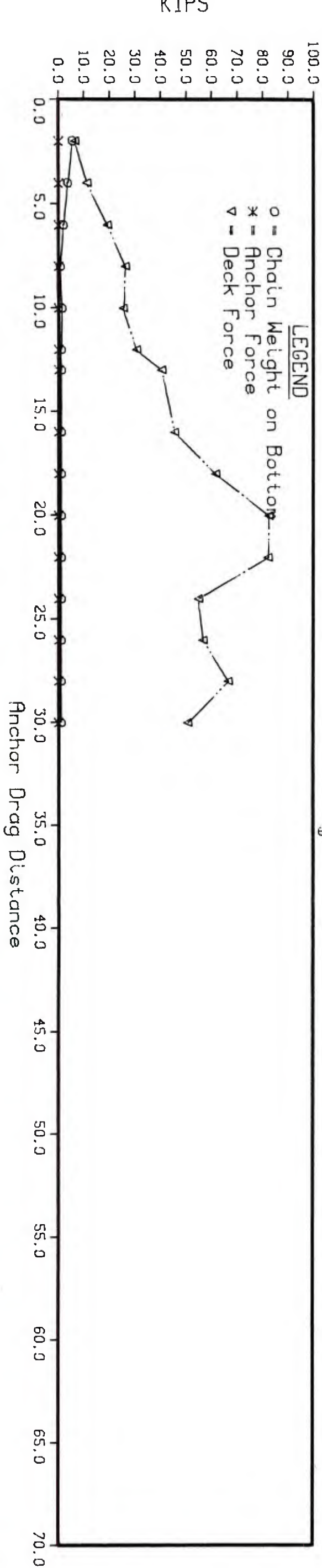
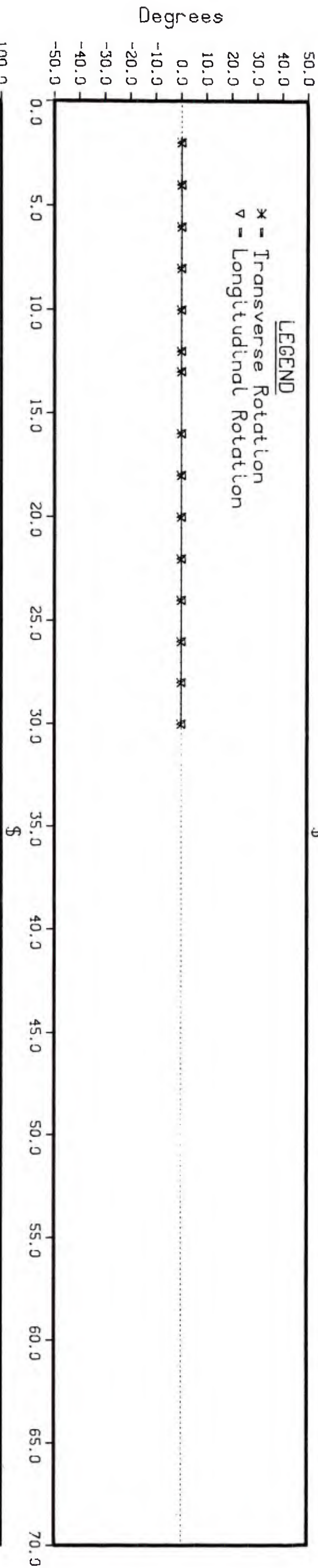
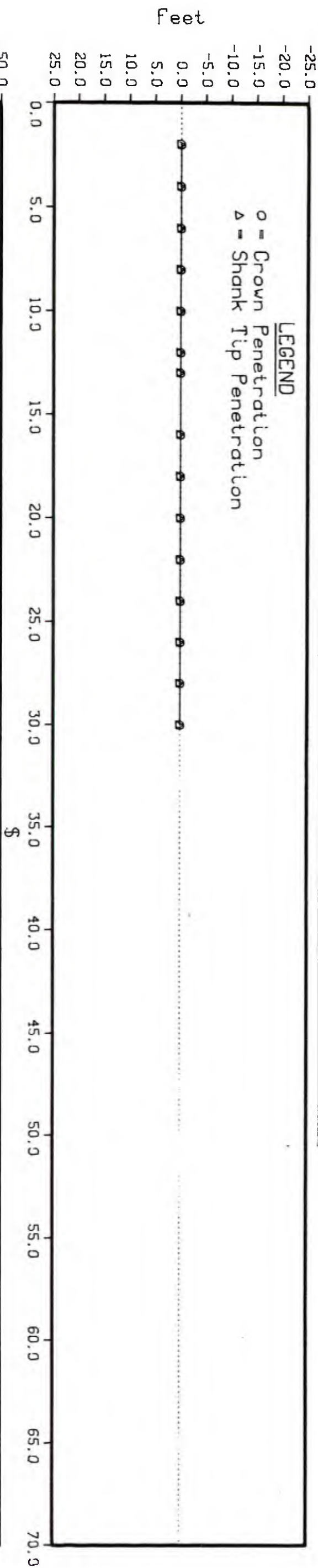
Day # = 92 SAN DIEGO HARBOR 1500 FT. SOUTHEAST OF BUOY 49

Test No. = 3

stockless, 5000lb. stabilizers-600lb. /pr. 35 deg. fx. fluke

Test Series No. = 5

fine sand bottom, depth 11-12 ft. mlw



Day # - 92 SAN D
 Test No. - 1
 Test Series No. - 6

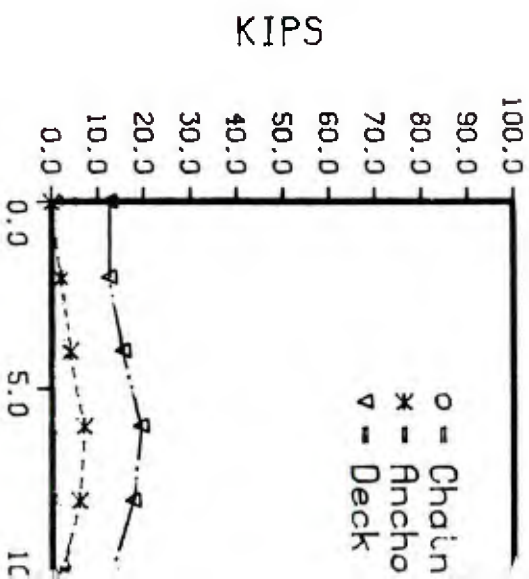
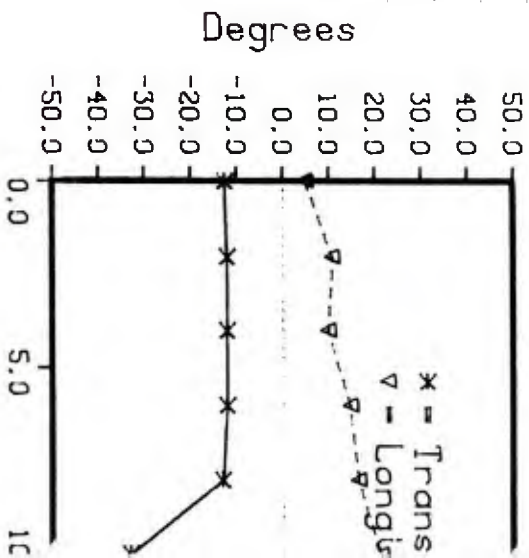
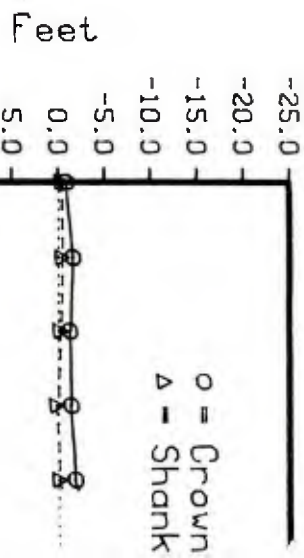
TEST DATE
 TEST NO.
 TEST SECT.
 TEST AOF
 START-ENR TIMES
 SEAFLOOR TYPE
 ANCHOR TYPE
 ANCHOR WEIGHT
 FLUXE ANGLE-TYPE
 AUX. ANCHOR TYPE
 AUX. ANCHOR WEIGHT
 MAIN-AUX ANCHOR SEPARATION
 DEPRESSORS-NO.-WT-EACH-TOTAL WT.
 MOORING LINE DESCRIPTION

STATO ANCHOR TEST

92
 1
 6
 SAN DIEGO HARBOR 1500 FT. SOUTHWEST OF QUAY 49
 1056 - 1244
 FINE SAND BOTTOM, DEPTH 11-12 FT. MLW
 STATO 1100.00 LB.
 1070.00 LB.
 35.00 DEG. - 0 02MOV LEFT
 0.00 LB.
 0.00 FFEET
 0.00 - 0.00 LB.
 ANCHOR TO 100FT PIN, STUDY INK CHAIN TO 400FT PIN, WIDE ROPE

NOTE - INITIAL SHANK DEPTH ZEROED TO REFLECT MEASURED WATERDEPTH

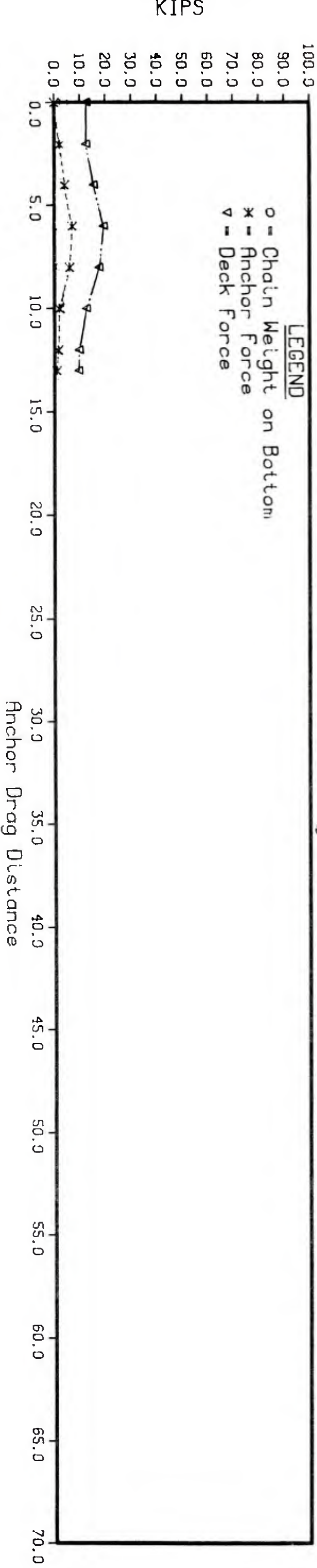
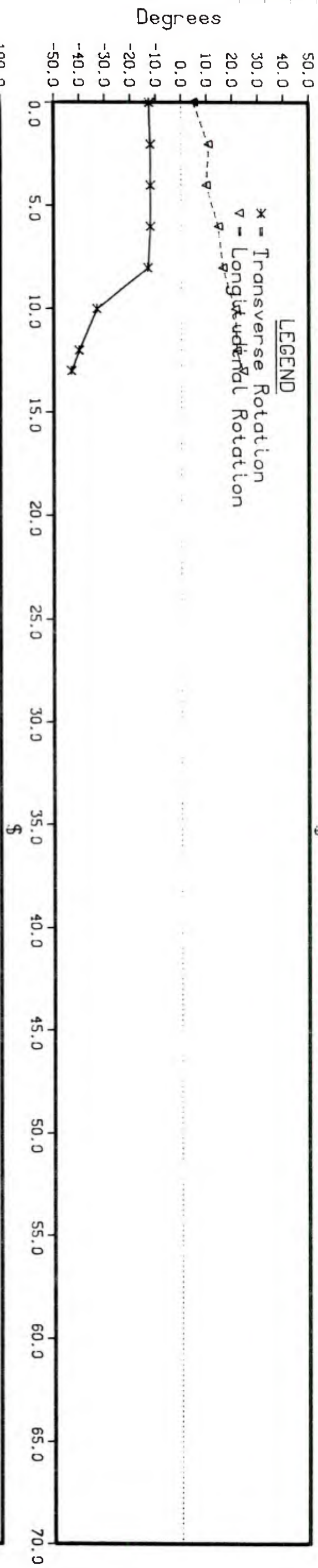
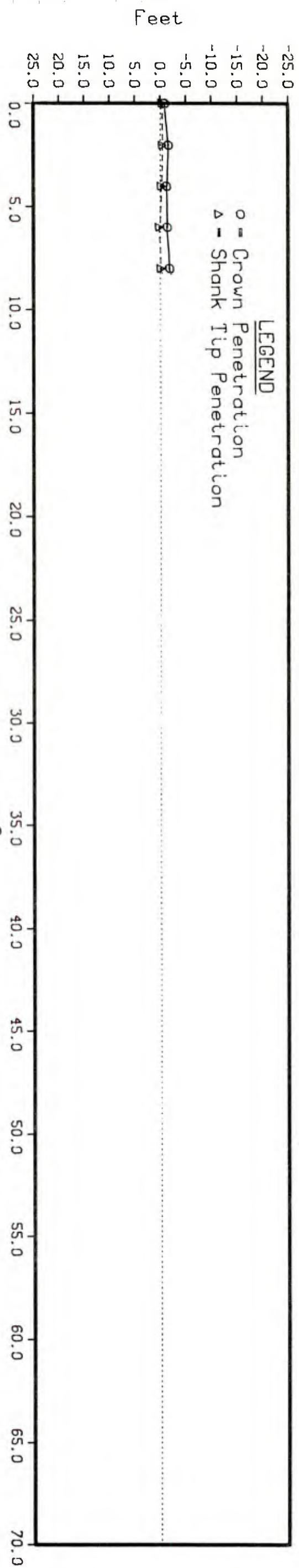
1. DEAD DISTANCE	2. DRAG TENSION	3. ANCHOR TENSION	4. PACKAGE DEPTH	5. ROTATION ANGLE	6. SHANK ANGLE	7. WIDE ROPE ANGLE	8. DECK HORIZ. FORCE	9. CHAIN LENGTH ON BOTTOM	10. CHAIN WEIGHT ON BOTTOM	11. ANCHOR CROWN DEPTH	12. ANCHOR SHANK TIP DEPTH	13. ANCHOR FLUXE TIP DEPTH	14. WATER DEPTH	15. TOTAL BOTTOM WEIGHT	NOTE - POSITIVE SHANK ANGLE INDICATES SHANK TIP BELOW CROWN
FEET	KIPS	KIPS	FEET	DEG.	DEG.	DEG.	KIPS	FEET	KIPS	FEET	FEET	FEET	FEET	FEET	FEET
0.0	11.3	0.0	15.9	-13.5	5.0		12.6	118.5	3732.1	15.1	15.4	15.4	15.4	15.4	15.4
2.0	13.3	2.0	15.4	-13.0	10.4		15.4	111.0	3532.0	14.4	15.4	15.4	15.4	15.4	15.4
4.0	16.4	4.0	15.0	-12.0	10.4		18.4	45.3	1490.4	14.7	15.4	15.4	15.4	15.4	15.4
6.0	20.5	7.0	16.1	-12.0	14.5		17.5	77.5	2448.9	14.1	15.4	15.4	15.4	15.4	15.4
8.0	19.5	6.0	15.4	-13.0	14.5		12.6	124.8	3969.9		17.0	17.0	17.0	17.0	17.0
10.0	13.3	2.0	15.5	-40.0	21.5		9.7	153.4	6682.4		16.0	16.0	16.0	16.0	16.0
12.0	10.3	1.5	15.4	-40.0	22.6		9.5	141.3	4466.8		16.0	16.0	16.0	16.0	16.0
13.0	10.3	1.0	15.5	-43.0	24.5										
DISTANCE RANGE TRAVELLED	13.0														
DISTANCE ANCHOR TRAVELLED	11.6														



Day # - 92 SAN DIEGO HARBOR 1500 FT. SOUTHEAST OF BUOY 49

Test No. - 1 stato 1000lb. 16 in. stabilizers 35 deg. mov. flukes

Test Series No. - 6 fine sand bottom. depth 11-12 ft. mllw



SPAN D



TEST DATE 95
TEST NO. 13
TEST STRIPS
TEST AREA
STRIP-FUN TYPE
SEAFLOOR TYPE
ANCHOR TYPE
ANCHOR WEIGHT
FLUME AND F-TYPE
AIR, ANCHOR TYPE
AIR, ANCHOR WEIGHT
AIR-ANCHOR SEPARATION
DEPRESSURE, WIND-DRIFT-TOTAL WT.
WINDING THE DECOMPRESSION

95
13
SAN DIEGO MARINE 1500 FT. SOUTHEAST OF BUOY 49
F14 - 1912
TUE - SAN BOTTOM, DEPTH 11-12 FT. W/LV
STUCKLESS, 5000 LB. STAIN 1750-5470 LB/500, 75 OF G. FT., FLUME
11370 LB.
75.00 DEG. - 1 0500V 125FT
0.00 LB.
0.0 FFF
0.0 - 0.0 LB.
WINDING TO JAWT 210, STAINING CHAIN TO JAWT 210, WIND 210

NOTE - INITIAL CHARGE NEEDS TO BE PAID BEFORE DELIVERY

NOTE - POSITIVE CHECK
ANGLE INDICATED
CHECK TO BE
DOWN

Day # - 95

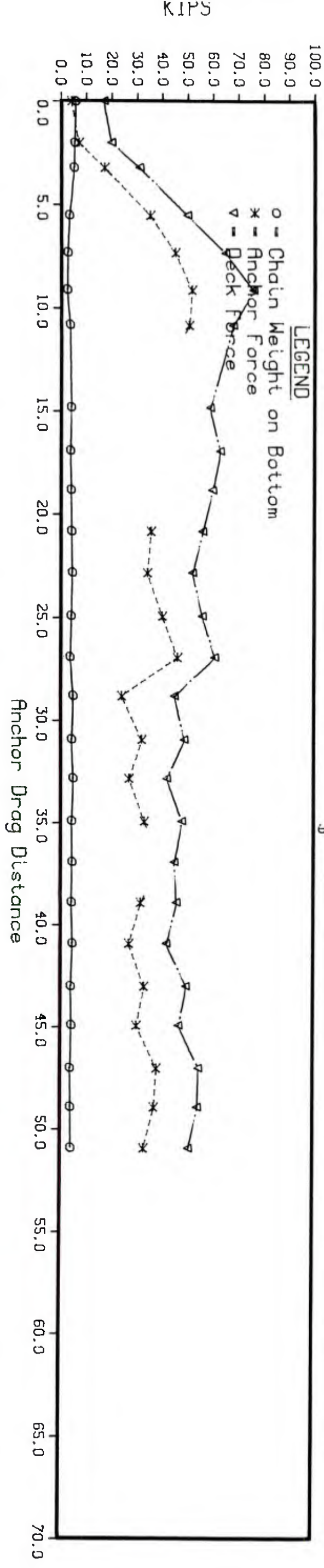
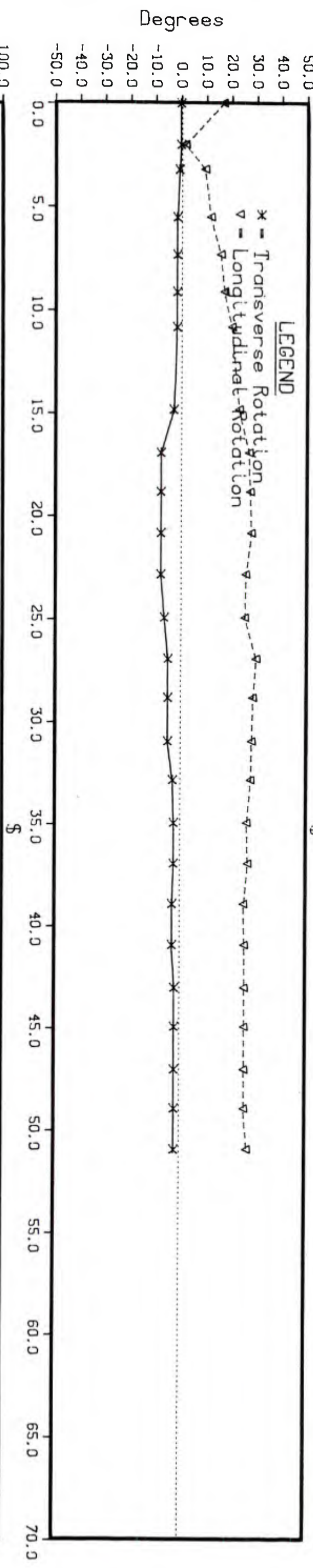
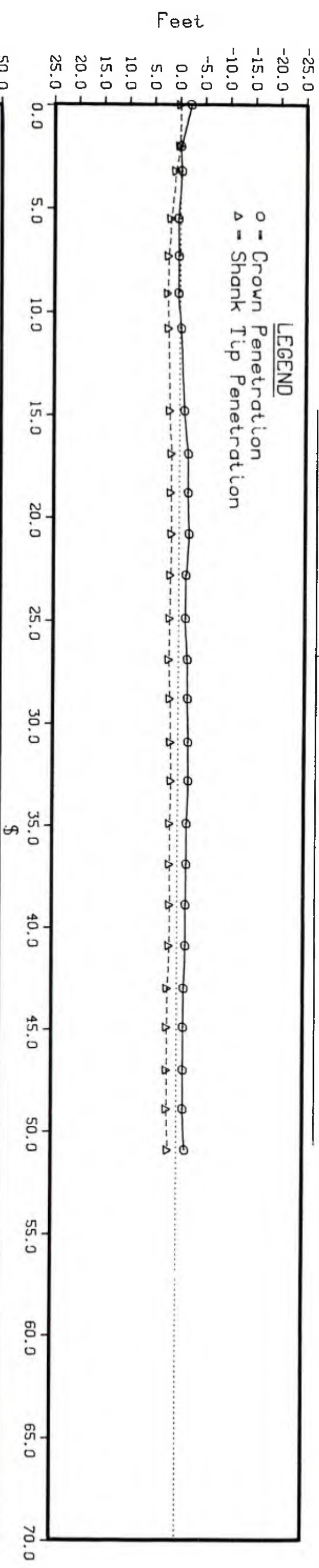
SAN DIEGO HARBOR 1500 FT. SOUTHEAST OF BUOY 49

Test No. - 1

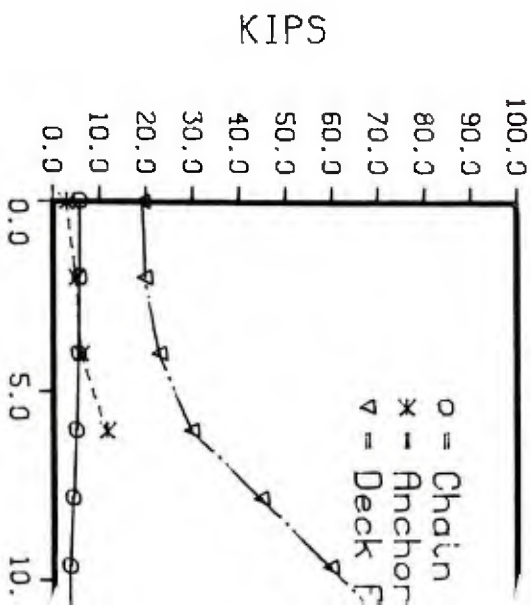
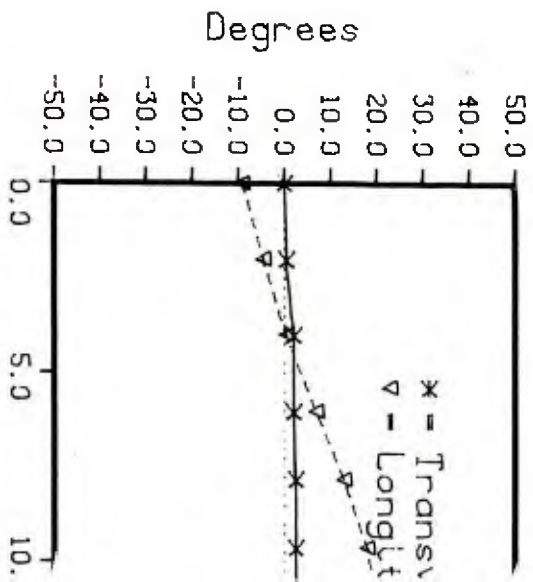
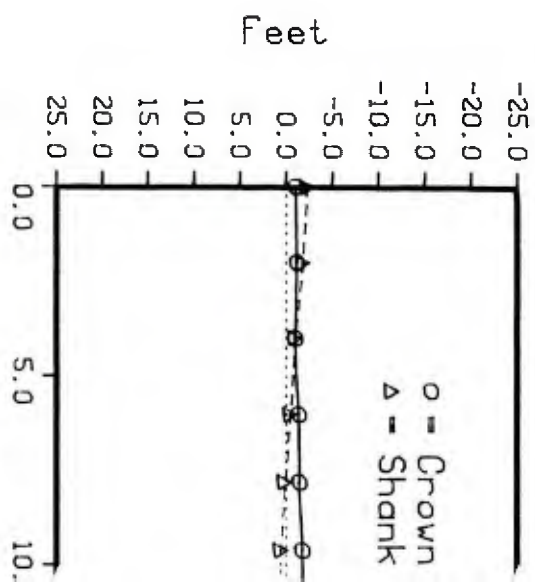
stockless, 9000lb. stabilizers-670lb/pr. 35 deg. fx. flukes

Test Series No. - 13

fine sand bottom. depth 11-12 ft. mllw



Day # - 95
Test No. - 2
Test Series No. - 13



```
TEST DATE
TEST NO.
TEST SERIALS
TEST AREA
START-FIN TIMES
STANDARD TYPE
ANCHOR TYPE
ANCHOR WEIGHT
FLUX* ANCHOR TYPE
FLUX* ANCHOR TYPE
FLUX* ANCHOR WEIGHT
MAIN-ANCHOR SEPARATION
POSTHOC-ANCHOR-FLUX*INTEL
POSITION LINE DESCRIPTION
```

```

95 STOPKF55 ANCHOP TEST
2
13
CAN DIEGN MARRNO 1500 FT. SOUTHEAST OF RUNY 40
1544 - 1400
FIVE SAND BOTTOM+ NEBTH 11-12 FT. MLY
STOPKF55 19000R. STAR11 127PS-670L/R/DR. 75 DEG. FX.
11370.00 LB.
75.00 DEG. -1 n=NOV j=fix
0.00 1R.
0.00 FFY
0.00
ANCHOP IN 140FT 2TH. STOPLIVE CHAIN TO 400FT 2TH. W10F R00F

```

NOTE - INITIAL CHALK DEPTH ZEROED TO OFFSET W/AS(10)F0N WATERDEPTH

[illegible]

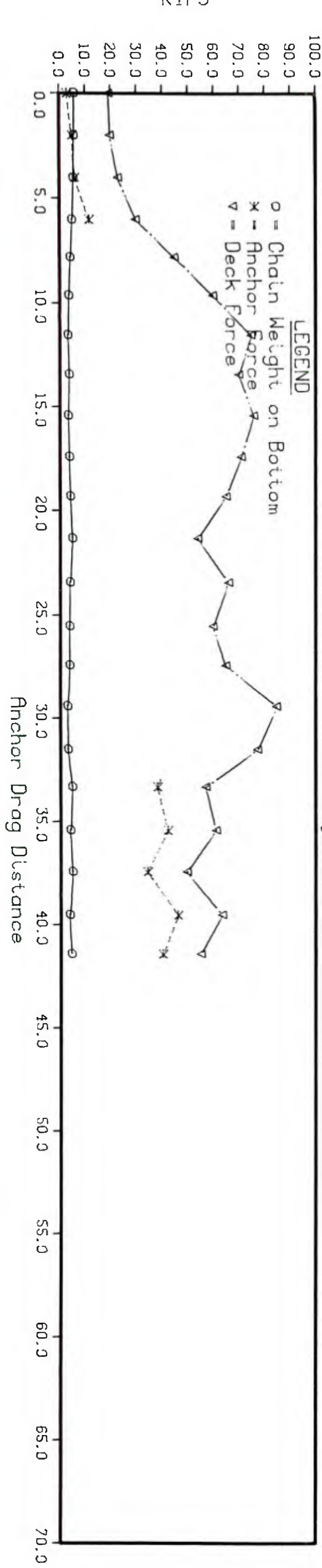
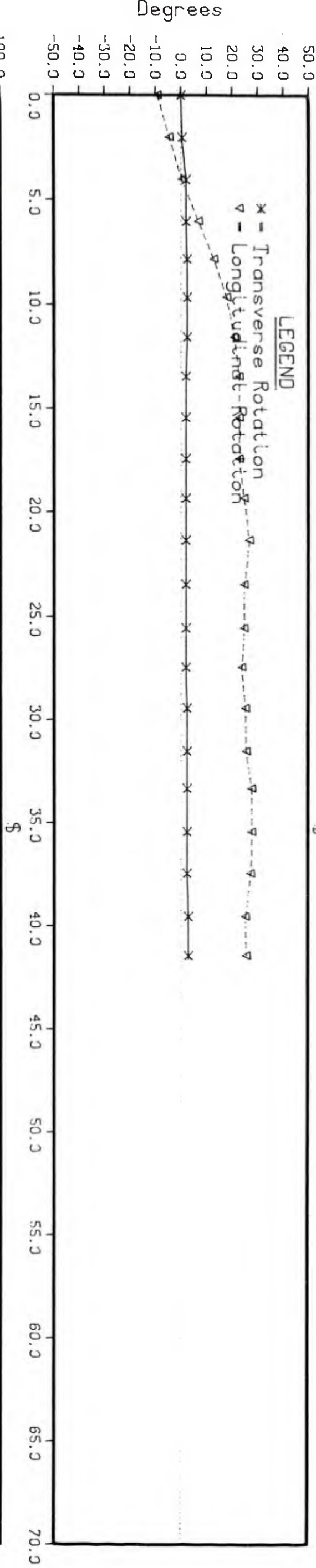
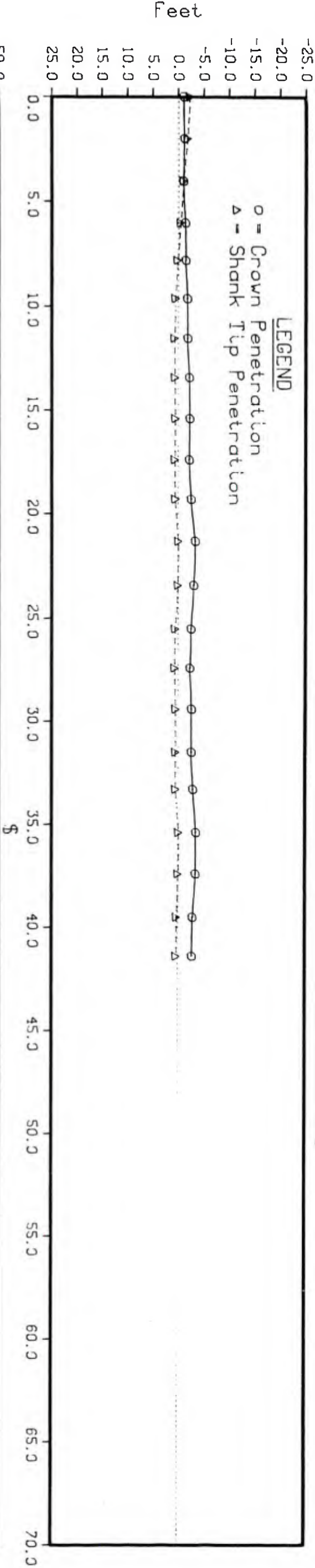
409F - POSITIVE CHAIR
409F IDENTIFY
CHAIR TYP AFFIDAVIT
PROVIN

Day # - 95
Test No. - 2
Test Series No. - 13

SAN DIEGO HARBOR 1500 FT. SOUTHEAST OF BUOY 49

stockless, 9000lb. stabilizers-670lb/pr. 35 deg. fx. flukes

fine sand bottom. depth 11-12 ft. mllw



Day # - 95 SPAN D
 Test No. - 1
 Test Series No. - 14

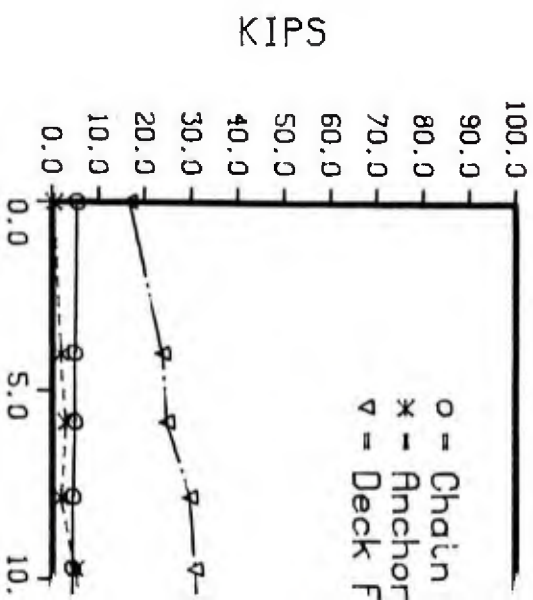
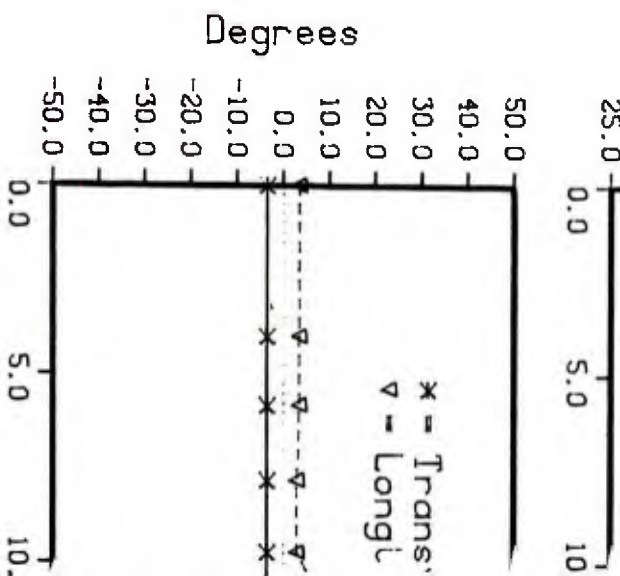
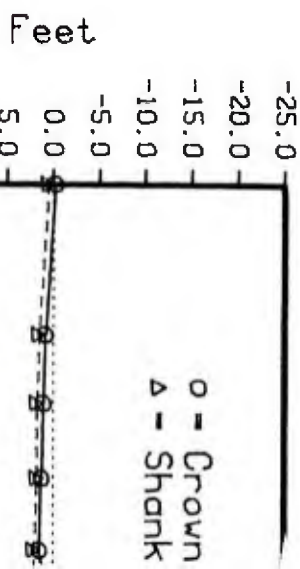
TEST DATE
 TEST NO. 95
 TEST SERIES 14
 TEST AREA SAN DIEGO HARBOUR 1500 FT. SOUTHEAST OF QUAY 40
 START-END TIMES 1337 - 1350
 SEAFLONG TYPE FINE SAND BOTTOM. DEPTH 11-12 FT. MLW
 ANCHOR TYPE STATO *3000LB. 37 DEG. WOV. FLOWERS
 ANCHOR WEIGHT 3000.00 LB.
 FLUKF ANGLE-TYPE 17.00 DEG. - 0 REMOV 1=FIX
 AUX. ANCHOR TYPE 0.00 LB.
 MAIN-ANCHOR SEPARATION 0.00 FT.
 DEPRESSION-WT.-EACH-TOTAL WT. 0.00 FT.
 ANCHOR TO LOFT 21N. STAINLINE CHAIN TO ANCH 21N. WIRE ROOF

NOTE - INITIAL CHAIN DEPTH ZEROED TO EFFECT MEASURED WATERDEPTH

1. DRAIN DISTANCE	2. DECK TENSION	3. ANCHOR TENSION	4. PACKAGE DEPTH	5. ROTATION ANGLE	6. CHAIN ANGLE	7. WIRE ROPE ANGLE	8. DECK HOIST. FORCE	9. CHAIN LENGTH ON BOTTOM	10. CHAIN EFFECTIVE DEPTH	11. ANCHOR CHAIN TIP DEPTH	12. ANCHOR CHAIN TIP DEPTH	13. ANCHOR FLUKF TIP DEPTH	14. WIRE DEPTH	15. TOTAL BOTTOM WEIGHT
FFFT	KIPS	KIPS	FEET	DEG	DEG	DEG	KIPS	FEET	FEET	FEET	FEET	FEET	FEET	FEET
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0.0	17.0	14.5	14.5	-3.5	3.5	8.1	16.8	171.5	5456.5	14.1	14.7	17.9	14.3	4564.5
4.0	24.0	2.0	15.7	-3.5	3.5	7.7	24.8	155.3	4910.0	15.1	15.7	18.9	14.3	7910.0
5.8	25.0	3.0	15.7	-3.5	3.5	7.3	29.8	140.8	4479.7	15.4	15.9	19.2	14.3	7941.9
7.8	30.0	2.0	15.8	-3.5	3.5	7.1	30.8	140.2	4460.0	15.7	16.3	19.5	14.3	7940.7
9.7	31.0	5.0	16.1	-3.5	3.5	7.0	31.8	139.0	4391.8	15.9	16.2	19.6	14.3	7901.8
11.7	32.0	8.0	15.4	-3.5	3.5	6.2	43.7	111.2	3539.6	14.6	17.0	19.1	14.3	6530.4
13.6	44.0	16.0	16.2	-3.5	3.5	5.9	48.7	102.3	3254.8	14.7	17.0	19.2	14.3	6254.8
15.5	49.0	20.0	16.2	-3.5	3.5	5.7	56.7	82.7	2530.4	14.8	17.2	19.3	14.3	5630.4
17.5	57.0	25.5	16.4	-3.5	3.5	5.1	64.7	79.0	2513.5	14.7	17.5	19.4	14.3	5513.5
19.3	65.0	31.0	16.4	-3.5	3.5	4.9	69.8	99.5	3166.6	14.0	17.8	19.0	14.3	6166.6
21.1	60.0	30.0	16.4	-3.5	3.5	4.9	77.9	158.6	5085.8	14.0	17.5	19.0	14.3	6085.8
22.9	38.0	20.0	16.4	-7.0	19.0	5.5	74.9	155.2	4937.0	14.3	17.0	19.1	14.3	7937.0
25.1	35.0	17.0	15.7	-10.0	20.0	8.9	14.8	151.6	5970.9	14.3	17.0	19.1	14.3	9870.9
26.6	15.0	3.0	15.7	-37.0	16.5	8.9	15.8	193.8	5916.2	14.3	17.0	19.1	14.3	9870.9
29.7	14.0	3.0	15.4	-44.3	18.3	8.9	14.8	193.8	5916.2	14.3	17.0	19.1	14.3	9870.9
31.8	14.0	3.0	15.4	-44.3	20.0	8.9	14.8	193.8	5916.2	14.3	17.0	19.1	14.3	9870.9
34.9	14.0	3.0	15.4	-44.3	20.0	8.9	14.8	193.8	5916.2	14.3	17.0	19.1	14.3	9870.9
37.8	14.0	5.0	16.1	-44.3	20.0	8.9	14.8	193.8	5916.2	14.3	17.0	19.1	14.3	9870.9
39.8	14.0	5.0	16.1	-44.3	20.0	8.9	14.8	193.8	5916.2	14.3	17.0	19.1	14.3	9870.9
39.8	14.0	5.0	16.1	-44.3	20.0	8.9	14.8	193.8	5916.2	14.3	17.0	19.1	14.3	9870.9

DISTANCE RANGE TRAVELLED 40.0
 DISTANCE ANCHOR TRAVELLED 39.8

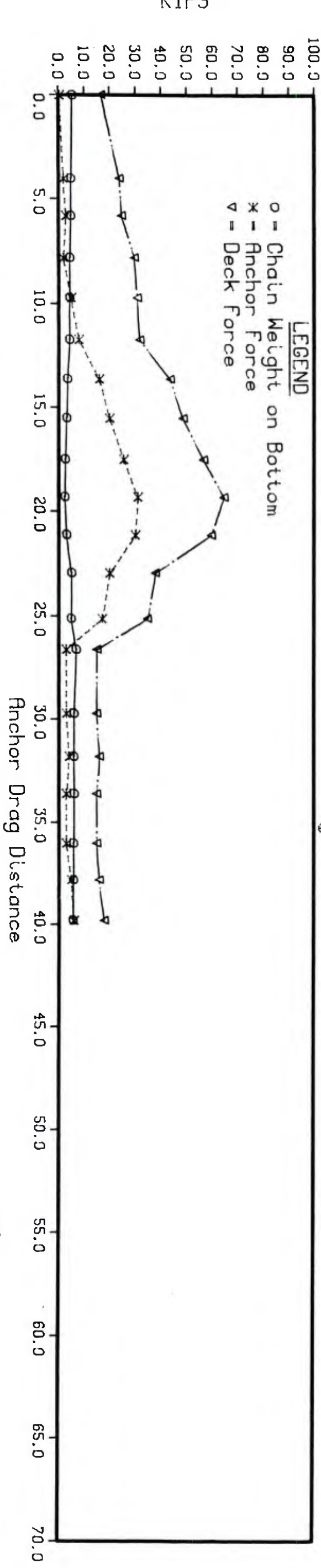
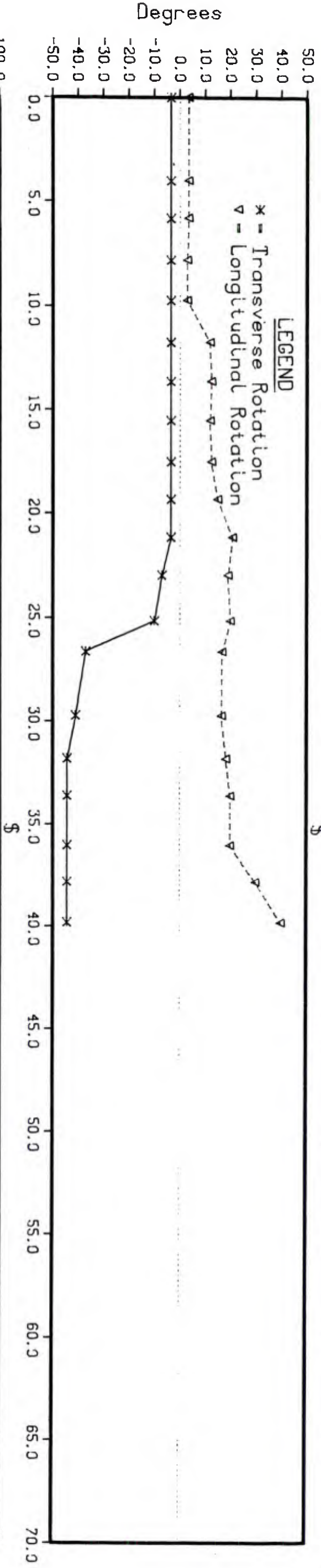
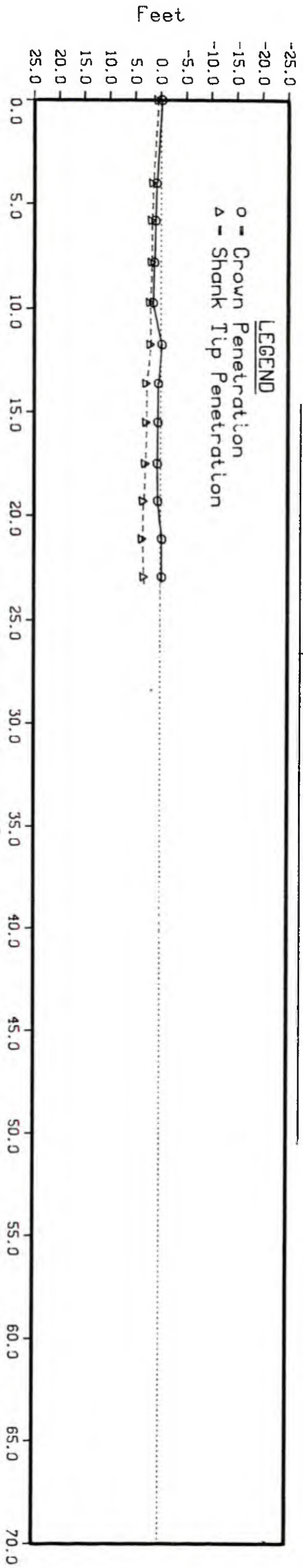
NOTE - POSITIVE SHANK
 ANGLE INDICATES
 SHANK TIP BELOW
 GROUND



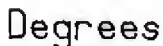
Day # - 95 SAN DIEGO HARBOR 1500 FT. SOUTHEAST OF BUOY 49

Test No. - 1 state , 3000lb. 37 deg. mov. flukes

Test Series No. - 14 fine sand bottom. depth 11-12 ft. mllw



SAND



Day # - 95

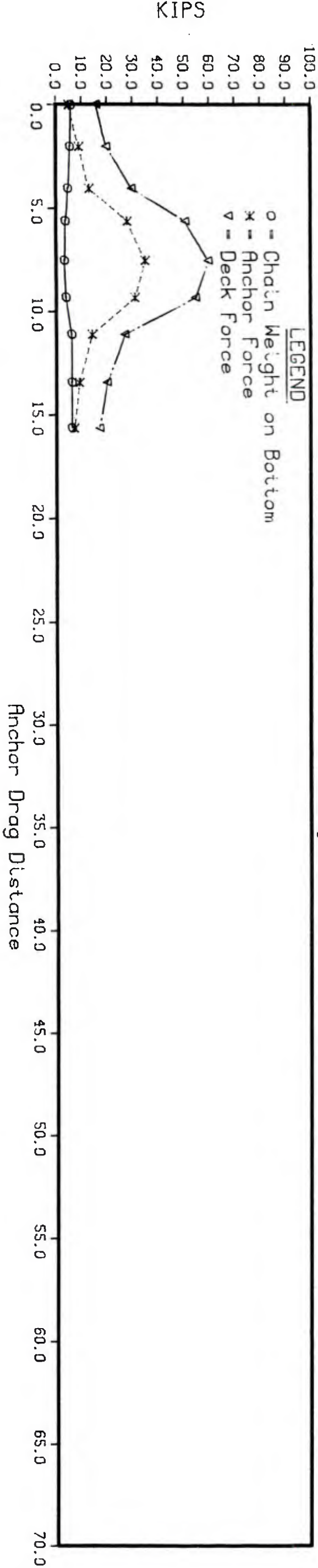
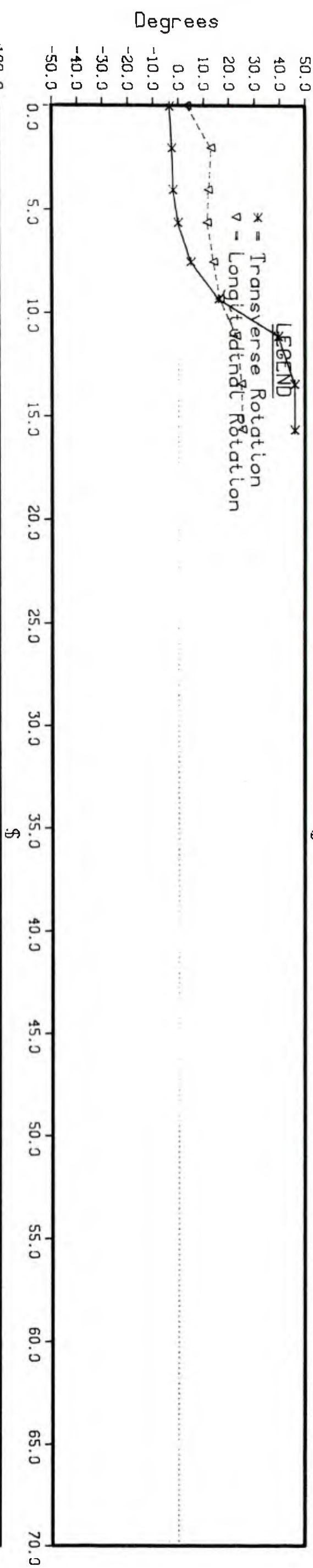
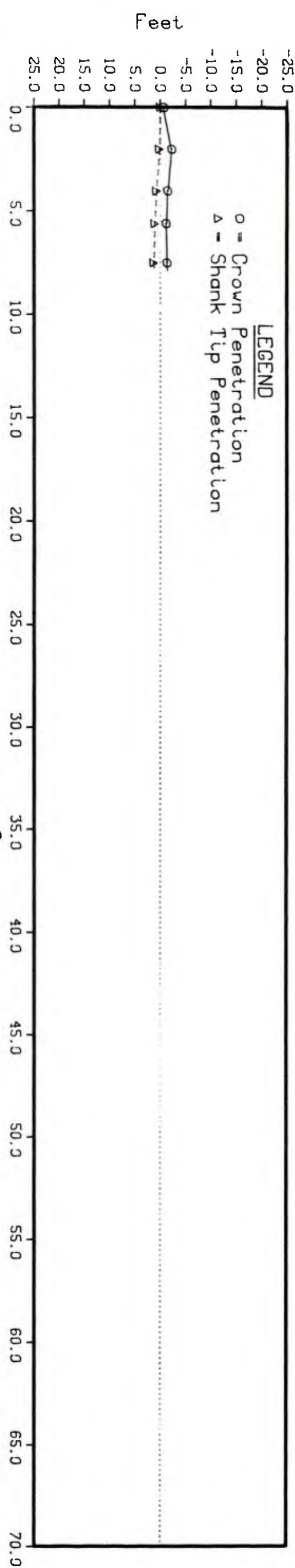
SAN DIEGO HARBOR 1500 FT. SOUTHEAST OF BUOY 49

Test No. - 2

stato ,3000lb. 37 deg. mov. flukes

Test Series No. - 14

fine sand bottom. depth 11-12 ft. mlv



Day # = 99 SN
 Test No. = 2
 Test Series No. = 6

TEST DATE
 TEST WPT
 TEST SPECIES
 TEST DECK
 STATION TYPE
 ANCHOR TYPE
 ANCHOR WEIGHT
 FLUXF ANGLE TYPE
 AUX. ANCHOR WEIGHT
 MAIN-AUX ANCHOR SEPARATION
 DEPRESSION-WT. FACT-TOTAL WT.
 MOORING LINE DESCRIPTION

STATO ANCHOR TEST

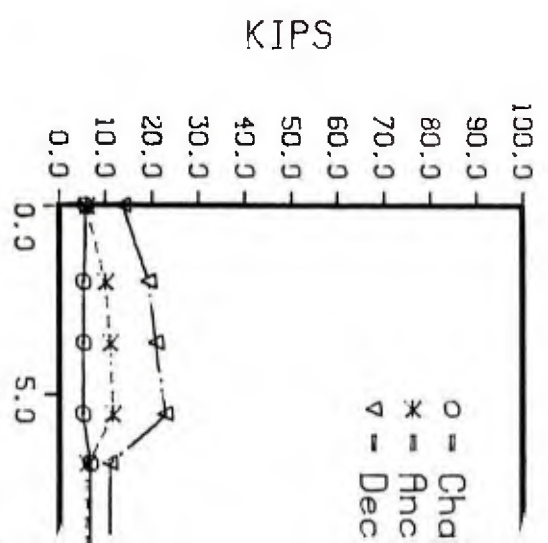
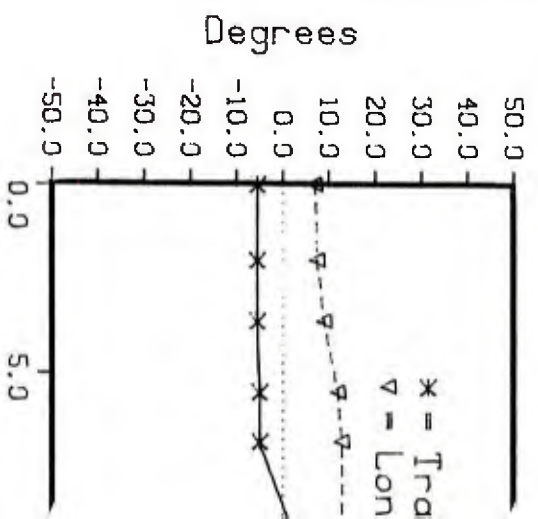
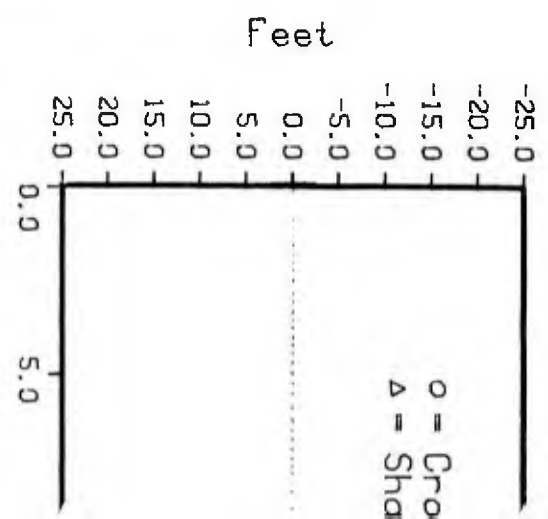
99
 2
 SAW DIEGN HARBOR 1500 FT. SOUTHWEST OF BUNY 40
 101A - 1013
 FINE SAND BOTTOM. DEPTH 11-12 FT. WLLW
 STATO 1000 R. 26 IN. STABILIZER 35 DEG. WY. FLUXF
 1000.00 10.
 15.00 DEG. = 0 0=MOV 1=FIX
 0.00 10.
 0.0 0.0 - 0.0 10.
 ANCHOR TO 100FT 21W. CHAIN TO 400FT 21W. WIDF ONDE

NOTE - INITIAL CHAIN DEPTH ZEROED TO OFFSET MEASURED WATERDEPTH

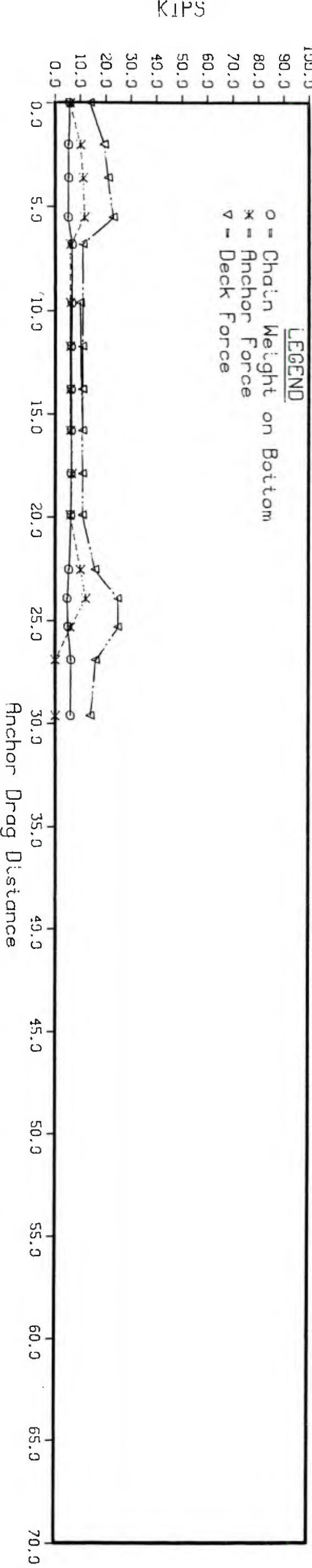
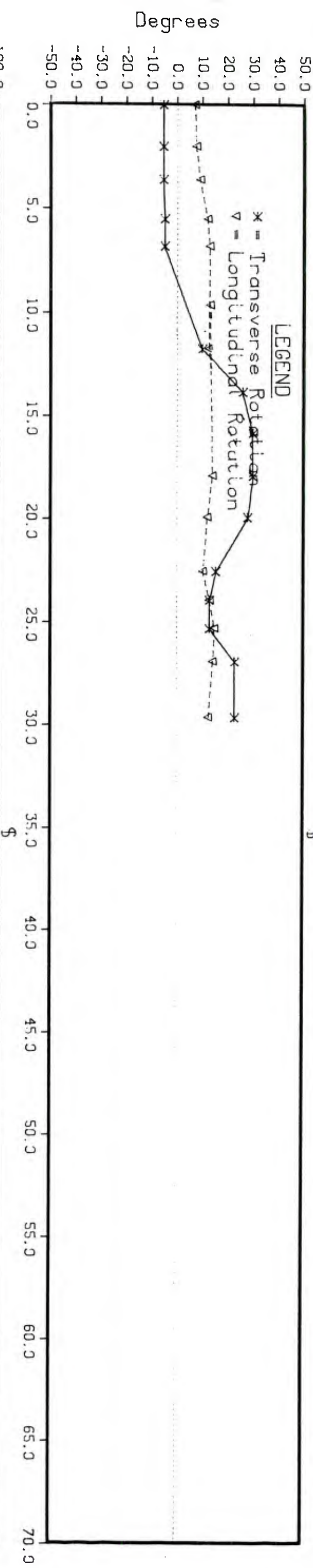
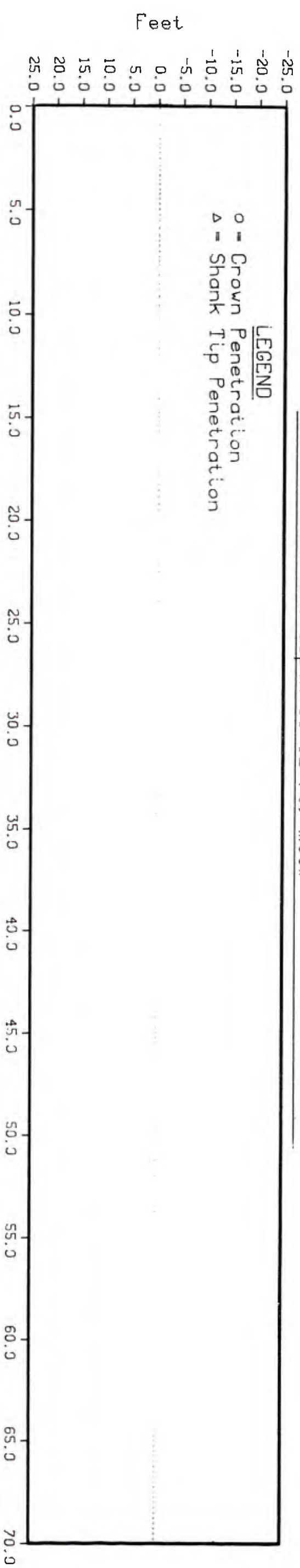
1. DECK DISTANCE	2. DECK TENSION	3. ANCHOR TENSION	4. BACKLAGE DEPTH	5. ROTATION ANGLE	6. SHAKE ANGLE	7. WIDE DEPTH ANGLE	8. DECK ANGLE	9. CHAIN LENGTH ON BOTTOM	10. CHAIN WEIGHT ON BOTTOM	11. ANCHOR CROWN DEPTH	12. ANCHOR CHAIN TIP DEPTH	13. ANCHOR FLUXF TIP DEPTH	14. WATD DEPTH	15. TOTAL BOTTOM WEIGHT
FEET	X IPS	K IPS	FEET	DEG	DEG	DEG	DEG	K IPS	FEET	100	FEET	FEET	FEET	FEET
0.0	14.0	6.0	14.1	-5.5	7.0	10.7	13.4	178.9	5402.3					14.5
2.0	10.5	10.0	14.0	-5.5	7.5	9.1	19.3	163.7	5207.5					14.5
7.6	21.0	11.0	14.0	-5.5	9.0	8.2	20.8	166.4	5296.4					14.5
4.3	23.0	11.5	13.9	-5.0	12.0	7.9	22.8	161.2	5130.4					14.5
11.0	11.0	6.0	13.4	-5.0	12.0	8.2	10.0	135.2	4722.7					14.5
11.0	11.0	6.0	12.9	10.0	12.5	10.5	10.6	10.8	4287.0					14.5
15.0	11.0	6.0	13.0	24.0	15.0	10.6	10.8	96.3	4268.1					14.5
15.0	11.0	6.0	13.0	30.0	17.0	10.5	10.8	95.7	4268.1					14.5
17.0	11.0	6.0	12.9	30.0	14.0	10.8	10.8	95.8	4230.4					14.5
19.0	11.0	6.0	13.1	28.0	12.0	10.8	10.8	95.8	4230.4					14.5
22.0	14.0	12.0	13.5	15.5	10.3	10.4	15.7	169.8	5401.7					14.5
23.0	25.0	12.0	13.8	13.0	8.3	24.7	167.2	4482.7	5115.0					14.5
25.0	25.0	0.0	13.0	13.0	7.5	15.0	24.8	160.2	4203.2					14.5
26.0	16.0	0.0	13.0	13.0	9.5	13.4	219.5	5980.9						14.5
29.0	14.0	0.0	13.0	23.0	12.5									14.5

DISTANCE RANGE TRAVELLED 30.0
 DISTANCE ANCHOR TRAVELLED 29.6

WNTF - POSITIVE CHAIN
 ANGLE INDICATES
 CHAIN TIP RFLW
 FROM



Day # = 99 SAN DIEGO HARBOR 1500 FT. SOUTHEAST OF BUOY 49
 Test No. = 2 stato 1000lb. 26 in. stabilizers 35 deg. mov. flukes
 Test Series No. = 6 fine sand bottom. depth 11-12 ft. mllw

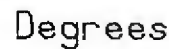
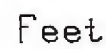


SPAN

SPAN

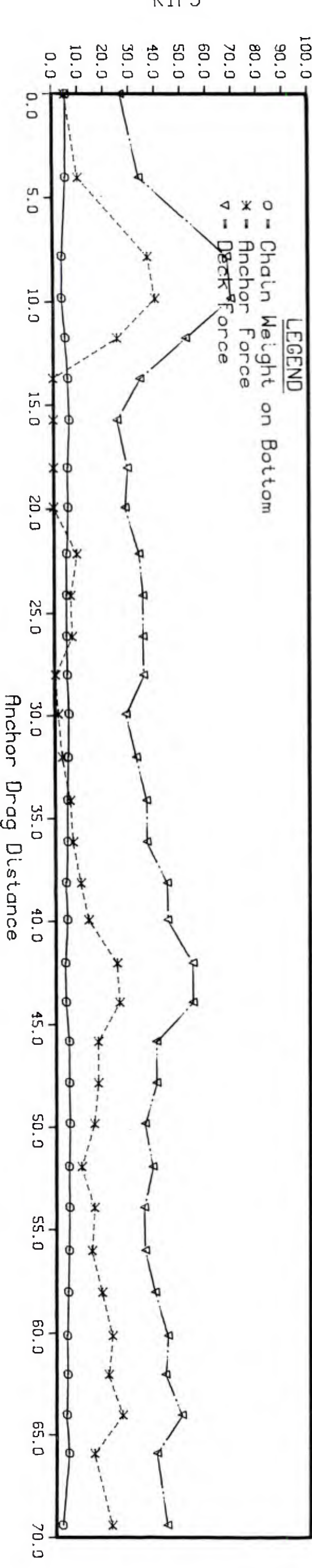
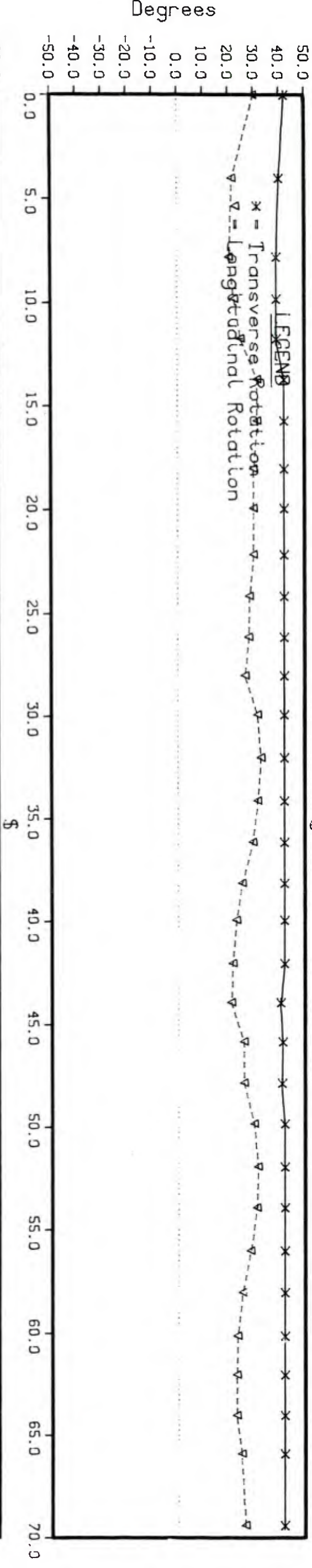
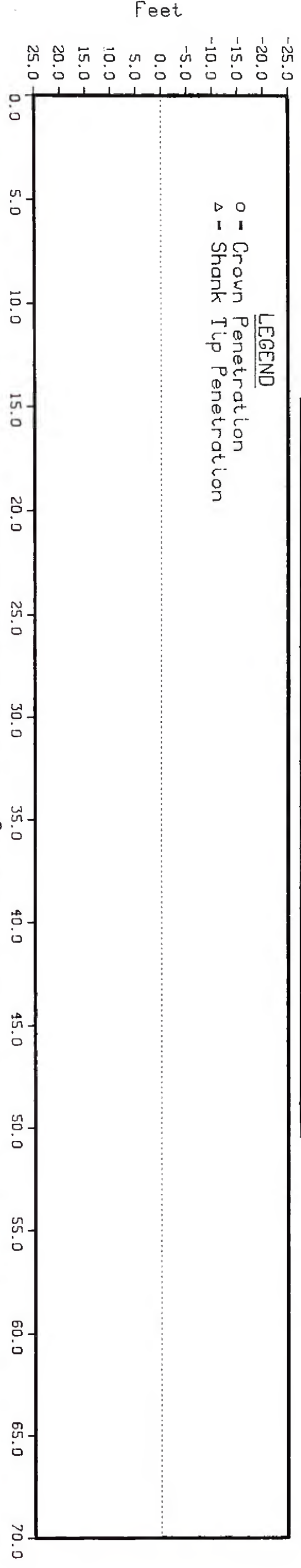
SPAN

SPAN



Day # - 100 SAN DIEGO HARBOR 1500 FT. SOUTHEAST OF BUOY 49

Test No. - 3
Test Series No. - 14
state, 3000lb. 18 in. stabilizer ext. 37 deg. mov. flukes
fine sand bottom. depth 11-12 ft. mllw



SAN D



Day # = 100

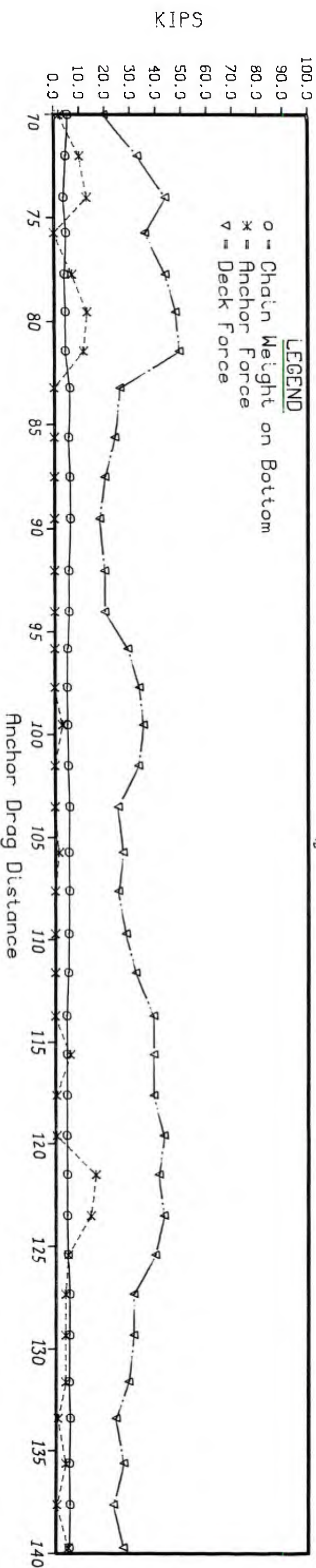
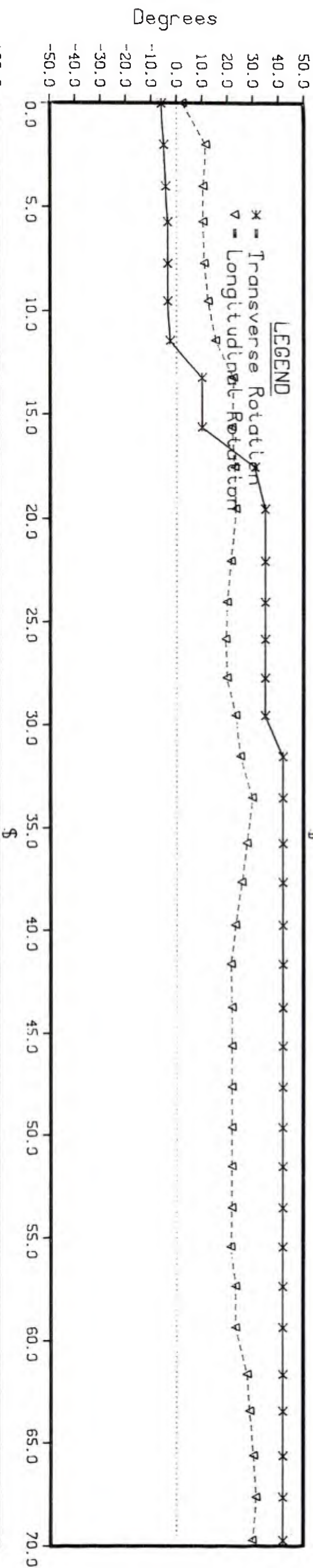
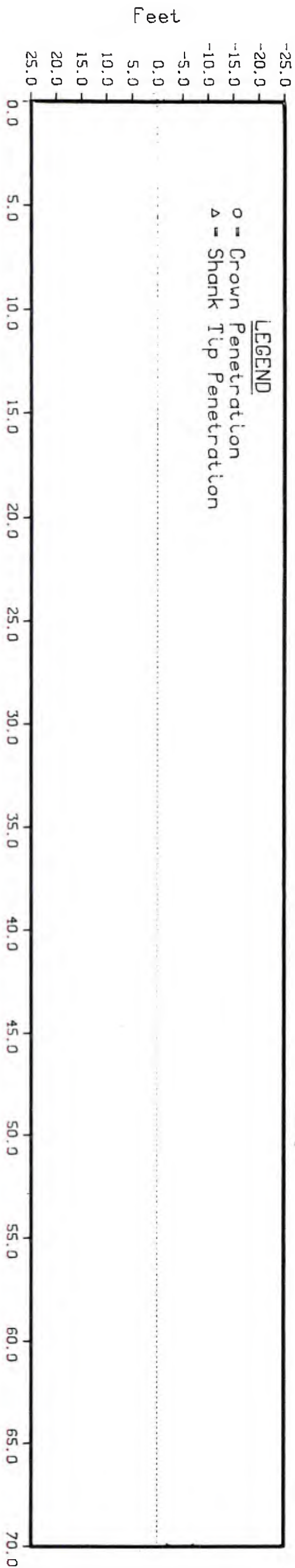
SAN DIEGO HARBOR 1500 FT. SOUTHEAST OF BUOY 49

Test No. = 3

stato , 3000lb. 18 in. stabilizerext. 37 deg. mov. flukes

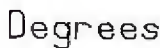
Test Series No. = 14

fine sand bottom. depth 11-12 ft. mllw



SAND

14



TEST DATE	
TEST NO.	100
TEST SERIES	4
TEST AREA	14
START-ENO TYPES	SAN DIEGO HARBOR 1500 FT. SOUTHEAST OF RUMY 40
SEAFLOOR TYPE	1500-1520
ANCHOR TYPE	FIVE SAM BOTTOM, DEPTH 11-12 FT., MUM
ANCHOR WEIGHT	STAD 1200LB, 18 IN. STABILIZER, 11.5DEG-MOV, FLUMES
FLUX* ANCH TYPE*	3000.00 LB
AUX. ANCHOR TYPE	11.50 DEG. - 0 0=MOV 1=FIX
AUX. ANCHOR WEIGHT	
MAIN-AUX ANCHOR SEPARATION	0.00 LB.
DEPRESS-NO.-WT-EACH-TOTAL WT.	0.0 FEET
ANCHOR LINE DESCRIPTION	0.0 - 0.0 LB.
	ANCHOR TO 100FT PIN STATION THE CABLE TO 600FT 20.

NOTE - INITIAL CHAMK DEPTH ZEROED TO REFLECT MEASURED WATERDEPTH

DISTANCE	RARGE TRAVELLED	42.0
DISTANCE	ANCHOR TRAVELLED	41.6

Note: Anchor depth at end of drag measured — centerline of shank at anchor crown = 18 inches

NOTE - POSITIVE CHAIR
ANGLE INDICATES
CHAIR TID BFLW
CONVM

Day # = 100

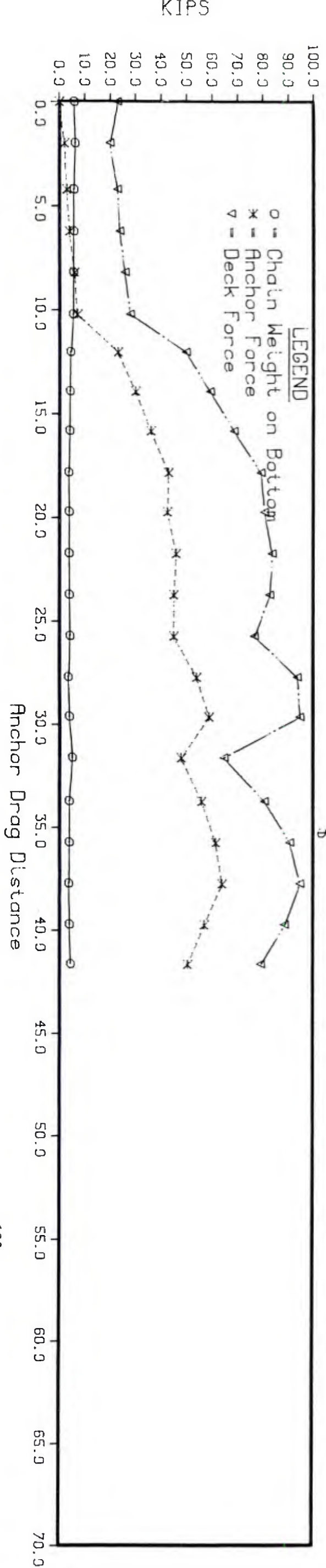
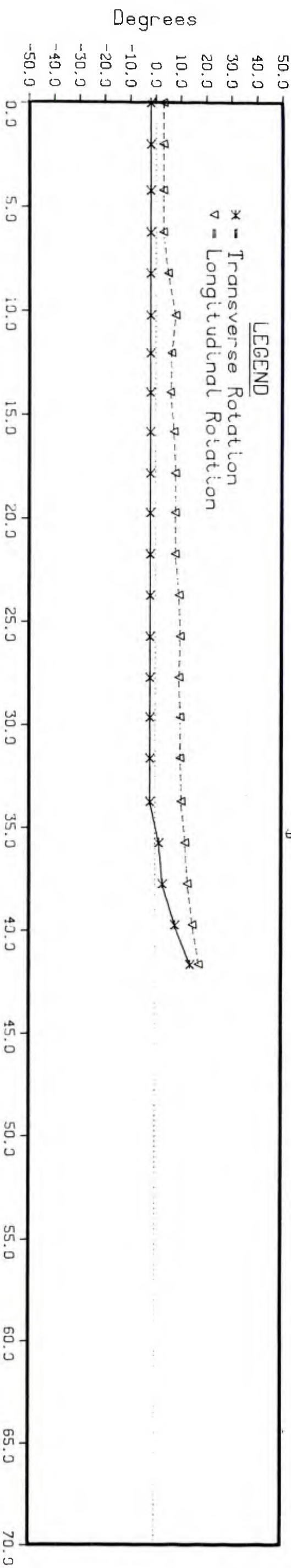
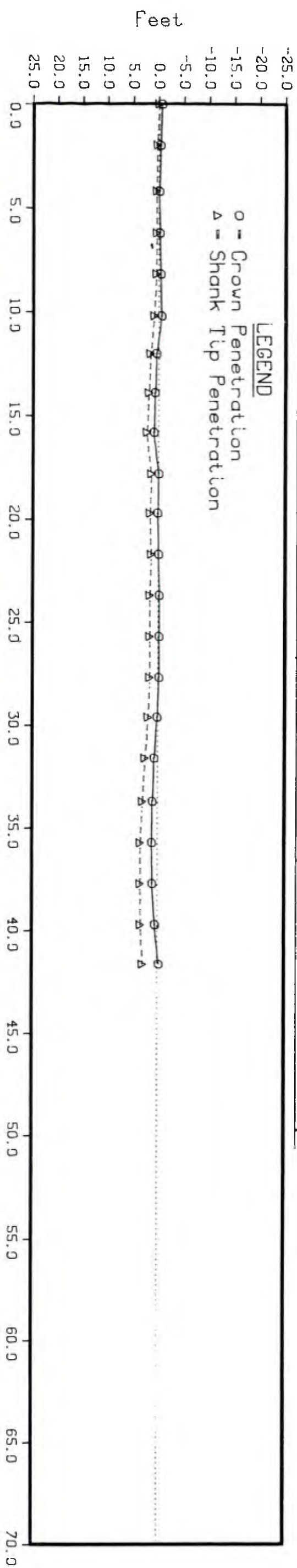
SAN DIEGO HARBOR 1500 FT. SOUTHEAST OF BUOY 49

Test No. = 4

stato , 3000lb. 18 in. stabilizerext. 31.5deg.mov. flukes

Test Series No. = 14

fine sand bottom. depth 11-12 ft. mltw



Day # - 100 SPAN
 Test No. - 5
 Test Series No. - 14

TEST DATE
 TEST NO.
 TEST SITE
 TEST SEAS
 TEST SITES
 SEAFLOOR TYPE
 ANCHOR TYPE
 ANCHOR WEIGHT
 FLUKE ANGLE-TYPE
 AUX. ANCHOR TYPE
 AUX. ANCHOR WEIGHT
 MAIN-AUX ANCHOR SEPARATION
 DEPRESSION-AUX-WT-EACH-TOTAL WT.
 MORING LINE DESCRIPTION

STATO ANCHOR TEST

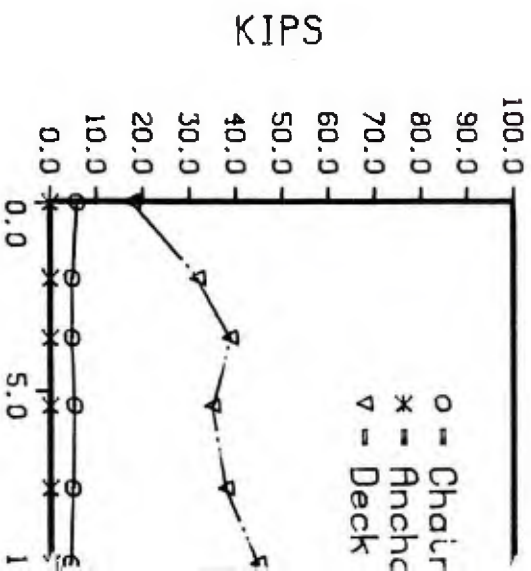
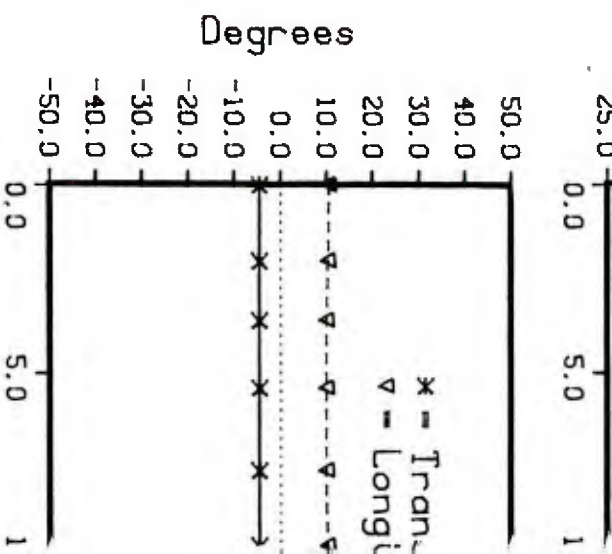
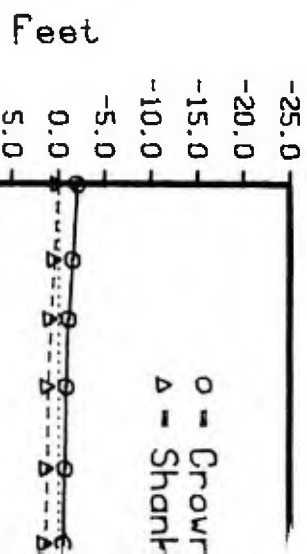
100
 51
 14 DIEGO HARBOR 1500 FT. SOUTHEAST OF RUNY 49
 1320-1344 BOTTOM, DEPTH 11-12 FT. MLY
 STATE SAN BOTOM, DEPTH 11-12 FT. MLY
 3000.00 LB. NORMAL STABILIZERS 31.5000.00V. FLUKES
 31.50 DEG. - 0 0.00V 3-FTX
 0.00 1A.
 0.0 FEET 0.0 LB.
 0.0 - 0.0 - 0.0 LB.
 ANCHOR TO 100FT 21N. STILL INK CHAIN TO 400FT 21N. WLOF ROPF

NOTE - INITIAL CHAIN DEPTH ZEROED TO REFLECT MEASURED WATPRODEPTH

1. NO.6 DISTANCE	2. NECK TENSION	3. ANCHOR DEPTH	4. PACKAGE DEPTH	5. ROTATION ANGLE	6. SHANK ANGLE	7. WLOF ROPF ANGLE	8. DECK WOPFZ. FORCE	9. CHAIN LENGTH ON BOTTOM	10. CHAIN WEIGHT ON BOTTOM	11. ANCHOR CROWN DEPTH	12. ANCHOR CHAIN TIP DEPTH	13. ANCHOR FLUKE TIP DEPTH	14. WATPRO DEPTH	15. TOTAL BOTTOM WEIGHT
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
FEET	KIPS	KIPS	FEET	DEG	DEG	DEG	DEG	FEET	105	FEET	FEET	FEET	FEET	105
0.0	15.0	0.0	15.4	-4.5	10.5	7.8	17.8	108.9	5848.7	13.2	15.2	17.1	15.2	4848.7
2.0	32.0	0.0	15.4	-4.5	10.5	6.5	11.8	146.7	4449.1	13.7	15.4	17.6	15.2	7449.1
3.6	32.0	0.0	15.4	-4.5	10.5	5.3	10.8	147.2	4459.1	14.1	16.1	18.1	15.2	7449.1
7.6	32.0	0.0	15.4	-4.5	10.5	5.0	10.8	154.7	5241.1	14.4	16.3	18.4	15.2	7241.1
9.6	45.0	0.0	15.4	-4.5	10.5	2.3	7.8	150.0	4241.5	14.5	16.4	18.5	15.2	7241.5
11.6	62.0	0.0	15.4	-4.5	10.5	4.1	49.8	132.6	3541.4	14.7	16.5	18.6	15.2	7241.4
13.4	57.0	0.0	15.4	-11.8	14.5	4.2	54.8	123.6	3541.4	14.7	17.5	18.6	15.2	7241.4
15.4	24.5	0.0	15.4	-34.5	19.5	5.5	24.4	213.7	5043.4				15.2	8043.6

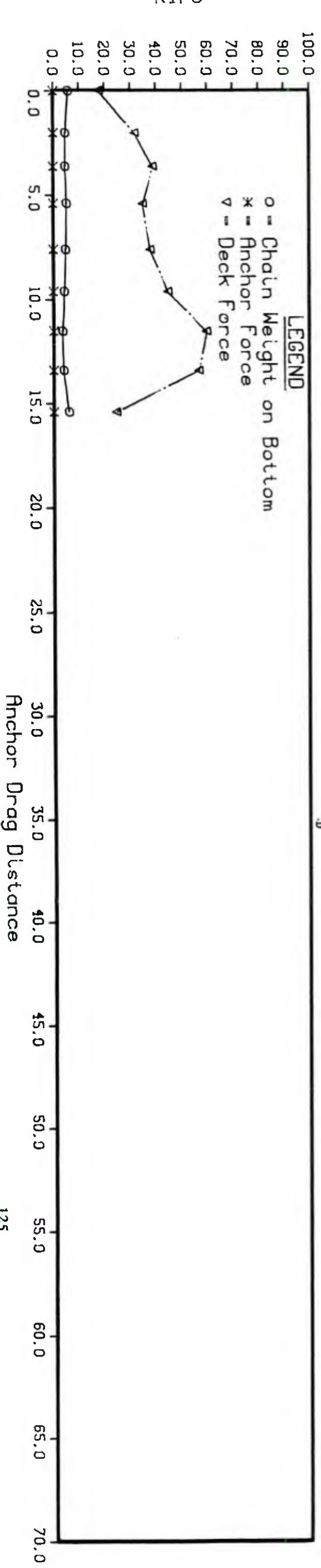
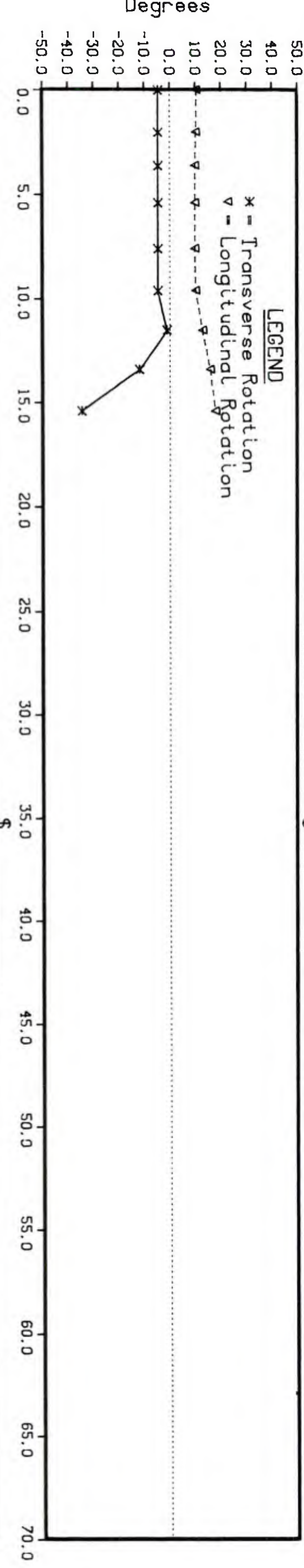
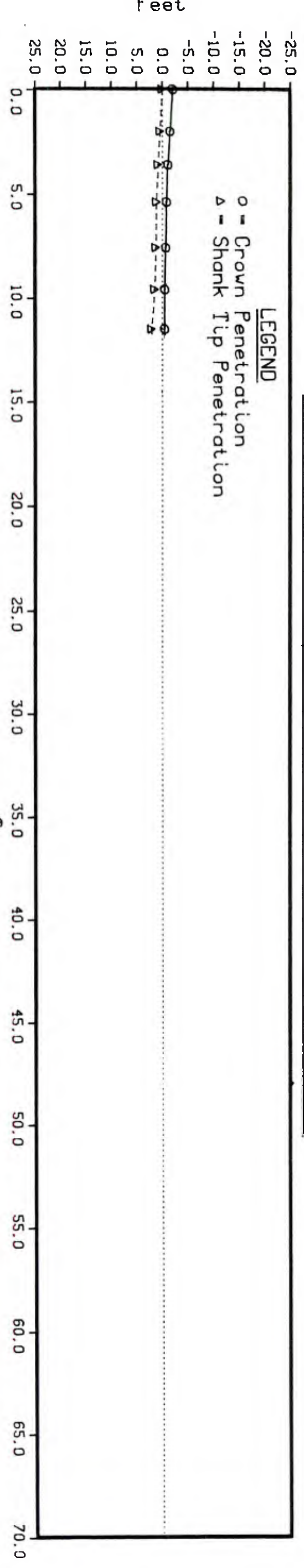
DISTANCE RANGE TRAVELLED 15.4

WOTF - POSITIVE CHAIN
 ANCHOR INDICATES
 SHANK TIP RING
 CROWN



Day # - 100 SAN DIEGO HARBOR 1500 FT. SOUTHEAST OF BUOY 49

Test No. - 5 stato , 3000lb. normal stabilizers 31.5deg.mov. flukes
Test Series No. - 14 fine sand bottom. depth 11-12 ft. mllw



Day # = 101
 Test No. = 1
 Test Series No. = 19

SAN DIE

TEST DATE	TEST NO.	TEST SERIES	TEST AREA	START-END TIMES	SEA FLOOR TYPE	ANCHOR TYPE	ANCHOR WEIGHT	FLUME ANGLE-TYPE	AUX. ANCHOR TYPE	AUX. ANCHOR WEIGHT	ANCHOR SEPARATION	DEPRESSIONS, IN. - WT. EACH-TOTAL WT.	MOORING LINE DESCRIPTION
101	19	1	SAN DIEGO HARBOUR	1500 FT. SOUTHEAST OF RUNY 49	1101 - 1122	FINE SAND BOTTOM, DEPTH 11-12 FT. MLV	6000 LB. NORMAL STABILIZERS	32 DEG. MOV. FLUKES	0.00	0.0	0.0	0.0	ANCHOR TO LAIFT 2-5 IN. STUD LINK CHAIN TO 340 FT PIN WIRE ROPE

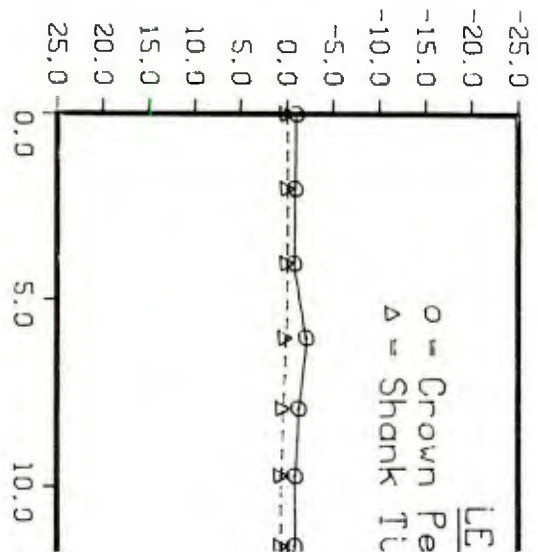
NOTE - INITIAL CHAIN DEPTH ZEROED TO REFLECT UNASPIRED WATERDEPTH

1. DRAG DISTANCE	2. DECK TENSION	3. ANCHOR TENSION	4. SHANK ANGLE	5. ROTATION ANGLE	6. WIRE ROPE ANGLE	7. DECK MORIZ. FORCE	8. CHAIN LENGTH ON BOTTOM	9. CHAIN UPGHT ON BOTTOM	10. ANCHOR CROWN DEPTH	11. ANCHOR SHANK TIP DEPTH	12. ANCHOR FLUKES TIP DEPTH	13. ANCHOR FLUKES TIP DEPTH	14. WATFO DEPTH	15. TOTAL BOTTOM WEIGHT
FEET	KIPS	KIPS	DEG.	DEG.	DEG.	KIPS	FEET	FEET	FEET	FEET	FEET	FEET	FEET	FEET
0.0	20.0	0.0	14.9	-4.5	5.4	7.3	19.8	172.8	865.1	16.2	15.1	18.5	15.1	1665.1
2.0	38.5	7.5	14.9	-4.3	4.0	5.8	18.3	145.9	7315.7	16.4	15.2	18.6	15.1	13315.7
4.0	44.5	11.3	14.9	-4.3	3.2	5.6	44.3	136.9	6864.0	14.5	15.1	18.6	15.1	12864.0
6.0	49.5	15.0	14.6	-2.5	10.5	5.4	49.3	130.6	6548.0	13.2	15.4	18.0	15.1	12548.0
8.2	65.0	25.0	15.0	-2.5	8.0	4.9	64.8	112.7	5654.1	13.9	15.6	18.5	15.1	11654.1
10.4	80.0	37.5	15.1	-2.5	7.0	4.3	79.8	103.9	5208.1	14.4	15.8	18.9	15.1	11208.1
12.8	107.0	57.5	15.1	-2.5	7.0	3.9	107.8	85.1	4268.6	14.4	15.8	18.9	15.1	10268.6
15.2	128.0	67.5	15.1	-2.5	7.0	3.7	107.8	85.1	4268.6	14.4	15.8	18.9	15.1	10268.6
17.5	124.0	65.0	15.5	-3.5	9.0	3.4	119.8	71.4	3880.6	14.4	16.1	19.0	15.1	9880.6
19.5	124.0	65.0	15.5	-3.5	9.0	3.4	129.8	69.7	3652.4	14.2	16.2	19.0	15.1	9652.4
21.5	138.0	91.3	15.6	-4.5	10.0	3.4	131.8	71.9	3607.9	14.2	16.3	19.0	15.1	9607.9
23.5	132.0	90.8	15.6	-8.0	11.5	3.3	130.8	62.8	3147.4	13.8	16.3	19.0	15.1	9647.9
25.5	140.0	100.0	15.4	-10.8	12.5	3.2	139.8	62.8	3147.4	13.5	16.1	18.2	15.1	9187.4
27.5	134.0	100.0	15.2	-10.5	13.0	3.2	133.8	78.2	4615.3	13.5	16.1	18.2	15.1	9187.4
29.5	46.0	28.0	15.0	33.0	4.0	45.0	159.5	7897.6						

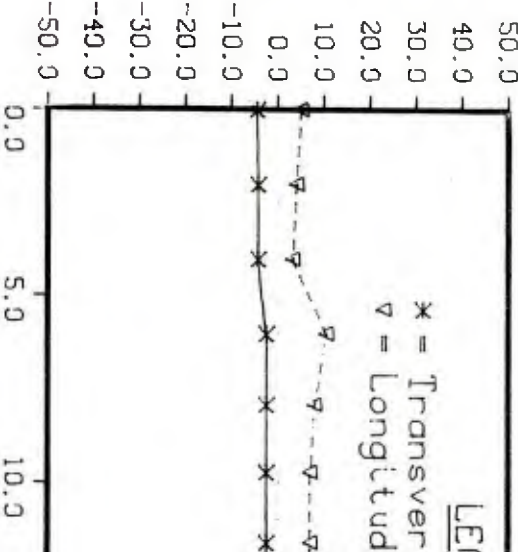
DISTANCE FROM LAIFT 32.8
 DISTANCE FROM HARBOUR 31.4

Note: Anchor depth at end of drag measured - centerline of shank at anchor crown - 4-15 inches.
 NOTE - POSITIVE SHANK ANGLE INDICATES SHANK TIP RFLIN FROM

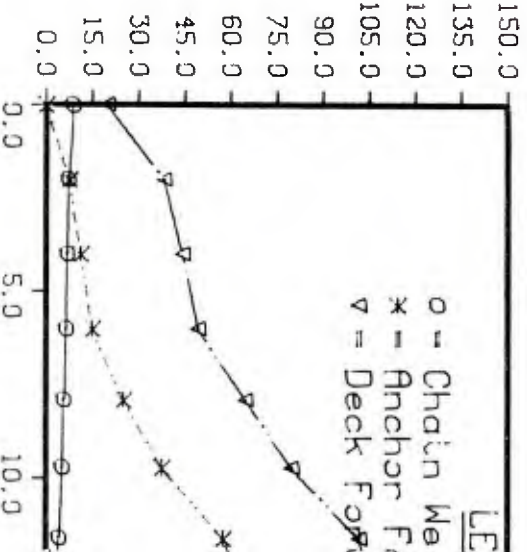
Feet



Degrees



KIPS



Day # = 101

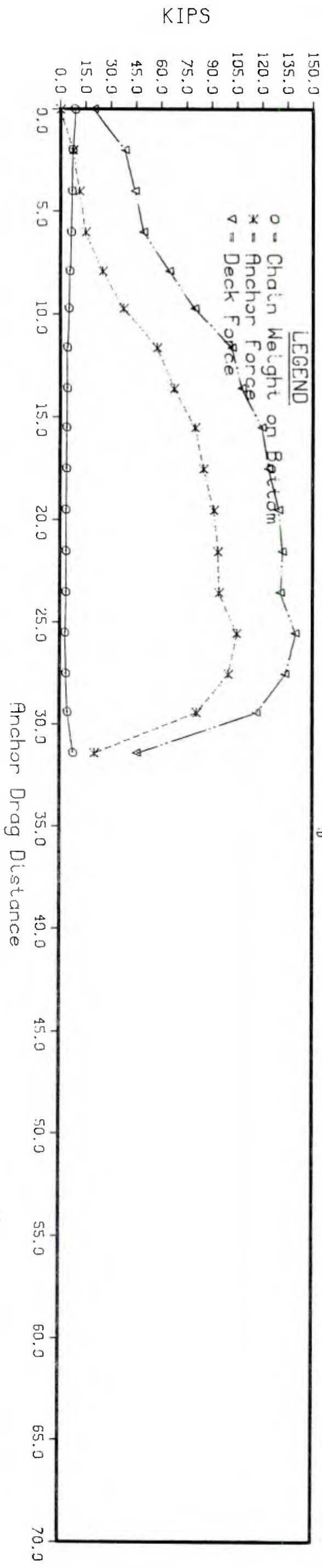
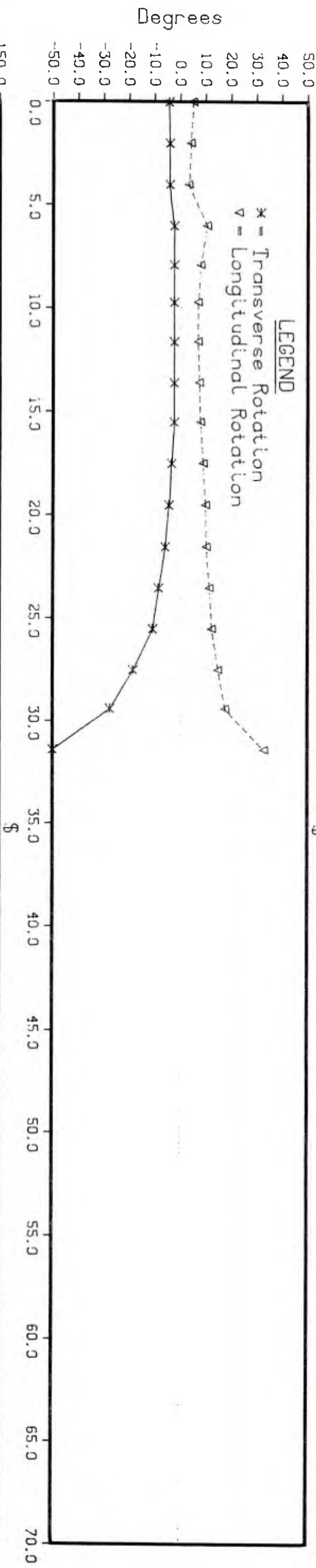
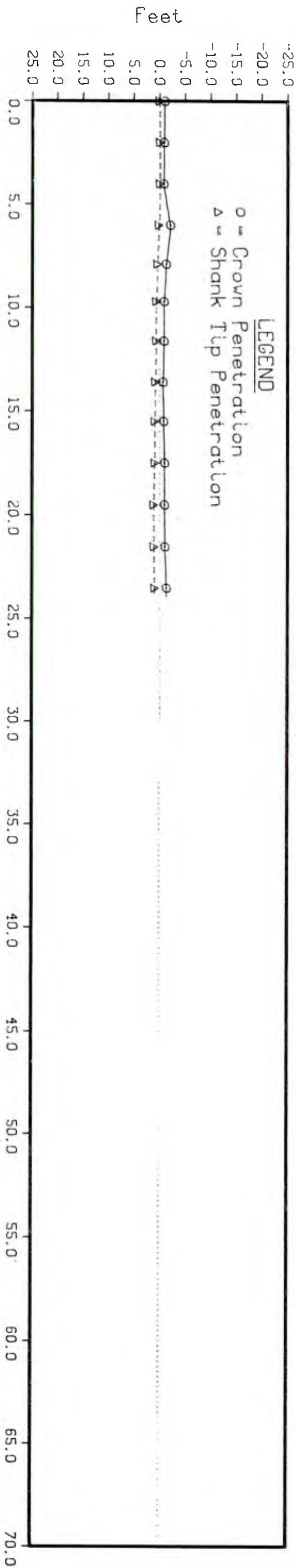
SAN DIEGO HARBOR 1500 FT. SOUTHEAST OF BUOY 49

Test No. = 1

state , 6000lb. normal stabilizers 32 deg. mov. flukes

Test Series No. = 19

fine sand bottom, depth 11-12 ft. mltw



Day # = 101
 Test No. = 2
 Test Series No. = 19

SAN DIE

TEST DATE
 TEST NO. 101
 TEST SITE 19
 TEST AREA SAN DIEGO HARBOR 1500 FT. SOUTHEAST OF RUNY 49
 START-END TIMES 1140 - 1156
 GEOTAG TYPE FINE SAND BOTTOM, DEPTH 11-12 FT. MLLW
 ANCHOR TYPE STAD - 6000LB. NORMAL STABILIZERS 32 DEG. MOV. FLUKES
 ANCHOR WEIGHT 6000.00 LB.
 FLUKE ANGLE-TYPE 32.00 DEG. - 0 02MOV 14FTX
 AUX. ANCHOR TYPE 0.00 LB.
 AUX. ANCHOR WEIGHT 0.00 LB.
 MAIN-AUX ANCHOR SEPARATION 0.00 LB.
 DEPRESSION-NO.-WT-EACH-TOTAL WT. 0.00 LB.
 MOORING LINE DESCRIPTION ANCHOR TO 140FT 2.5IN. STUDLINK CHAIN TO 140FT 2IN WIRE ROPE

NOTE - INITIAL CHAIN DEPTH ZEROED TO REFLECT MEASURED WATERDEPTH

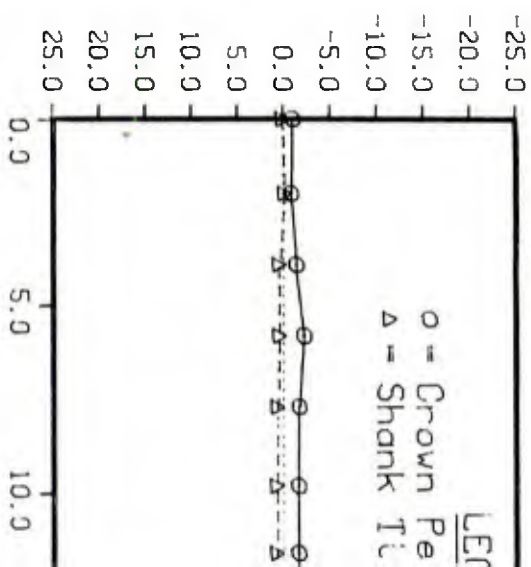
1. DRAG DISTANCE	5. ROTATION ANGLE	9. CHAIN LENGTH ON BOTTOM	13. ANCHOR FLUKE TIP DEPTH
2. DECK TENSION	6. SHANK ANGLE	10. CHAIN WEIGHT ON BOTTOM	14. WATER DEPTH
3. ANCHOR TENSION	7. WIRE ROPE ANGLE	11. ANCHOR CROWN DEPTH	15. TOTAL BOTTOM WEIGHT
4. PACKAGE DEPTH	8. DECK HORIZ. FORCE	12. ANCHOR SHANK TIP DEPTH	
1	2	3	4
FEET	KIPS	FEET	DEG
0.0	29.5	14.4	0.0
2.0	39.5	12.5	5.4
3.0	39.0	10.6	3.0
5.0	39.0	14.7	9.5
7.0	39.0	14.5	12.5
9.0	39.0	14.5	11.0
11.0	39.0	14.5	11.0
13.0	39.0	14.5	11.0
15.0	39.0	14.5	11.0
17.0	39.0	14.5	11.0
19.0	39.0	14.5	11.0
21.0	39.0	14.5	11.0
23.0	39.0	14.5	11.0
25.0	39.0	14.5	11.0
27.0	39.0	14.5	11.0
29.0	39.0	14.5	11.0
31.0	39.0	14.5	11.0
33.0	39.0	14.5	11.0
35.0	39.0	14.5	11.0
37.0	39.0	14.5	11.0
39.0	39.0	14.5	11.0
41.0	39.0	14.5	11.0
43.0	39.0	14.5	11.0
45.0	39.0	14.5	11.0

DISTANCE RANGE TRAVELLED 30.0
 DISTANCE ANCHOR TRAVELLED 29.0

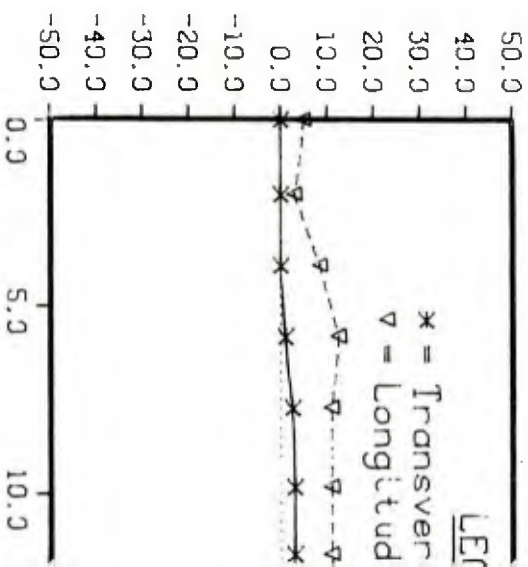
Note: Anchor depth at end
 of drag measured -
 centerline of shank at
 anchor crown = (-24) inches.

NOTE - POSITIVE SHANK
 ANGLE INDICATES
 SHANK TIP BELOW
 CROWN

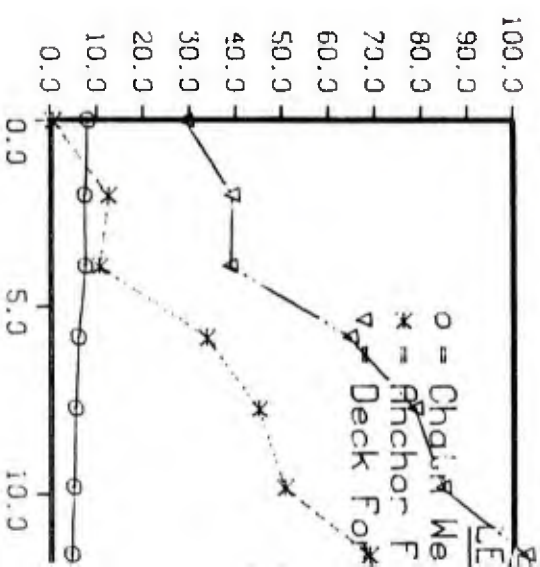
Feet



Degrees



KIPS



Day # = 101

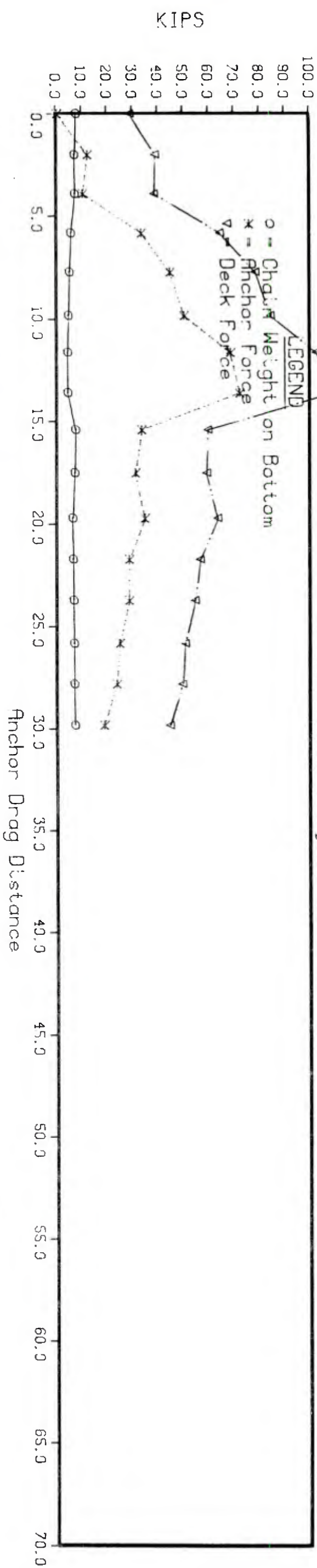
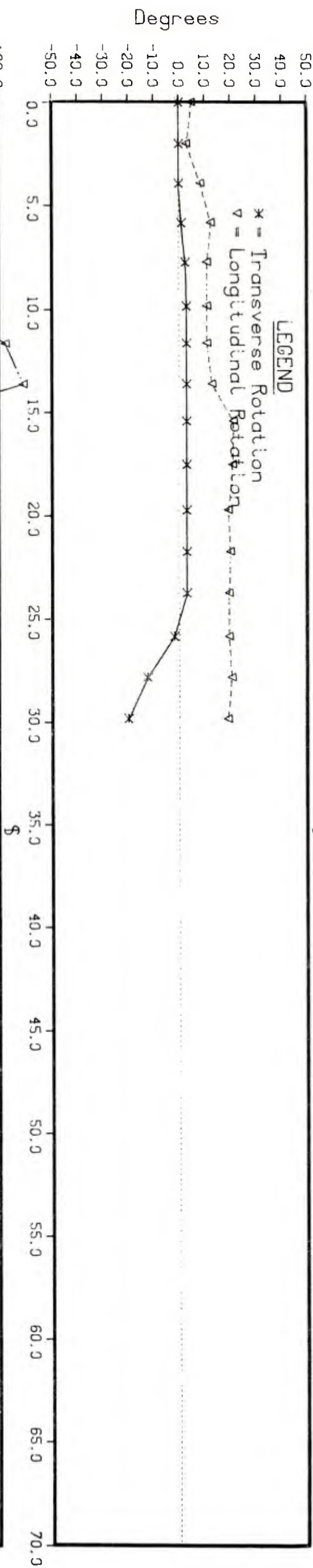
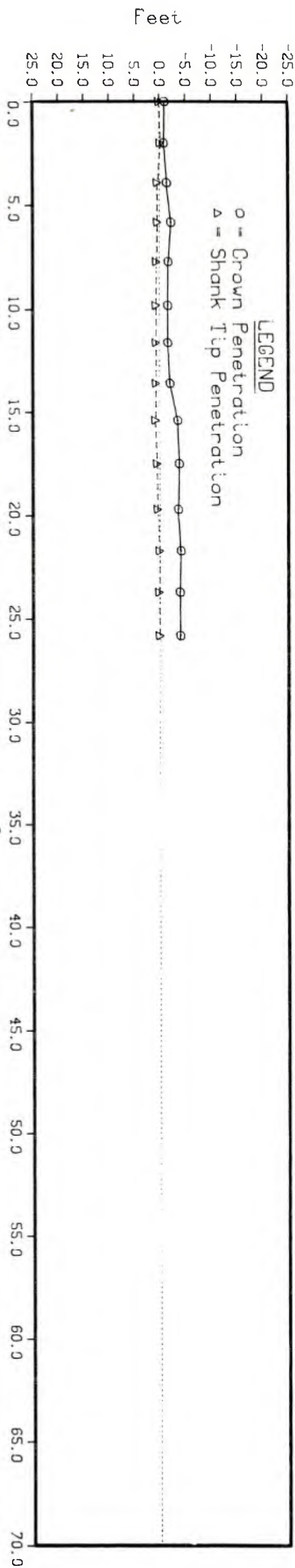
SAN DIEGO HARBOR 1500 FT. SOUTHEAST OF BUOY 49

Test No. = 2

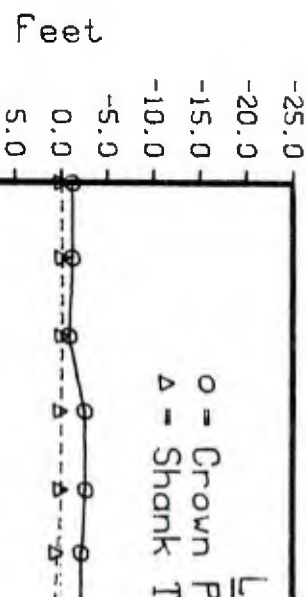
state , 6000lb. normal stabilizers 32 deg. mov. flukes

Test Series No. = 19

fine sand bottom. depth 11-12 ft. mltw



SANDI

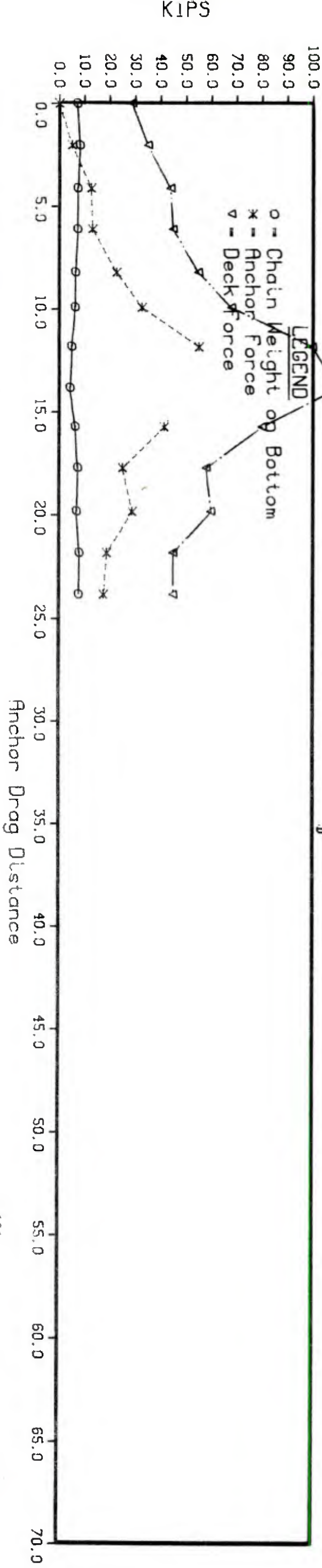
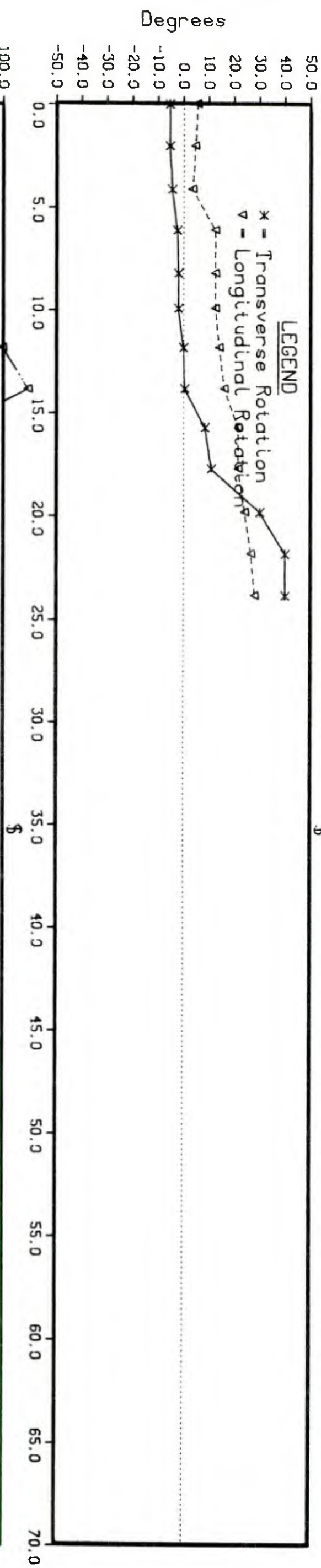
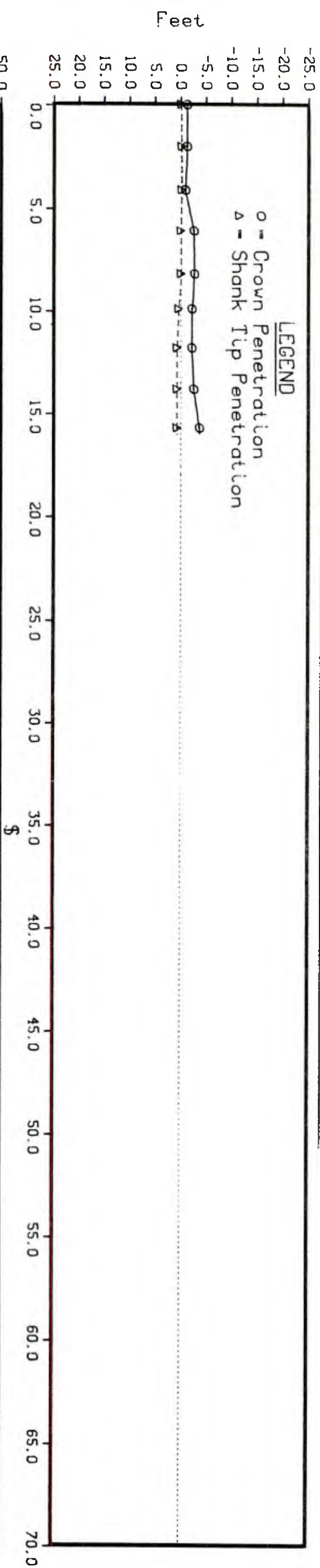


Feet

Degrees

Angle of Incidence (degrees)	Angle of Deflection (degrees) - Transverse (x)	Angle of Deflection (degrees) - Longitudinal (v)
0	0	0
10	~2	~5
20	~4	~10
30	~6	~15
40	~8	~20
50	~10	~25
60	~12	~30
70	~14	~35
80	~16	~40
90	~18	~45

Day # = 101 SAN DIEGO HARBOR 1500 FT. SOUTHEAST OF BUOY 49
Test No. = 3 stato , 6000lb. normal stabilizers 32 deg. mov. flukes
Test Series No. = 19 fine sand bottom. depth 11-12 ft. mllw



Day # = 101 SAN
 Test No. = 1
 Test Series No. = 20

STOCKLESS ANCHOR TEST

TEST DATE 101
 TEST NO. 1
 TEST SERIES 20
 TEST AREA CAN DIEGO HARBOR 1500 FT. SOUTHEAST OF BUOY 49
 START-END TIMES 1400 - 1421
 SEAFLOOR TYPE FINE SAND BOTTOM, DEPTH 11-12 FT. MLW
 ANCHOR TYPE STOCKLESS 5000LB. TANDEM SHANK/SHOCKLE 35 DEG. FX. FLUKES
 ANCHOR WEIGHT 5950.00 LB.
 FLUKE ANGLE-TYPE 15.00 DEG. - 1 HANDY LEFT
 AUX. ANCHOR TYPE 5000LB STOCKLESS ANCHOR
 AUX. ANCHOR WEIGHT 5950.00 - LB.
 MAIN-AUX ANCHOR SEPARATION 45.0 FEET
 DEPRESSORS-MIN-WT-EACH-TOTAL WT. 0 - 0.0 LB.
 MOORING LINE DESCRIPTION ANCHOR TO 45FT PIN, STUPEL CHAIN TO AUX ANCHOR TO 140FT
 2.5IN STUPEL CHAIN TO 140FT PIN, WIRE ROPE

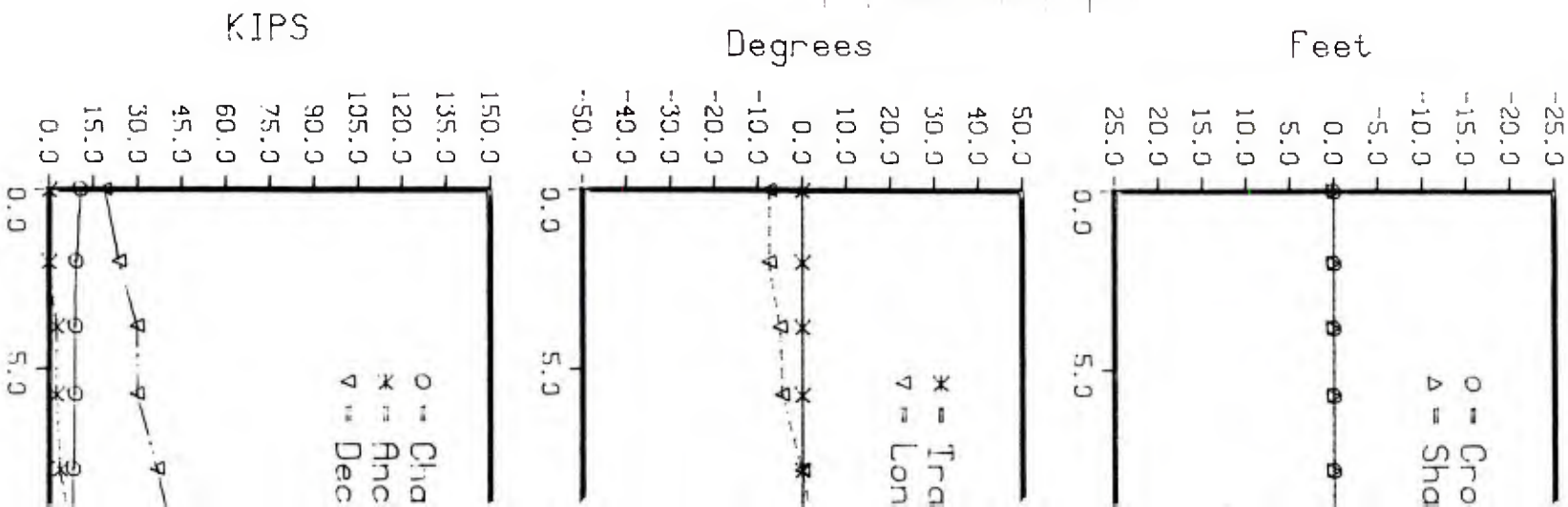
NOTE - INITIAL CHAIN DEPTH ZEROED TO REFLECT MEASURED WATERDEPTH

1. DEAG DISTANCE	2. DECK TENSION	3. ANCHOR TENSION	4. PACKAGE DEPTH	5. ROTATION ANGLE	6. SHANK ANGLE	7. WIRE ROPE ANGLE	8. DECK HORIZ. FORCE	9. CHAIN LENGTH ON BOTTOM	10. CHAIN WEIGHT ON BOTTOM	11. ANCHOR CROWN DEPTH	12. ANCHOR SHANK TIP DEPTH	13. ANCHOR FLUKE TIP DEPTH	14. WATER DEPTH	15. TOTAL BOTTOM WEIGHT
FEET	KIPS	KIPS	FEET	DEG.	DEG.	DEG.	DEG.	FEET	LBS.	FEET	FEET	FEET	FEET	LBS.
0.0	19.0	0.0	0.0	0.0	-7.5	8.2	18.9	244.9	0.0	0.0	0.0	0.0	13.0	22486.3
2.0	24.0	0.0	0.0	0.0	-7.5	8.2	23.8	200.2	9215.2	0.0	0.0	0.0	13.0	21115.2
3.8	30.0	2.5	0.0	0.0	-5.0	7.4	29.8	191.4	8774.4	0.0	0.0	0.0	13.0	20076.4
5.7	36.0	2.5	0.0	0.0	-4.5	7.3	29.8	192.4	8826.4	0.0	0.0	0.0	13.0	20276.4
7.8	37.0	3.8	0.0	0.0	0.0	7.1	16.7	177.3	8065.0	0.0	0.0	0.0	13.0	19985.0
9.6	42.0	7.5	0.0	0.0	2.7	6.4	41.7	175.1	7997.0	0.0	0.0	0.0	13.0	19897.0
11.6	41.0	16.3	0.0	0.0	0.0	5.4	40.7	156.8	7038.0	0.0	0.0	0.0	13.0	19897.0
13.3	59.5	23.1	0.0	0.0	0.0	5.1	79.2	127.5	5571.2	0.0	0.0	0.0	13.0	19897.0
15.3	79.5	31.3	0.0	0.0	7.5	4.7	100.7	103.4	4362.5	0.0	0.0	0.0	13.0	16249.5
17.2	101.0	33.8	0.0	0.0	7.5	4.4	98.7	115.5	4966.4	0.0	0.0	0.0	13.0	16249.5
19.0	104.0	40.0	0.0	0.0	7.5	4.4	98.7	115.5	4966.4	0.0	0.0	0.0	13.0	16249.5
21.1	126.0	40.0	0.0	0.0	7.5	4.4	98.7	115.5	4966.4	0.0	0.0	0.0	13.0	16249.5
23.0	129.5	43.8	0.0	0.0	6.5	4.1	129.2	82.6	1318.1	0.0	0.0	0.0	13.0	15270.4
24.9	137.0	43.8	0.0	0.0	6.5	3.9	146.7	58.2	2095.9	0.0	0.0	0.0	13.0	15270.4
27.0	155.0	51.3	0.0	0.0	6.5	3.9	146.7	58.2	2095.9	0.0	0.0	0.0	13.0	13905.9

DISTANCE RANGE TRAVELLED 26.0
 DISTANCE ANCHOR TRAVELLED 27.0

Note: Anchor depth at end
 of drag measured at
 centerline of shank at
 anchor crown = 10 inches.

NOTE - POSITIVE SHANK
 ANGLE INDICATES
 SHANK TIP BELOW
 CROWN

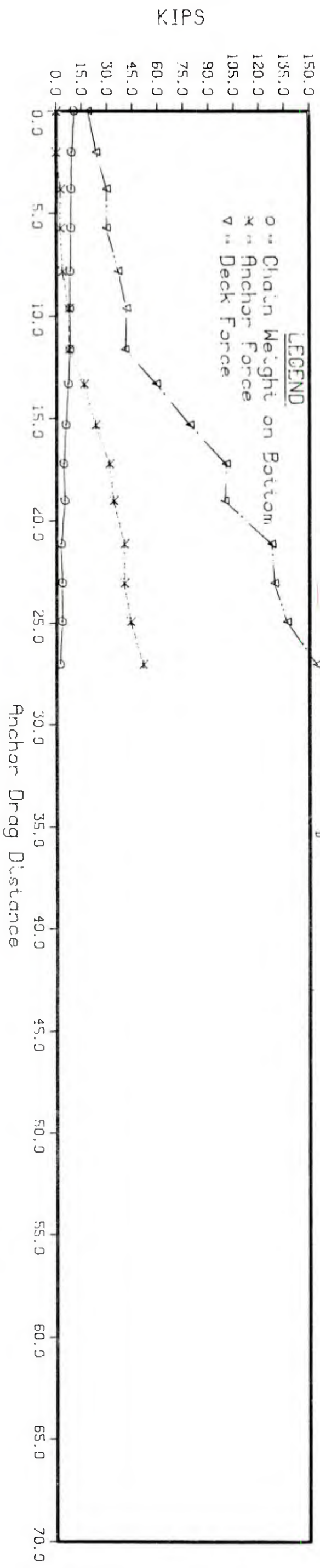
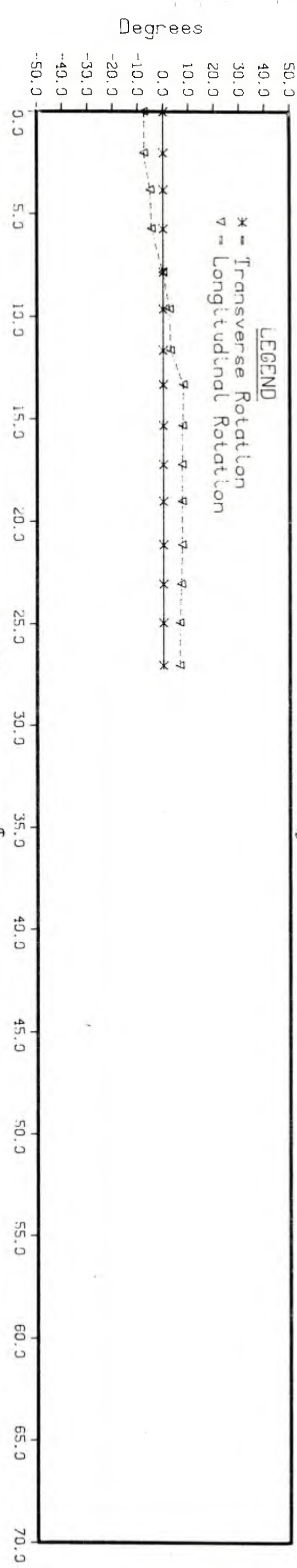
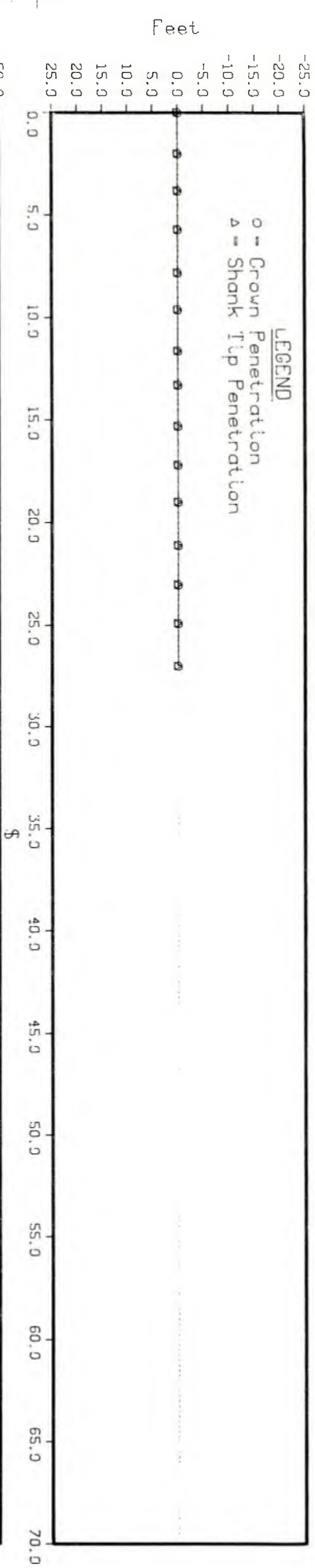


Day # = 101

Test No. = 1
Test Series No. = 20

SAN DIEGO HARBOR 1500 FT. SOUTHEAST OF BUOY 49

stockless, 5000lb. lander, shanktooshackle 35 deg. fx, flukes.
fine sand bottom, depth 11-12 ft. mllw



Day # = 101 SAN
 Test No. = 2
 Test Series No. = 20

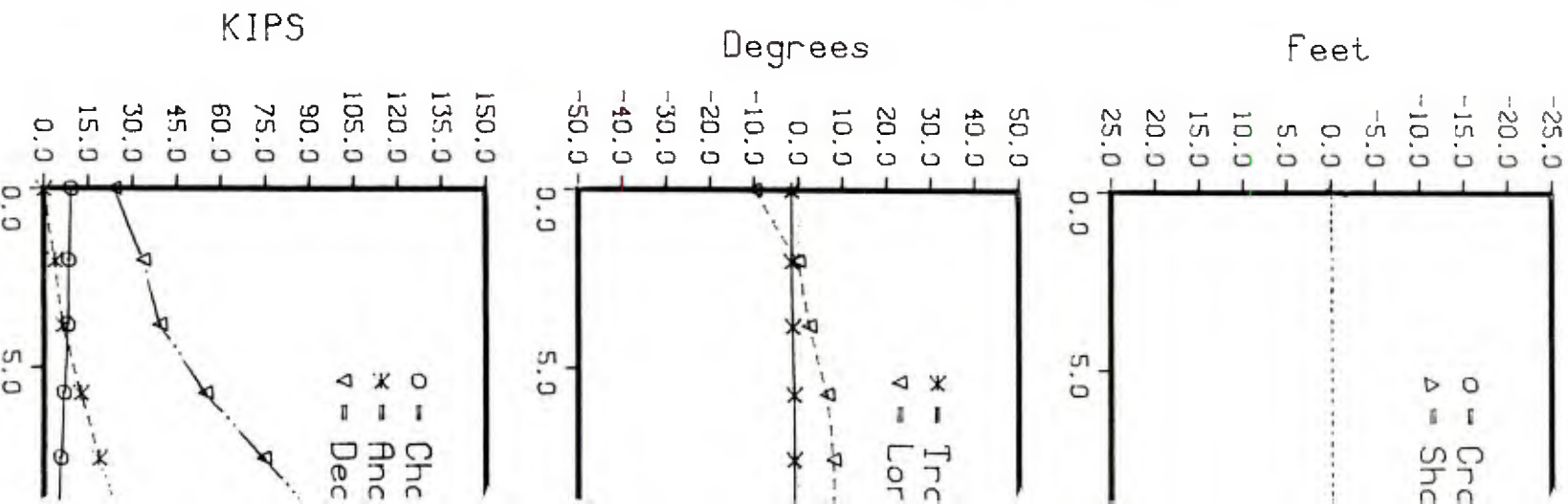
STORLESS ANCHOR TEST

TEST DATE 101
 TEST SITES 2
 TEST AREA SAN DIEGO MARINA 1500 FT. SOUTHWEST OF RUNG 49
 START/END TIMES 1446 SAN 11-12 FT. WLY
 SECT/TOB TYPE STOCKLESS 5000LB. TANDM SHANKTSHACKLF 35 NEG. FX. FLUKES
 ANCHOR TYPE 5950.00 LB. 0=MOV 1=FIX
 FLUKES ANGLE-TIME 15.00 DEG. LB.
 ANCHOR WEIGHT 5000LB STOCKLESS ANCHOR
 AUX. ANCHOR TYPE 5950.00 LB.
 MAIN-AUX ANCHOR SEPARATION 45.0 FEET
 DEPRESSORS-NO.-WT-EACH-TOTAL WT. 0 - 0.0 - 0.0 LB.
 MOORING LINE DESCRIPTION ANCHOR TO 45FT PIN, STUOLINK CHAIN TO AUX ANCHOR TO 100FT
 2.5IN STUOLINK CHAIN TO 300FT 2IN, WIRE PUFF

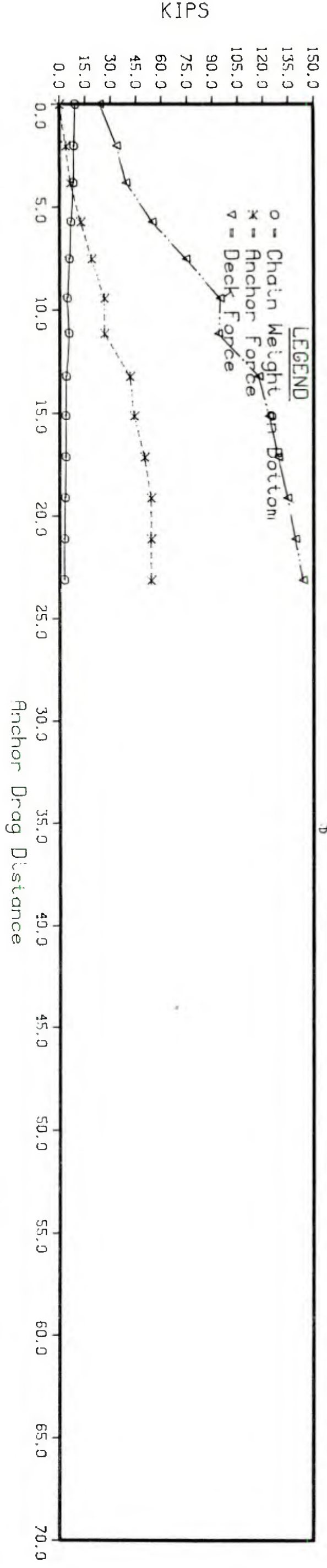
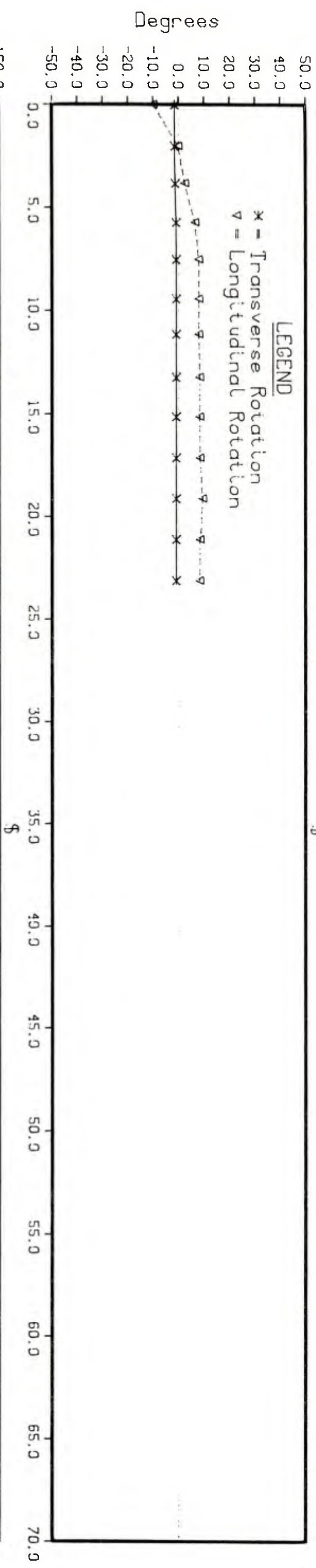
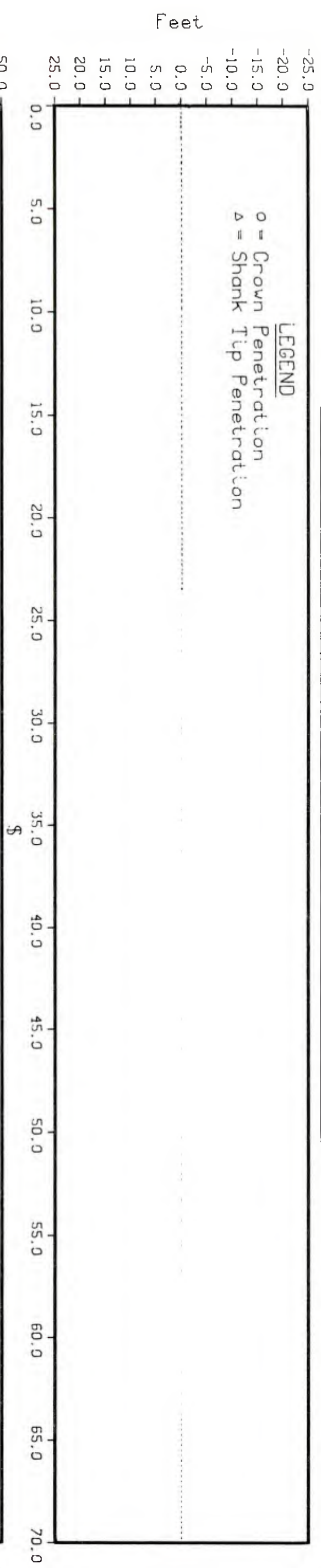
1. DRUM DISTANCE	2. DECK TENSION	3. ANCHOR TENSION	4. PICTAGE DEPTH	5. ROTATION ANGLE	6. SHANK ANGLE	7. WIRE ROPE ANGLE	8. DECK HORIZ. FORCE	9. CHAIN LENGTH ON BOTTOM	10. CHAIN WEIGHT ON BOTTOM	11. ANCHOR CROWN DEPTH	12. ANCHOR SHANK TIP DEPTH	13. ANCHOR FLUKES TIP DEPTH	14. WATER DEPTH	15. TOTAL BOTTOM WEIGHT
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
FEET	KIPS	KIPS	FEET	DEG	DEG	NEG	KIPS	FEET	LRG	FEET	FEET	FEET	FEET	LRG
0.0	24.0	0.0	11.8	-1.5	-9.4	8.1	23.4	201.0	9256.7				13.0	21156.7
2.0	34.0	3.0	12.3	-1.5	0.0	7.3	33.7	182.3	6318.1				13.0	20218.1
3.8	39.5	6.3	12.9	-1.3	2.5	6.7	49.2	176.6	4029.8				13.0	19029.8
5.7	55.0	12.5	13.1	-1.0	6.5	6.1	54.7	151.9	4703.8				13.0	16693.8
7.5	75.0	18.8	12.9	-1.0	8.0	5.3	74.7	130.3	5710.5				13.0	1610.5
9.4	95.0	26.3	13.3	-1.0	8.0	4.9	94.7	106.7	4523.7				13.0	16423.7
11.1	94.0	41.3	13.9	-1.0	8.1	4.3	117.7	92.0	3720.8				13.0	17320.8
12.2	118.0	41.3	13.9	-1.0	8.1	4.2	133.7	87.4	3556.8				13.0	15690.4
13.1	124.0	43.8	13.8	-1.0	8.4	4.0	129.2	88.3	3604.8				13.0	15504.8
14.1	129.5	50.0	13.4	-1.0	8.4	4.0	134.7	80.7	3271.2				13.0	15171.2
15.1	135.0	52.8	13.7	-1.0	8.4	3.9	139.2	74.4	2987.3				13.0	14807.3
20.1	144.0	53.0	13.8	-1.0	8.1	3.9	153.7	73.2	2844.1				13.0	14744.1
DISTANCE RANGE TRAVELLED 24.0														
DISTANCE ANCHOR TRAVELLED 23.1														

DISTANCE RANGE TRAVELLED 24.0
 DISTANCE ANCHOR TRAVELLED 23.1

Note: Anchor depth at end
 of drag measured -
 centerline of shank at
 anchor crown = 22 inches.
 NOTE - POSITIVE SHANK
 ANGLE INDICATES
 SHANK TIP BELOW
 CROWN



Day # = 101 SAN DIEGO HARBOR 1500 FT. SOUTHEAST OF BUOY 49
Test No. = 2 stockless, 5000lb. tandem shankto shackle 35 deg. fx. flukes
Test Series No. = 20 fine sand bottom. depth 11-12 ft. mllw



Day # = 102 SN
 Test No. = 1
 Test Series No. = 21

TEST DATE
 TEST NO.
 TEST SITES
 START-END TIMES
 SEAFLOOR TYPE
 ANCHOR TYPE
 FLUX ANGLE TYPE
 FLUX ANCHOR WEIGHT
 FLUX ANCHOR TYPE
 FLUX ANCHOR WEIGHT
 MAIN-ANCHOR SEPARATION
 DEPRESSION-MT-EACH-TOTAL MT.
 MOORING LINE DESCRIPTION

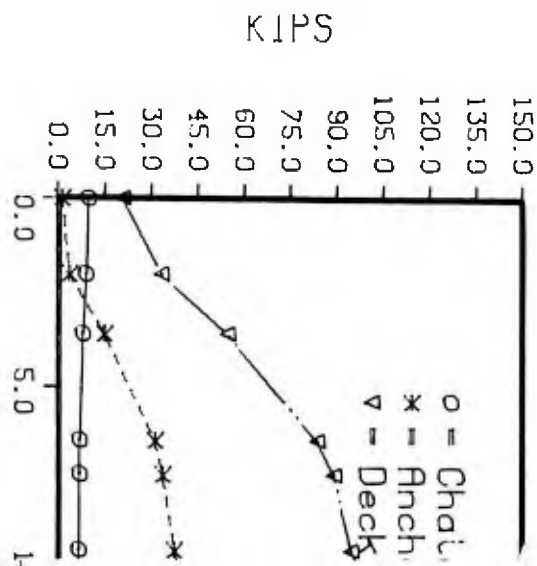
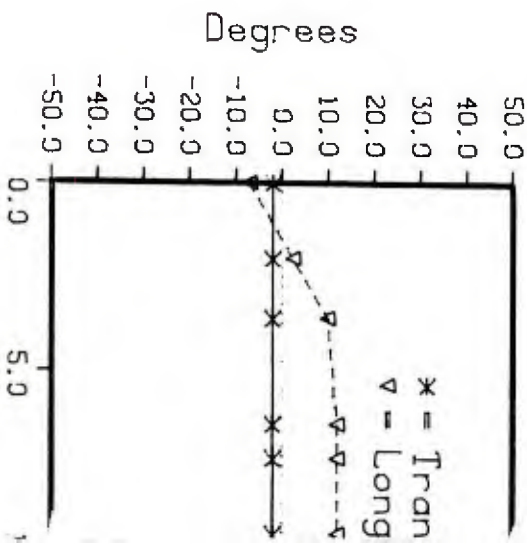
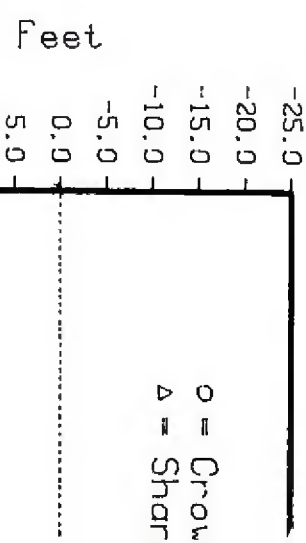
STOCKLESS ANCHOR TEST

102
 1
 21
 CAN DIEGO HARBOR 1500 FT. SOUTHWEST OF QUAY 49
 0423 0440
 FINE SAND BOTTOM, DEPTH 11-12 FT. ALL
 STOCKLESS, SONAR, TANDER GUNWORTHACKLE 35 DEG. FX. FLUXES
 15-20 DEG. IN. 0-400 1-FT
 SONAR STOCKLESS ANCHOR
 0000-00-10
 45-00 FEET
 0-0-0
 ANCHOR TO 45FT 2IN. STOCKLESS CHAIN TO 100FT 100FT
 2-5IN STOCKLESS CHAIN TO 100FT 2IN. WIRE ROPE

1. DRAG DISTANCE	2. DECK TENSION	3. ANCHOR TENSION	4. SHANK ANGLE	5. ROTATION ANGLE	6. SHANK ANGLE	7. DECK ANGLE	8. DECK ANGLE	9. CHAIN LENGTH ON BOTTOM	10. CHAIN WEIGHT ON BOTTOM	11. ANCHOR PLOW DEPTH	12. ANCHOR SHANK TIP DEPTH	13. ANCHOR FLUX TIP DEPTH	14. ANCHOR FLUX TIP DEPTH	15. TOTAL BOTTOM WEIGHT
FFFT	KIPS	KIPS	DEG	DEG	DEG	DEG	DEG	FEET	LBS	FEET	FEET	FEET	FEET	LBS
0.0	21.0	1.3	0.0	-2.0	-2.0	7.0	7.0	20.0	211.6	0.0	0.0	0.0	0.0	2160.1
2.0	31.5	3.0	0.0	-2.0	-2.0	6.0	6.0	19.0	194.0	0.0	0.0	0.0	0.0	2060.1
4.0	55.0	15.0	0.0	-2.0	-2.0	4.0	4.0	17.0	174.0	0.0	0.0	0.0	0.0	1980.4
6.0	82.0	31.0	0.0	-2.0	-2.0	3.0	3.0	15.0	157.5	0.0	0.0	0.0	0.0	1891.3
8.0	82.0	31.0	0.0	-2.0	-2.0	3.0	3.0	15.0	157.5	0.0	0.0	0.0	0.0	1891.3
10.0	108.0	33.0	0.0	-2.0	-2.0	3.0	3.0	15.0	157.5	0.0	0.0	0.0	0.0	1891.3
12.0	112.0	52.0	0.0	-2.0	-2.0	3.0	3.0	15.0	157.5	0.0	0.0	0.0	0.0	1891.3
14.0	112.0	52.0	0.0	-2.0	-2.0	3.0	3.0	15.0	157.5	0.0	0.0	0.0	0.0	1891.3
16.0	112.0	52.0	0.0	-2.0	-2.0	3.0	3.0	15.0	157.5	0.0	0.0	0.0	0.0	1891.3
18.0	112.0	52.0	0.0	-2.0	-2.0	3.0	3.0	15.0	157.5	0.0	0.0	0.0	0.0	1891.3
20.0	112.0	52.0	0.0	-2.0	-2.0	3.0	3.0	15.0	157.5	0.0	0.0	0.0	0.0	1891.3
22.0	112.0	52.0	0.0	-2.0	-2.0	3.0	3.0	15.0	157.5	0.0	0.0	0.0	0.0	1891.3
24.0	112.0	52.0	0.0	-2.0	-2.0	3.0	3.0	15.0	157.5	0.0	0.0	0.0	0.0	1891.3
26.0	112.0	52.0	0.0	-2.0	-2.0	3.0	3.0	15.0	157.5	0.0	0.0	0.0	0.0	1891.3
28.0	112.0	52.0	0.0	-2.0	-2.0	3.0	3.0	15.0	157.5	0.0	0.0	0.0	0.0	1891.3
30.0	112.0	52.0	0.0	-2.0	-2.0	3.0	3.0	15.0	157.5	0.0	0.0	0.0	0.0	1891.3

Note: Anchor depth at end of drag measured - centerline of shank at anchor crown = 25 inches.

NOTE - POSITIVE SHANK ANGLE INDICATES SHANK TIP DOWN



Day # = 102

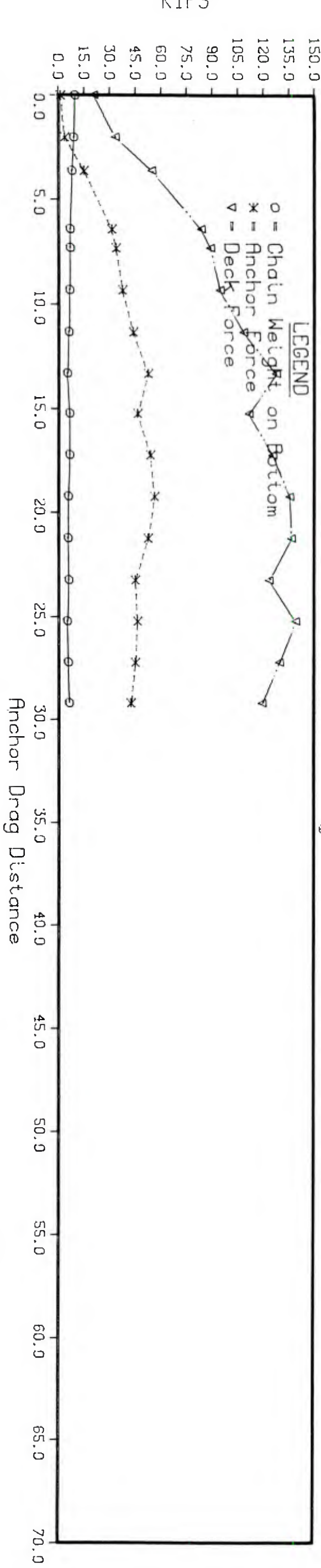
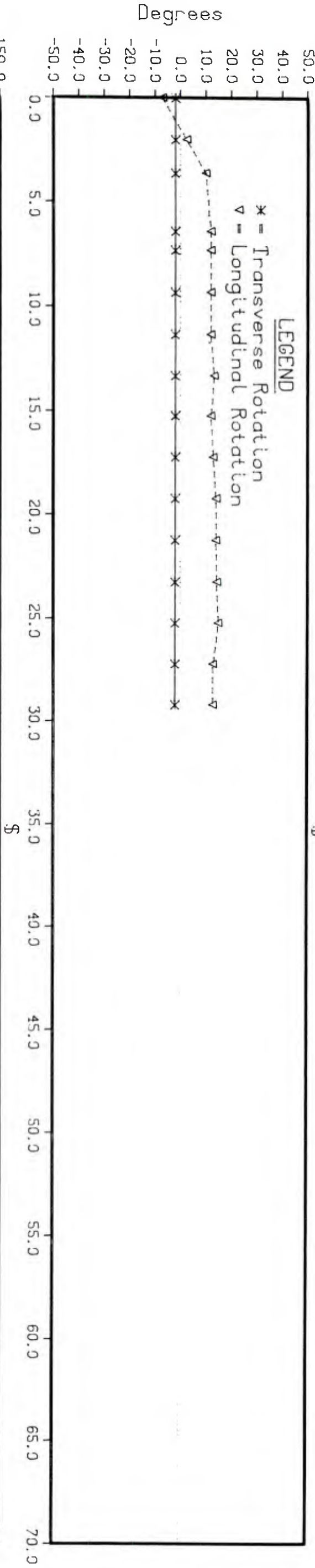
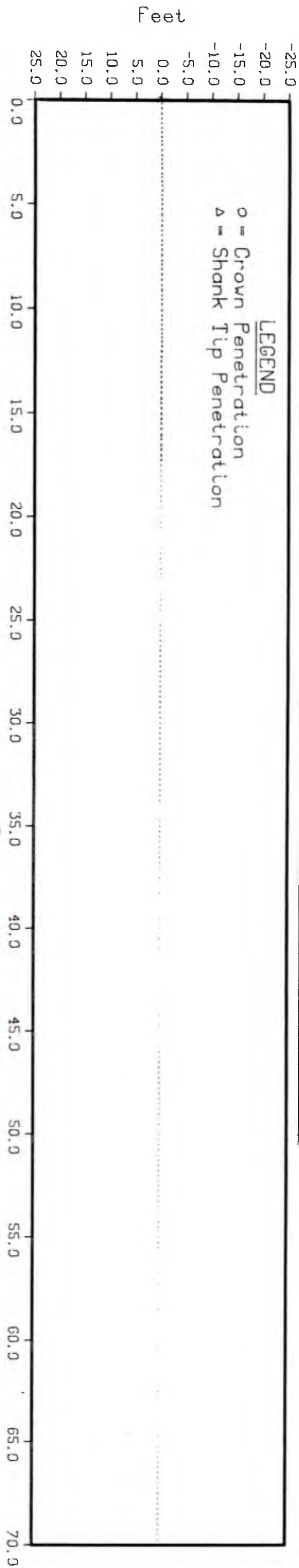
SAN DIEGO HARBOR 1500 FT. SOUTHEAST OF BUOY 49

Test No. = 1

Test Series No. = 21

stockless, 5000lb. tandem crowntoshackle 35 deg. fx. flukes

fine sand bottom. depth 11-12 ft. mllw



Day # = 102 SAN
 Test No. = 2
 Test Series No. = 21

STOCKLESS ANCHOR TEST

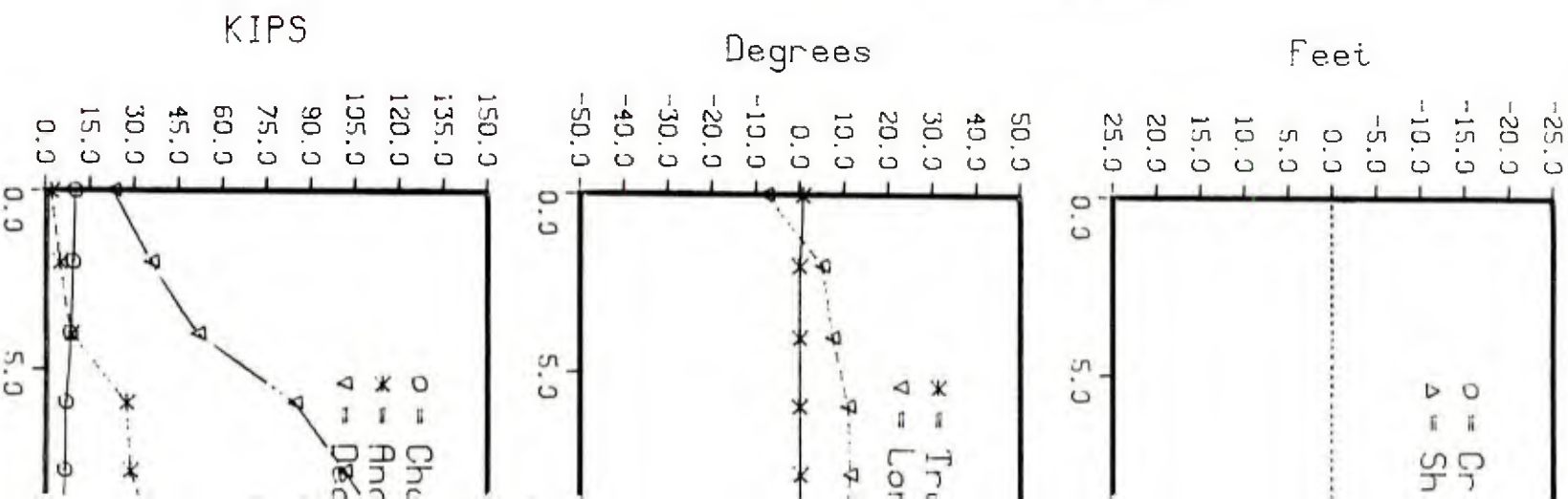
TEST DATE 102
 TEST NO. 2
 TEST AREA SAN DIEGO HARBOR 1500 FT. SOUTHWEST OF BUOY 49
 START-END TIMES 1007 - 1020
 SEAT/DOCK TYPE FINE SAND BOTTOM, DEPTH 11-12 FT. WLY
 ANCHOR TYPE STOCKLESS, 5000LB. R. TANGW. CROWN/SHACKLE 35 DEG. FX. FLUKES
 ANCHOR WEIGHT 5950.00 LB.
 FLUME ANGLE-TYPE 35.00 DEG. - 1 0=MOV 1=FT1
 AUT. ANCHOR TYPE 5000LB STOCKLESS ANCHOR
 MAIN-AUX ANCHOR SEPARATION 5950.00 LB.
 DEPRESSORS-NO.-WT.-EACH-TOTAL WT. 45.0 FEET
 MOORING LINE DESCRIPTION 0.0 LB.
 ANCHOR TO 45FT PIN. STUPLINK CHAIN TO AUX ANCHOR TO 100FT
 3.5IN STUPLINK CHAIN TO 340FT PIN. W/OF ROPF

1. DRAG DISTANCE	2. DEPTH	3. ANCHOR TENSION	4. ANCHOR DEPTH	5. ROTATION ANGLE	6. SHANK ANGLE	7. WIDE ROPF ANGLE	8. DEFY MOMENT	9. CHAIN LENGTH ON BOTTOM	10. ANCHOR FROM DEPTH	11. ANCHOR SHANK TIP DEPTH	12. ANCHOR FLUME TIP DEPTH	13. WATD DEPTH	14. TOTAL ROTATION WEIGHT
FEET	KIPS	FEET	DEG.	DEG.	DEG.	DEG.	KIPS	FEET	FEET	FEET	FEET	FEET	FEET
0.0	21.0	1.0	14.6	-7.5	5.2	6.5	22.9	216.5	*****				2190.6
2.0	34.0	5.0	15.1	0.0	7.5	6.7	35.9	203.4	9175.5				21275.5
4.0	52.0	8.7	15.4	0.0	11.5	6.7	51.8	183.5	8177.5				20277.5
5.9	85.0	27.5	16.0	0.0	11.5	3.9	84.8	153.2	6837.0				18737.0
7.8	102.0	28.8	16.1	0.0	11.5	3.4	101.8	147.8	6589.0				18489.0
9.4	119.0	37.5	16.4	0.0	10.6	3.3	118.8	131.9	5788.2				17888.2
11.7	105.0	35.6	16.5	0.0	8.5	3.1	128.1	129.9	5689.2				17589.2
13.7	128.5	45.4	16.6	0.0	8.5	3.0	133.8	128.6	5525.2				17525.2
15.7	134.0	50.0	16.7	0.0	8.6	2.9	139.1	127.7	5428.4				17428.4
17.7	139.5	51.8	16.8	0.0	7.7	2.8	143.1	128.7	5428.4				17428.4
19.6	141.5	57.5	16.8	0.0	7.0	2.6	140.8	131.1	5760.5				17650.5
21.6	141.0	56.3	16.7	0.0	7.0	2.5	137.9	140.4	6418.4				18518.4
23.6	138.0	50.0	16.6	0.0	7.5	2.7	143.8	133.2	5855.0				17755.0
25.6	144.0	56.3	16.6	0.0	7.5	2.7	143.8	137.9	6090.5				17900.5
27.6	139.0	48.8	16.8	0.0	7.5	2.7	143.8	137.9	6090.5				17900.5

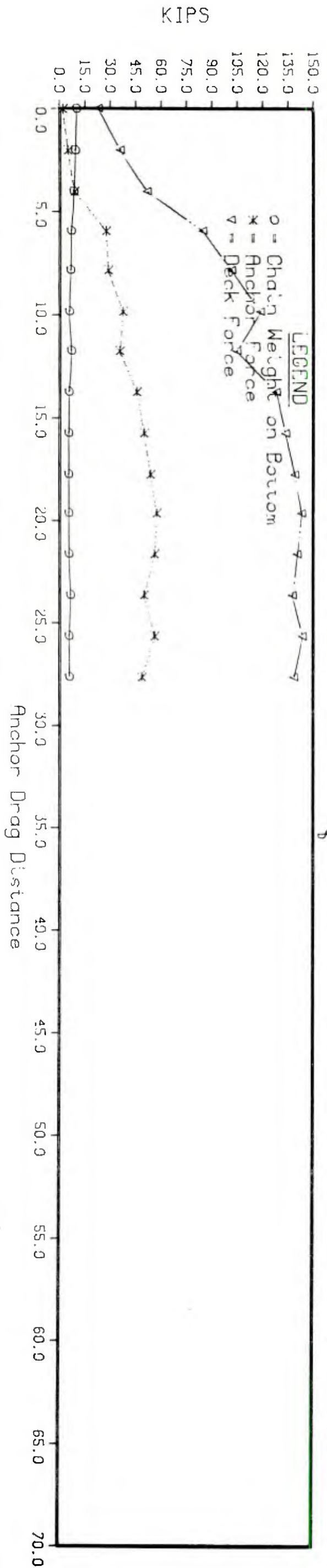
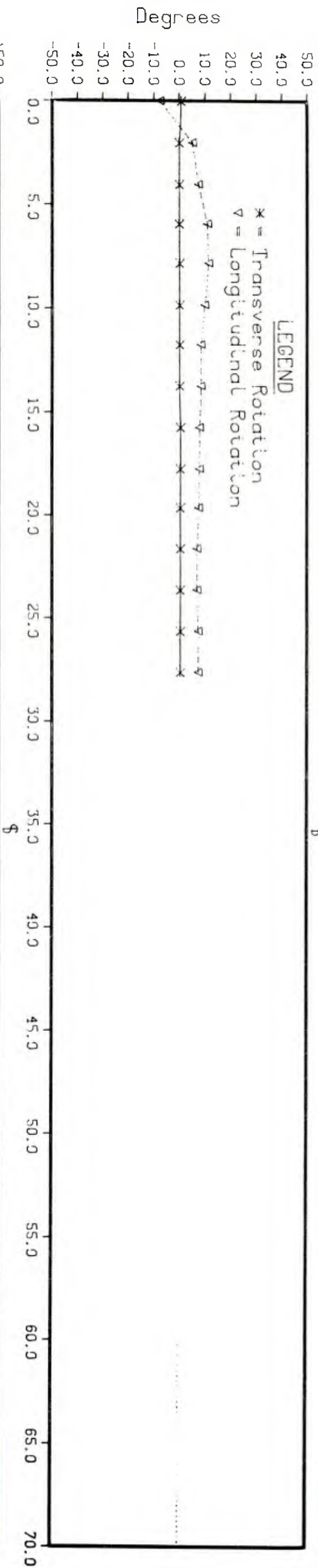
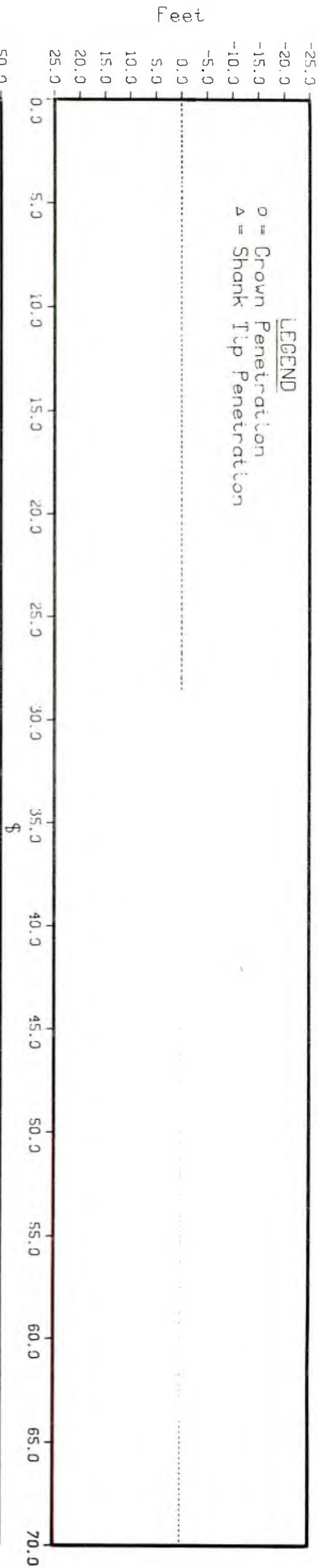
DISTANCE RANGE TRAVELLED 28.0
 DISTANCE ANCHOR TRAVELLED 27.6

Note: Anchor depth at end
 of drag measured -
 centerline of shank at
 anchor crown = 22 inches.

NOTE - POSITIVE SHANK
 ANGLE INDICATES
 SHANK TIP BFLWD
 FROM



Day # = 102 SAN DIEGO HARBOR 1500 FT. SOUTHEAST OF BUOY 49
Test No. = 2 stockless, 5000lb. landem crowntoshackle 35 deg. f.x. flukes
Test Series No. = 21 fine sand bottom. depth 11-12 ft. mlw



Day # = 102
 Test No. = 1
 Test Series No. = 22

SRN 1

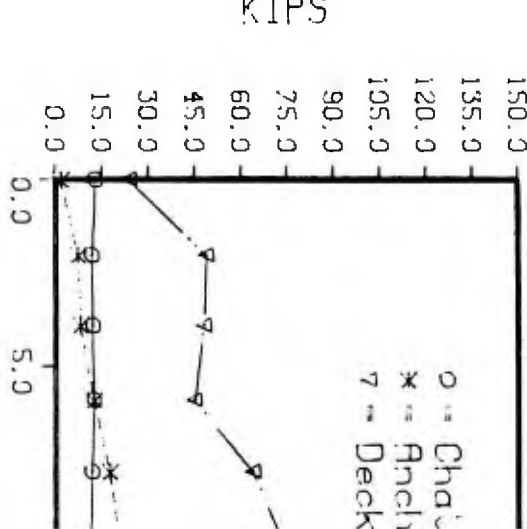
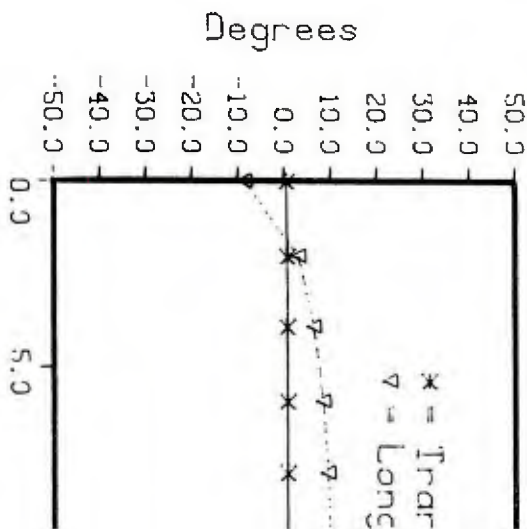
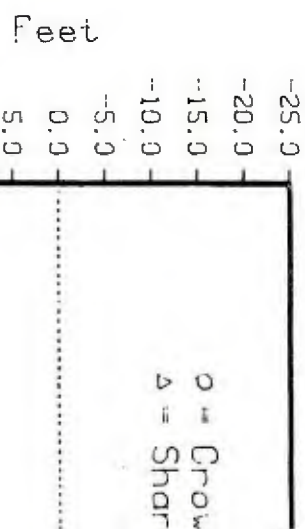
STOCKLESS ANCHOR TEST

TEST DATE 102
 TEST NO. 1
 TEST SITES 32
 TEST AREA SAN DIEGO HARBOUR 1500 FT. SOUTHWEST OF BUOY 40
 START-END TIMES 1302 - 1322
 SEAFLOOR TYPE FINE SAND BOTTOM, DEPTH 11-12 FT. MLW
 ANCHOR TYPE STOCKLESS 45000 LB. TANDEN GR. PLINGTOSHA CLF 15 DEG. FIX. FLINSE
 ANCHOR WEIGHT 5850.00 LB.
 FLINSE ANGLE-TYPE 15.00 DEG. - 1 0=ANY 1=FIX
 AUX. ANCHOR TYPE ENROLL STOCKLESS ANCHOR
 MAIN-ANCHOR WEIGHT 5950.00 LB.
 DEPRESSORS+NO.-WT.EACH-TOTAL WT. 90.0 FEET
 MOORING LINE DESCRIPTION ANCHOR TO 90FT PIN, STUPE INK CHAIN TO AUX ANCHOR-BOTTOM PIN
 TO 45FT PIN CHAIN TO 100FT 2.5IN CHAIN TO 340FT PIN W/PF DOP

1. ORAG DISTANCE	2. DECK TENSION	3. ANCHOR TENSION	4. PACKAGE DEPTH	5. ROTATION ANGLE	6. SHANK ANGLE	7. WIRE DROP ANGLE	8. DECV ANGLE	9. CHAIN LENGTH ON BOTTOM	10. CHAIN WEIGHT ON BOTTOM	11. ANCHOR FROM DEPTH	12. ANCHOR CHAIN TIP DEPTH	13. ANCHOR FLINSE TIP DEPTH	14. W/PF DEPTH	15. TOTAL BOTTOM WEIGHT
FEET	KIPS	KIPS	FEET	DEG	DEG	DEG	DEG	FEET	W/PF	FEET	FEET	FEET	FEET	FEET
9.0	24.0	1.9	10.0	4.5	1.0	4.0	23.0	108.4	*****	*****	*****	*****	*****	*****
2.0	49.0	7.5	11.0	4.7	1.0	4.3	47.0	205.2	*****	*****	*****	*****	*****	*****
3.0	48.0	4.1	11.7	4.7	1.0	4.0	47.0	201.7	*****	*****	*****	*****	*****	*****
5.0	45.0	12.5	11.8	4.7	1.0	4.0	44.0	207.4	*****	*****	*****	*****	*****	*****
7.0	44.0	17.5	12.1	4.7	1.0	4.0	43.0	207.4	*****	*****	*****	*****	*****	*****
9.0	75.0	21.0	12.3	4.7	1.0	4.0	42.0	207.4	*****	*****	*****	*****	*****	*****
11.0	87.0	33.1	12.4	4.7	1.0	4.0	41.0	207.4	*****	*****	*****	*****	*****	*****
13.0	102.0	40.0	12.4	4.7	1.0	4.0	40.0	207.4	*****	*****	*****	*****	*****	*****
15.0	121.0	40.0	12.4	4.7	1.0	4.0	39.0	207.4	*****	*****	*****	*****	*****	*****
17.0	125.0	42.5	12.5	4.7	1.0	4.0	38.0	207.4	*****	*****	*****	*****	*****	*****
19.0	120.0	37.5	12.5	4.7	1.0	4.0	37.0	207.4	*****	*****	*****	*****	*****	*****
21.0	124.0	41.3	12.7	4.7	1.0	4.0	36.0	207.4	*****	*****	*****	*****	*****	*****
23.0	133.0	45.0	12.6	4.7	1.0	4.0	35.0	207.4	*****	*****	*****	*****	*****	*****
25.0	146.0	50.0	12.7	4.7	1.0	4.0	34.0	207.4	*****	*****	*****	*****	*****	*****
27.0	145.0	50.0	12.5	4.7	1.0	4.0	33.0	207.4	*****	*****	*****	*****	*****	*****
29.0	65.0	31.3	12.4	4.7	1.0	4.0	32.0	207.4	*****	*****	*****	*****	*****	*****
DISTANCE RANGE TRAVELLED 30.0														
DISTANCE ANCHOR TRAVELLED 29.5														

Note: Anchor depth at end of drag measured - centerline of shank at anchor crown = 16 inches.

NOTE - POSITIVE SHANK ANGLE INDICATES SHANK TIP BELOW TOWN



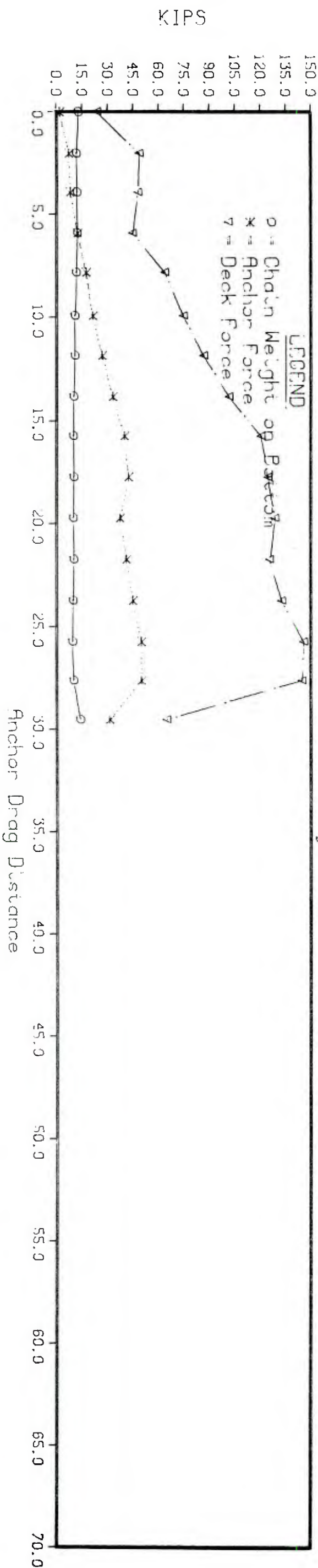
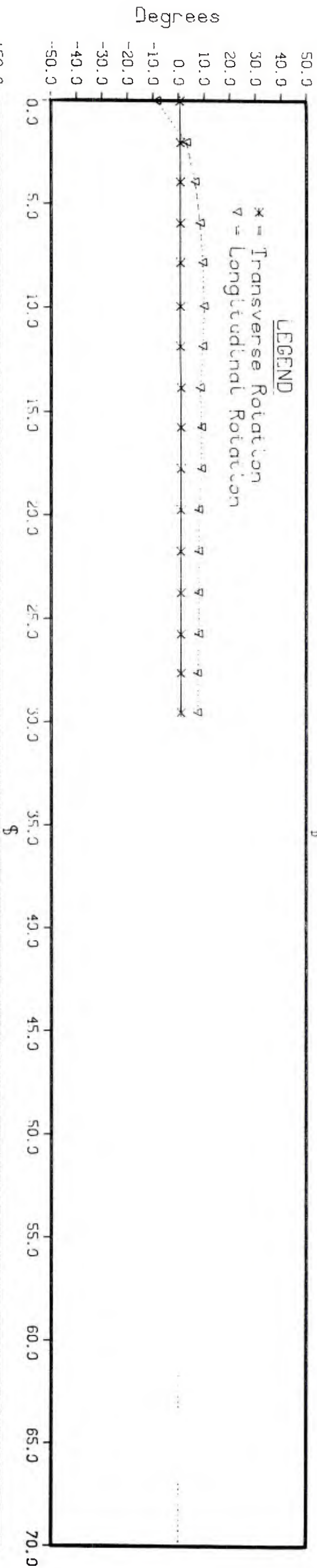
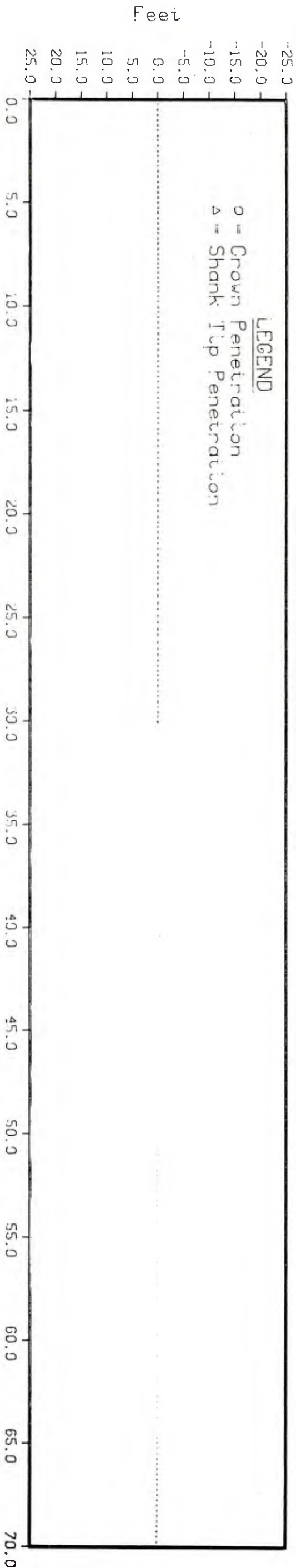
Day # = 102

SAN DIEGO HARBOR 1500 FT. SOUTHEAST OF BUOY 49

Test No. = 1

Test Series No. = 22

stockless, 5000lb. tandem gr. ring to shackle 35 deg. fix. fluke
fine sand bottom, depth 11-12 ft. mlv

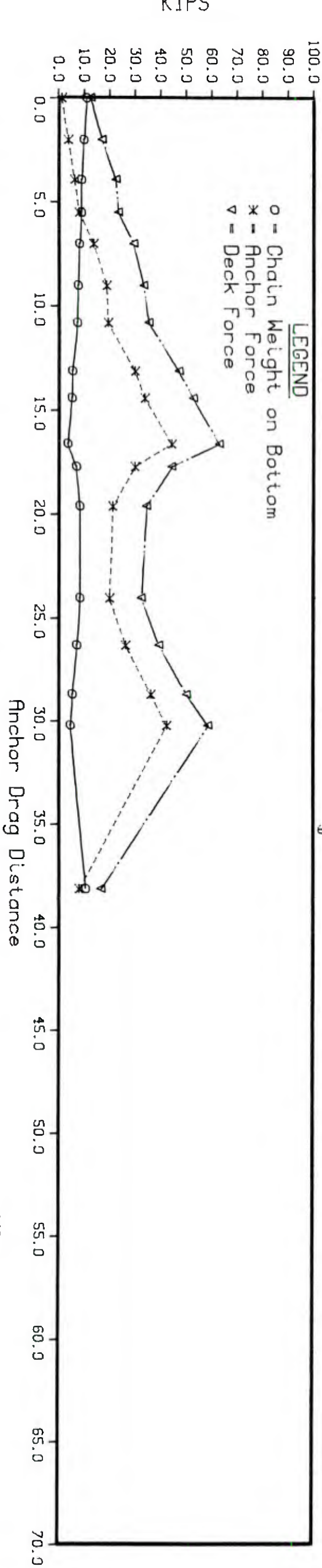
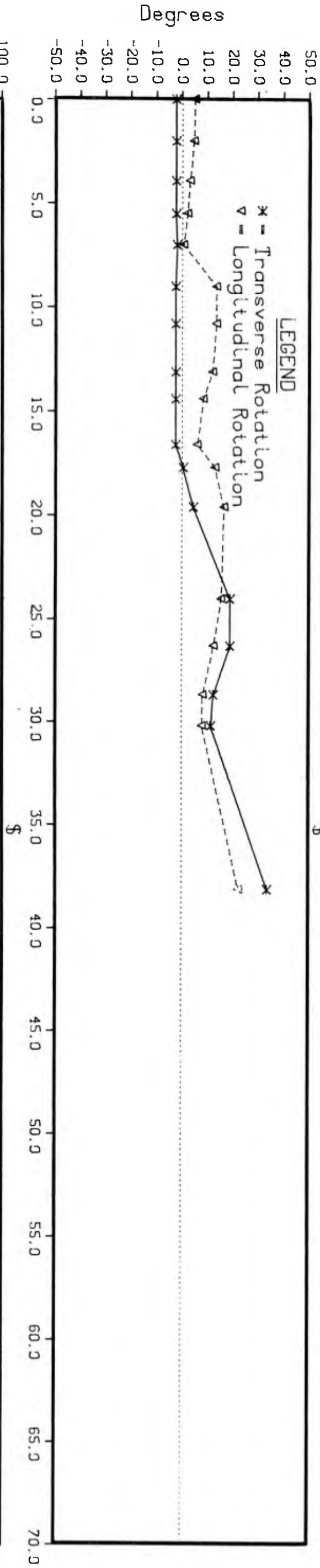
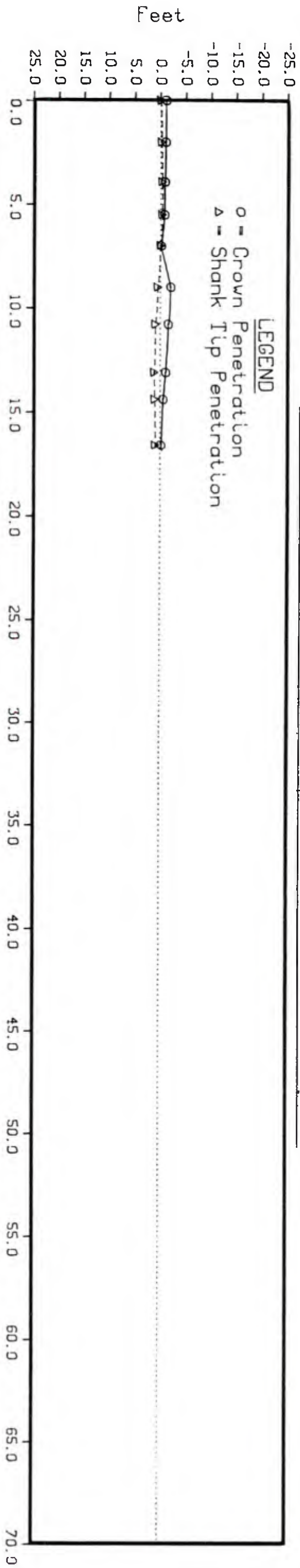


Day # - 106 SAN DIEGO HARBOR AT BUOY 21

Test No. - 1

Test Series No. - 24

stato 3000lb. 18 in. stabilizext. 31.5 deg.mov.flukes
1-3 ft. mud over dense sand depth 35-38 ft. mllw



Day # - 106
 Test No. - 2
 Test Series No. - 24

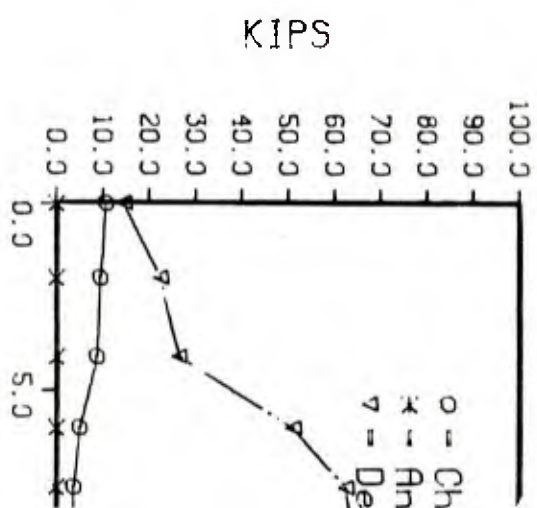
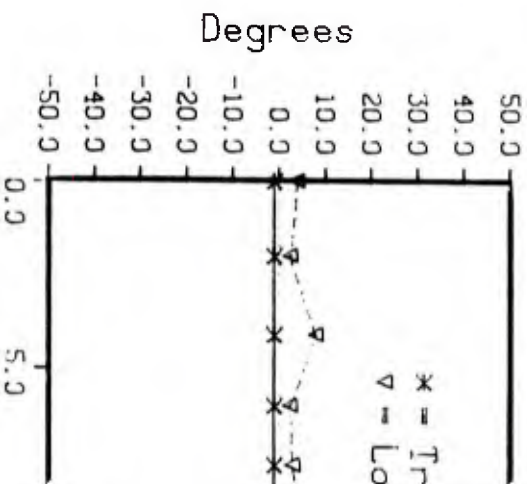
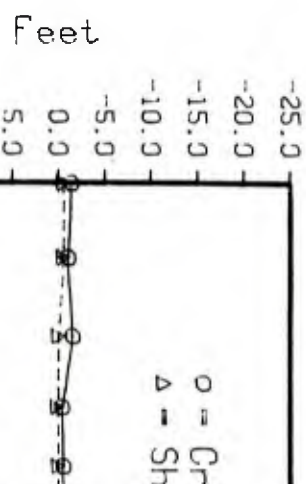
SAN

TEST DATE
 TEST NO.
 TEST SITE
 TEST AREA
 STARTED TIMES
 STOPPED TIMES
 ANCHOR TYPE
 ANCHOR WEIGHT
 FLUX ANGLE TYPE
 FLUX ANCHOR WEIGHT
 MAIN ANCHOR WEIGHT
 MAIN-AUX ANCHOR SEPARATION
 DEPRESSIONS-NO.-WT EACH-TOTAL WT.
 MOORING LINE DESCRIPTION

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
FEET	MPS	MPS	FEET	DEG	DEG	DEG	MPS	FEET	LR5	FEET	FEET	FEET	FEET	LR5
0.0	15.0	0.0	40.1	-1.0	4.4	13.2	14.4	245.2	8486.1	19.6	40.4	43.1	40.4	1364.9
2.0	23.0	0.0	40.2	-1.0	2.5	11.7	22.5	220.5	8233.5	19.4	40.4	43.2	40.4	1280.1
4.1	27.0	0.0	40.4	-1.0	2.5	11.4	26.5	207.0	8040.5	19.4	40.4	43.2	40.4	1177.5
7.0	52.0	0.0	40.4	-1.0	2.5	10.0	51.2	133.4	5640.5	40.5	40.4	43.6	40.4	604.5
9.4	63.5	0.0	40.7	-1.0	3.4	9.3	42.7	108.4	3808.4	40.4	40.4	43.7	40.4	600.4
10.1	37.0	0.0	41.0	-1.0	5.4	8.5	34.4	110.7	3902.0	40.4	41.4	43.8	40.4	5987.5
12.1	37.0	0.0	40.3	3.5	14.5	8.5	34.4	214.4	4401.3	39.1	41.4	43.3	40.4	11601.3
18.4	21.0	0.0	39.4	5.2	17.5	8.9	34.4	234.6	8876.5	17.5	40.4	42.7	40.4	1177.5

DISTANCE RANGE TRAVELLED 20.0
 DISTANCE ANCHOR TRAVELLED 18.4

NOTE - POSITIVE SHANK ANGLE INDICATES SHANK TIP BELOW CROWN



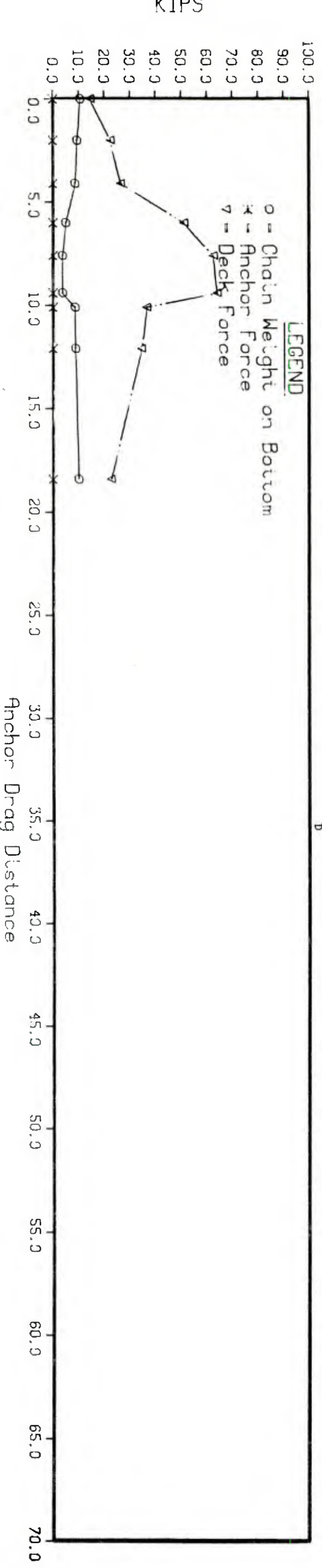
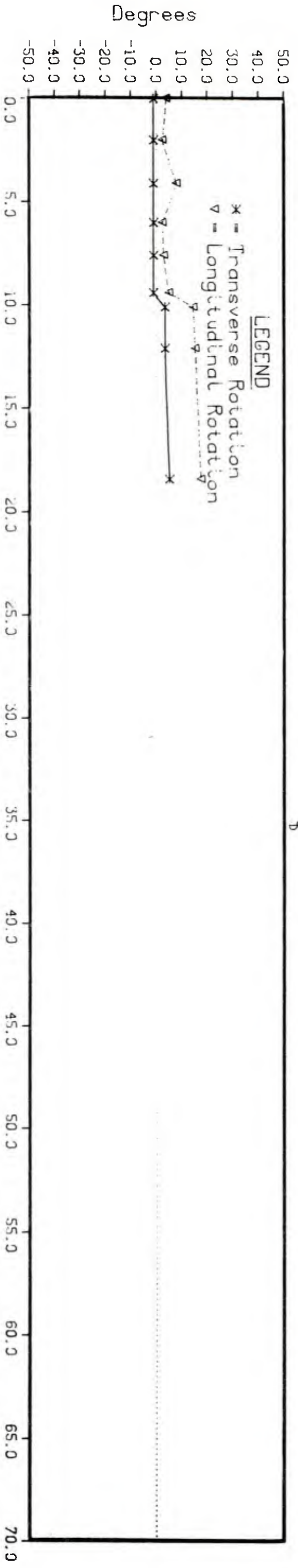
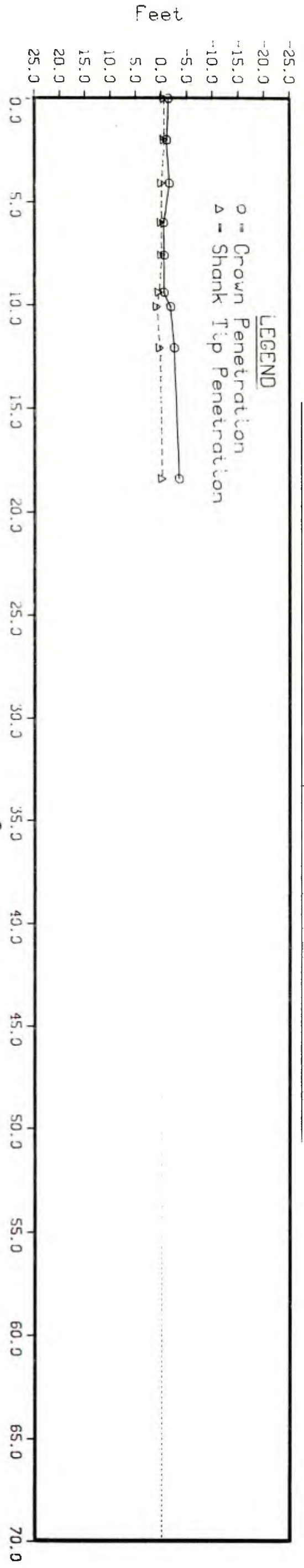
Day # - 106

SAN DIEGO HARBOR AT BUOY 21

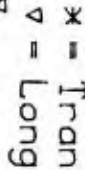
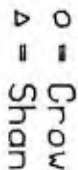
Test No. - 2

Test Series No. - 24

stato , 3000lb. 18 in. stabilizext. 31.5 deg.mov.flukes
1-3 ft. mud over dense sand depth 35-38 ft. mllw



SPAN



Day # - 106

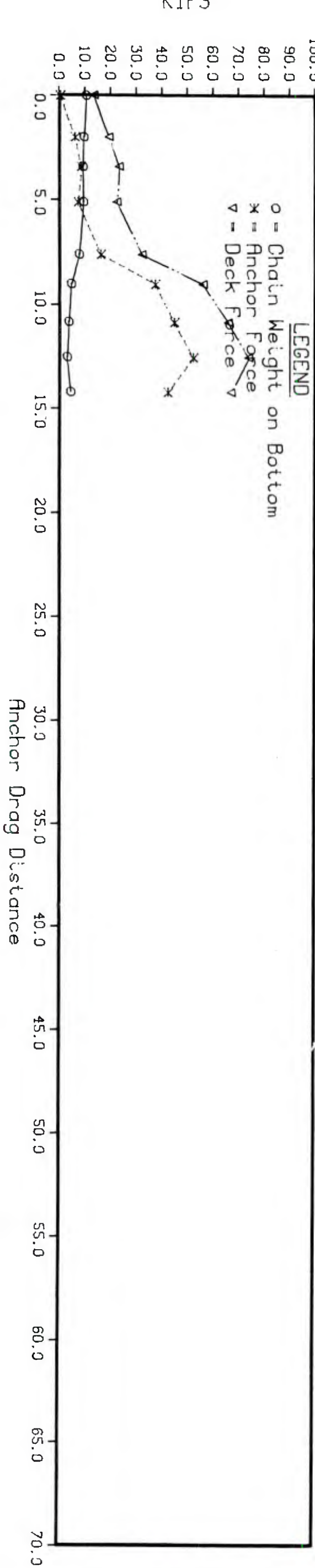
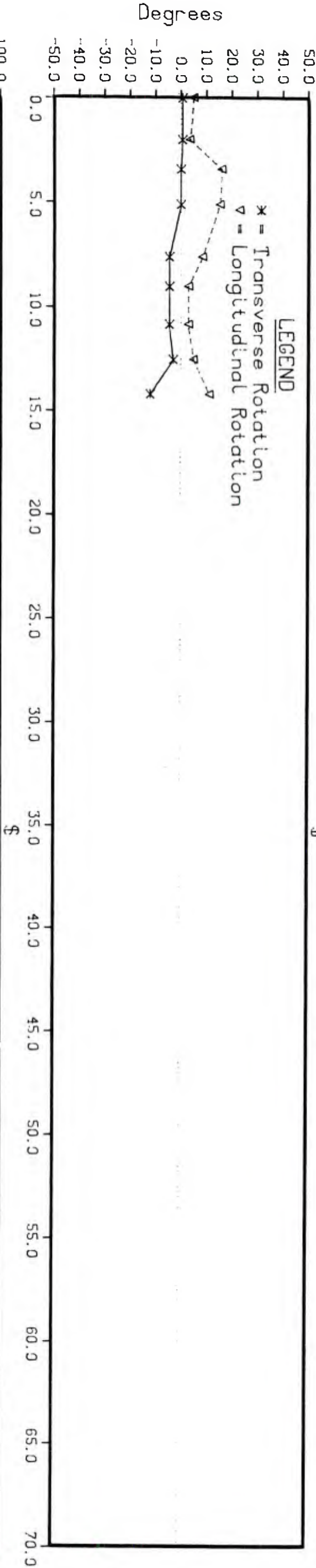
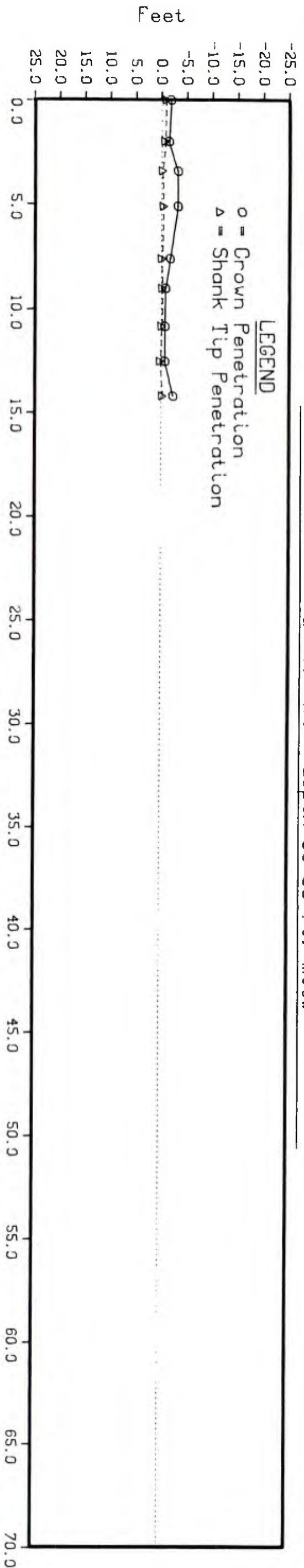
SAN DIEGO HARBOR AT BUOY 21

Test No. - 3

stato , 3000lb. 18 in. stabilizext. 31.5 deg.mov.flukes

Test Series No. - 24

1-3 ft. mud over dense sand depth 35-38 ft. mltw



Day # = 170
Test No. = 1
Test Series No. = 0

INDIAN

TEST DATE
TEST NO.
TEST AREA
START-END TYPES
SCAFFOLD TYPE
ANCHOR TYPE
FLUME ANGLE-TYPE
FLUME ANGLE-TYPE
AUX. ANCHOR WEIGHT
AUX. ANCHOR TYPE
PAIN-AUX ANCHOR SEPARATION
DEPRESSORS-NO.-MT-EACH-TOTAL MT.
MOORING LINE DESCRIPTION

STATID ANCHOR TEST

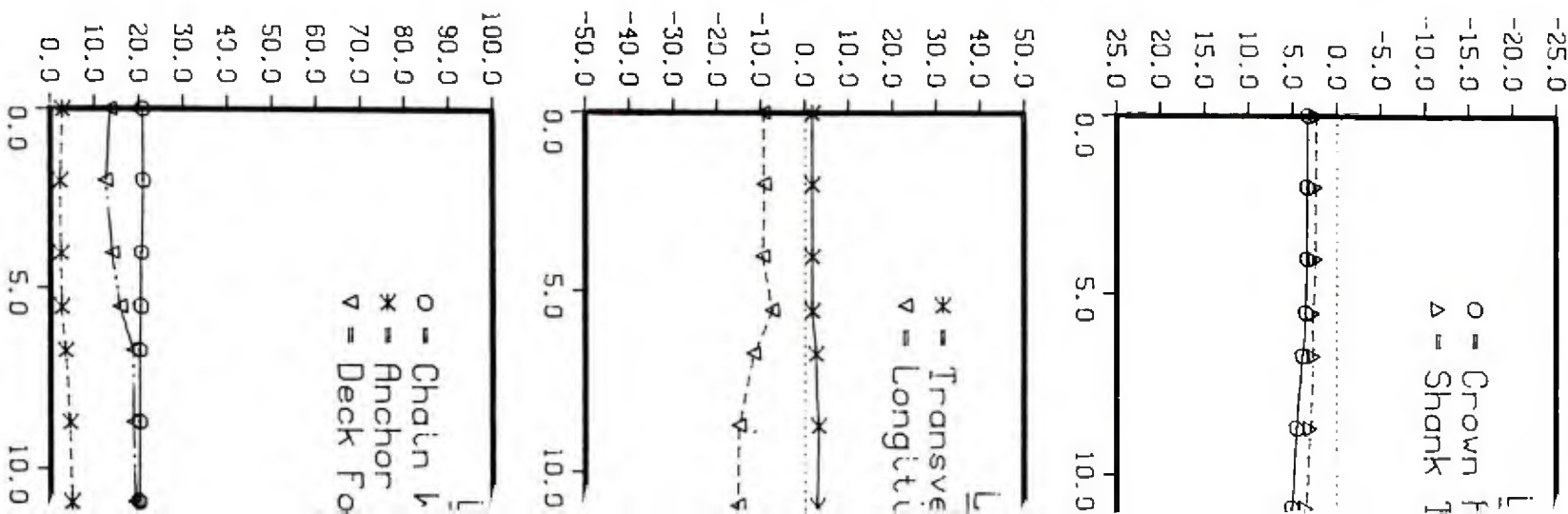
170
0
INDIAN ISLAND WASHINGTON
1700 - 1720
SLIT
STATION 1000000. 16 IN. STABILIZERS
1070.00 LB.
50.00 DEC. - 0 0-MOV 1-FIX
0.00 LB.
0 - 0.0 - 0.0 LB.
90 FT. 2 IN. CHAIN, 300 FT. 2.5 IN. CHAIN, 400 FT. 1 5/8 IN.
IMRC ROPE, 346 FT. 2 IN. IMRC ROPE

1. DRAG DISTANCE	2. DECK TENSION	3. ANCHOR TENSION	4. PACKAGE DEPTH	5. ROTATION ANGLE	6. SHANK ANGLE	7. WIRE ROPE ANGLE	8. DECK MORITZ. FORCE	9. CHAIN LENGTH ON BOTTOM	10. CHAIN WEIGHT ON BOTTOM	11. ANCHOR CROWN DEPTH	12. ANCHOR SHANK TIP DEPTH	13. ANCHOR FLUME TIP DEPTH	14. WATER DEPTH	15. TOTAL BOTTOM WEIGHT
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
FEET	KIPS	KIPS	FEET	DEG	DEG	DEG	KIPS	FEET	LB'S	FEET	FEET	FEET	FEET	LB'S
0.0	14.0	2.0	89.4	1.7	-9.4	15.4	13.4	447.1	20773.9	89.7	88.7	92.2	88.4	21843.9
2.0	13.1	2.2	89.5	1.7	-9.3	11.1	12.5	449.3	20861.3	89.8	88.8	92.3	88.4	21931.3
4.0	14.6	2.4	89.5	1.7	-9.6	15.4	14.0	449.3	20861.3	89.8	88.8	92.3	88.4	21931.3
6.7	16.3	3.4	89.6	1.7	-11.7	14.5	14.7	453.1	20713.2	89.9	89.1	92.4	88.4	21841.2
12.7	19.2	4.4	90.9	2.1	-15.0	14.2	14.7	453.1	20713.2	90.0	89.0	93.5	88.4	21841.2
15.7	22.0	5.0	91.0	3.0	-15.3	13.4	14.2	453.1	20713.2	90.0	89.0	93.5	88.4	21841.2
14.6	24.7	6.8	92.0	3.8	-16.8	13.0	14.0	453.1	20713.2	90.0	89.0	93.5	88.4	21841.2
18.2	25.2	7.4	92.4	3.8	-17.5	12.9	14.0	453.1	20713.2	90.0	89.0	93.5	88.4	21841.2
20.4	26.3	8.6	92.5	3.6	-17.5	12.5	14.0	453.1	20713.2	90.0	89.0	93.5	88.4	21841.2
22.3	28.5	10.0	93.1	3.6	-17.5	12.5	14.0	453.1	20713.2	90.0	89.0	93.5	88.4	21841.2
24.2	30.6	10.4	93.8	3.3	-17.3	12.3	12.1	26.9	405.0	186.6	91.7	95.6	86.4	19733.3
26.1	31.6	10.8	94.5	3.3	-16.8	11.9	29.9	400.2	188.1	92.0	96.3	86.4	19756.8	
27.9	32.2	11.2	95.3	3.3	-16.4	11.7	30.9	397.9	187.0	92.0	96.5	86.4	19736.8	
29.9	32.2	11.4	95.3	3.6	-16.6	11.5	31.5	397.6	187.9	92.7	97.2	86.4	19761.9	
31.6	32.0	11.8	95.4	4.2	-23.9	11.4	32.7	399.8	180.9	94.0	97.4	86.4	19515.2	
33.9	32.0	11.6	95.3	4.3	-24.6	11.4	31.4	399.5	180.8	96.0	97.8	86.4	19545.3	
35.8	33.6	12.4	95.3	5.7	-30.6	11.4	33.0	399.3	180.7	96.2	93.1	97.4	86.4	19144.4
37.8	33.6	12.4	95.5	7.3	-30.6	11.3	32.9	394.0	180.7	96.3	93.1	97.4	86.4	19177.7
39.9	34.6	13.0	95.9	8.3	-27.5	11.3	34.0	393.1	180.6	96.7	93.9	98.1	86.4	19013.8
41.7	34.6	13.0	95.8	8.4	-31.2	11.3	33.9	392.2	179.4	96.7	93.5	97.9	86.4	19088.8
43.5	34.6	13.2	95.9	9.1	-34.0	11.2	33.9	392.2	180.9	96.8	93.5	97.9	86.4	19088.8
45.3	34.4	13.0	95.9	9.0	-35.1	11.1	33.8	392.6	180.9	96.8	93.4	97.8	86.4	19159.5
47.4	35.5	14.6	96.4	9.9	-36.0	10.9	34.6	392.2	180.1	97.4	93.8	97.7	86.4	19087.7
								390.8	179.4	97.4	93.8	98.3	86.4	19016.1
50.0														
47.4														

NOTE - POSITIVE SHANK ANGLE INDICATES SHANK TIP BELOW CROWN

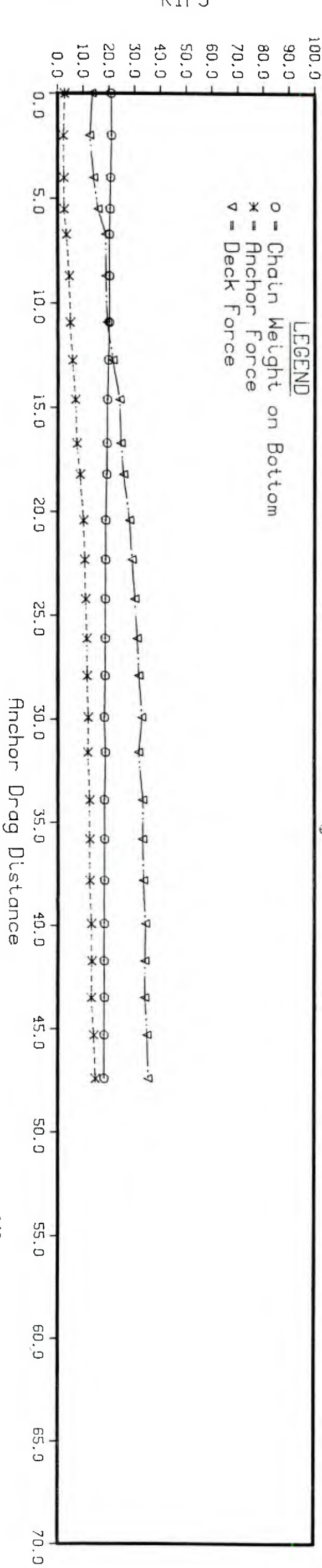
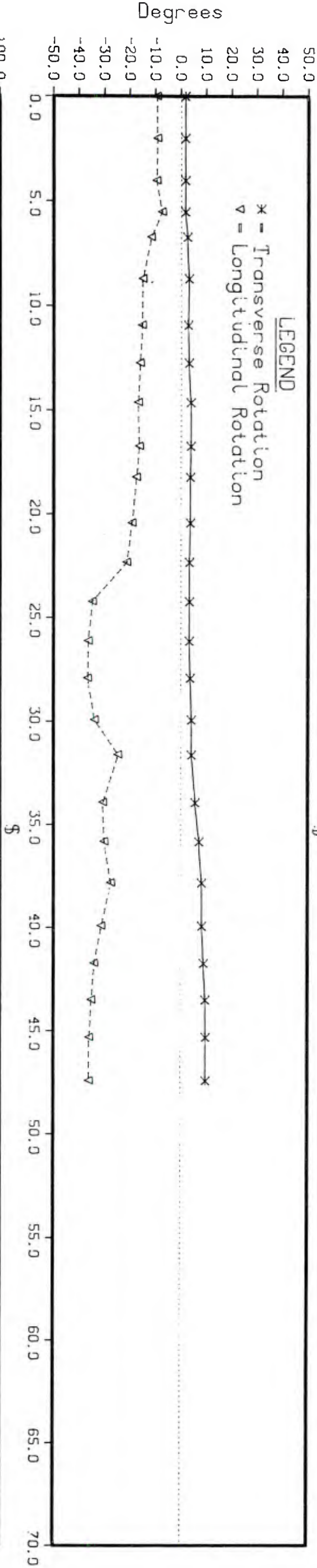
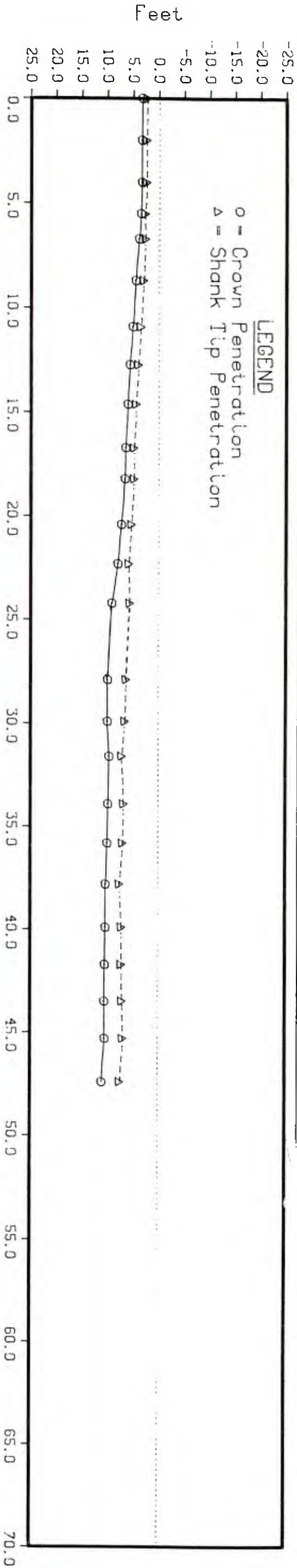
Degrees

Feet



Day # = 170
INDIAN ISLAND WASHINGTON

Test No. = 1
Test Series No. = 0
state 1000lb, 16 in. stabilizers 50 deg. mov. flukes
silt



Day # = 172
 Test No. = 7
 Test Series No. = 0

STOCKLESS ANCHOR TEST

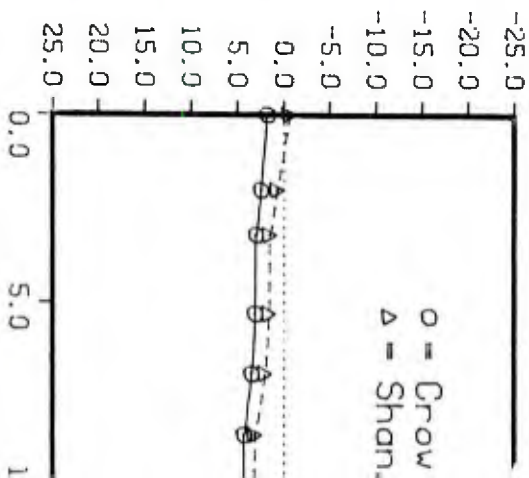
TEST DATE 172
 TEST NO. 7
 TEST RUN 0
 TEST AREA INDIAN ISLAND WASHINGTON
 START-END TIMES 1255 - 1320
 SEAFLOOR TYPE SILT
 ANCHOR TYPE STOCKLESS 9000LBS.+451A05+ 48 DEG FX FLUKES
 ANCHOR HEIGHT 11370 LB.
 FLUKES ANGLE-TYPE 48-00 DEG. - 0 0-MOV 1-FIX
 ANCHOR ANGLE-TYPE 0-00 LB.
 ANCHOR ANCHOR SEPARATION 0-00 LB.
 PAIN-AUX ANCHOR SEPARATION 0-00 LB.
 DEPRESSORS+NO-MT-EACH-TOTAL MT. 90 FT. 2 IN. CHAIN, 360 FT. 2.5 IN. CHAIN, 400 FT. 1 5/8 IN.
 FLOORING LINE DESCRIPTION 1MC ROPE, 346 FT. + 2 IN. 1MC ROPE

1. DRAG DISTANCE	2. DECK TENSION	3. ANCHOR TENSION	4. PACKAGE DEPTH	5. ROTATION ANGLE	6. SHANK ANGLE	7. WIRE ROPE ANGLE	8. DECK HORIZ. FORCE	9. CHAIN LENGTH ON BOTTOM	10. CHAIN HEIGHT ON BOTTOM	11. ANCHOR CROWN DEPTH	12. ANCHOR SHANK TIP DEPTH	13. ANCHOR FLUKES TIP DEPTH	14. WATER DEPTH	15. TOTAL BOTTOM WEIGHT
FEET	KIPS	KIPS	FEET	DEG	DEG	DEG	DEG	KIPS	FEET	LB	FEET	FEET	FEET	FEET
0-0	18-0	2-5	79-0	5-4	-17-4	15-8	17-3	427-7	1980-0	80-6	78-2	63-6	78-4	20937-0
2-0	23-4	9-1	80-1	5-3	-12-6	14-7	22-6	407-9	18806-7	81-3	79-5	64-7	78-8	19943-7
3-2	24-3	9-1	80-8	5-3	-11-2	14-1	23-5	407-6	18791-5	81-8	80-3	65-3	78-8	19928-5
5-3	25-2	10-1	81-3	3-6	-11-0	14-0	24-4	408-4	18631-5	81-9	80-4	65-4	78-8	19768-5
6-9	25-7		82-3	3-1	-10-8	13-8	24-9	408-1	18615-1	82-3	80-8	65-8	78-8	19732-1
8-5	26-7		82-3	3-1	-8-0	13-1	28-0	395-9	18205-1	83-1	81-9	66-8	78-8	19342-1
10-7	32-2		82-5	2-8	-6-0	12-8	31-4	382-9	17603-9	83-1	82-2	67-0	78-8	18740-9
12-4	36-3		83-7	2-1	-4-9	12-2	35-5	372-5	17031-7	84-2	83-5	68-2	78-8	18168-7
14-1	39-2	22-0	84-4	1-6	-4-9	11-8	38-3	365-6	16604-8	85-8	84-2	68-9	78-8	18168-7
16-4	44-0		84-9	1-2	-4-9	11-7	43-1	348-7	15835-2	86-4	84-7	69-4	78-8	18072-2
18-6	25-6	26-8	85-9	-8	-5-4	11-4	25-1	428-3	19676-0	86-4	85-6	70-4	78-8	20813-8
19-8	47-8		87-3	-6	-6-3	11-1	46-9	341-6	15480-4	87-2	86-3	91-1	78-8	18617-4
22-1	53-1	31-6	87-3	-5	-6-9	10-6	52-2	322-7	14535-1	87-9	87-0	91-8	78-8	18272-1
23-8	58-3		88-1	-1	-7-6	10-6	57-3	312-9	14792-4	88-6	87-8	92-6	78-8	18299-4
25-8	59-5	32-6	90-9	-4	-7-6	10-3	58-5	313-8	14605-7	91-6	90-6	95-4	78-8	18222-7
28-1	59-5		91-8	-9-8	-8-1	10-3	60-2	308-2	13808-4	92-5	91-5	96-3	78-8	18943-4
30-6	60-7	33-1	93-2	-1-2	-8-3	10-1	63-4	300-7	13431-6	93-9	91-9	96-8	78-8	18943-4
32-9	60-7		93-2	-1-3	-8-3	10-1	63-4	312-7	13431-6	94-0	92-7	97-6	78-8	18943-4
35-0	65-4	39-8	93-2	-1-3	-8-3	10-1	63-4	280-2	12803-0	94-4	92-6	97-7	78-8	18943-4
37-1	65-4		93-2	-1-3	-8-3	10-1	63-4	280-2	12803-0	94-4	92-6	97-7	78-8	18943-4
39-1	67-3	39-9	94-1	-1-3	-8-3	10-1	66-4	289-8	12803-0	95-0	93-6	98-1	78-8	18943-4
41-3	67-3		94-1	-1-3	-8-3	10-1	66-4	289-8	12803-0	95-0	93-6	98-1	78-8	18943-4

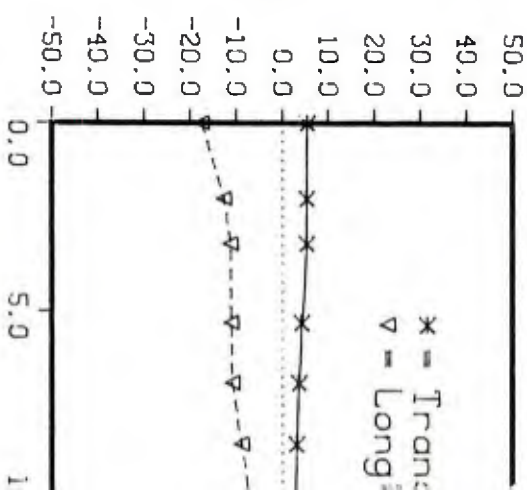
DISTANCE RANGE TRAVELLED 44.0
 DISTANCE ANCHOR TRAVELLED 41.3

NOTE - POSITIVE SHANK ANGLE INDICATES SHANK TIP BELOW CROWN

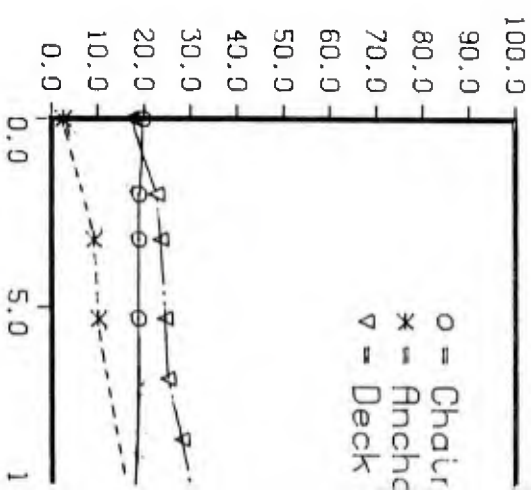
Feet



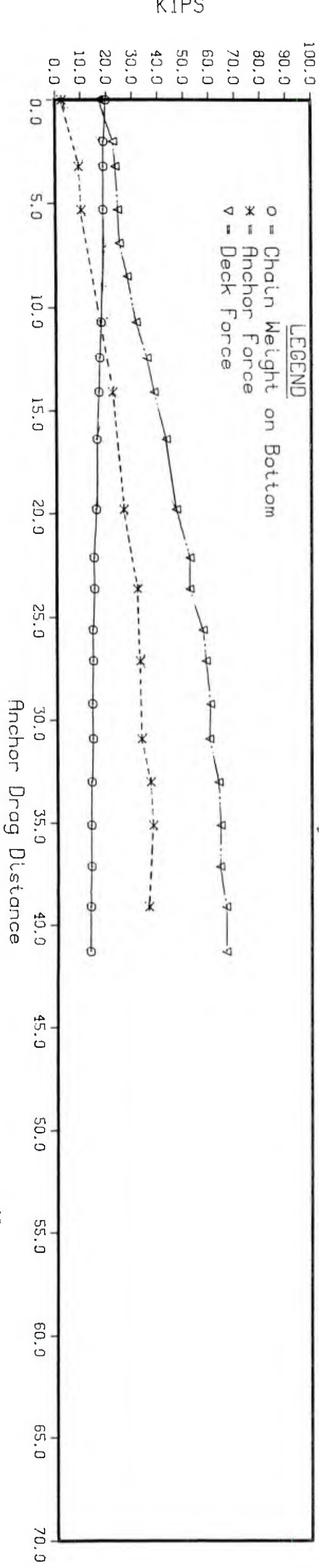
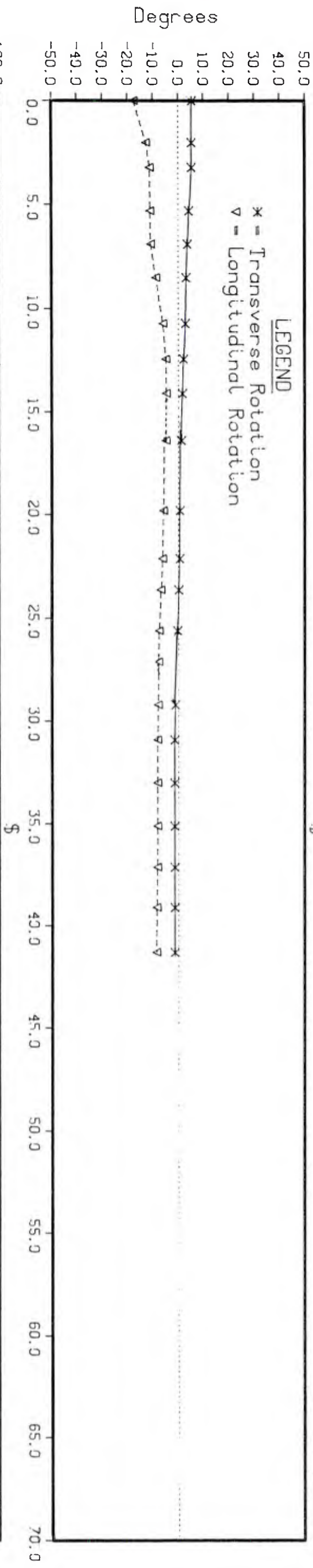
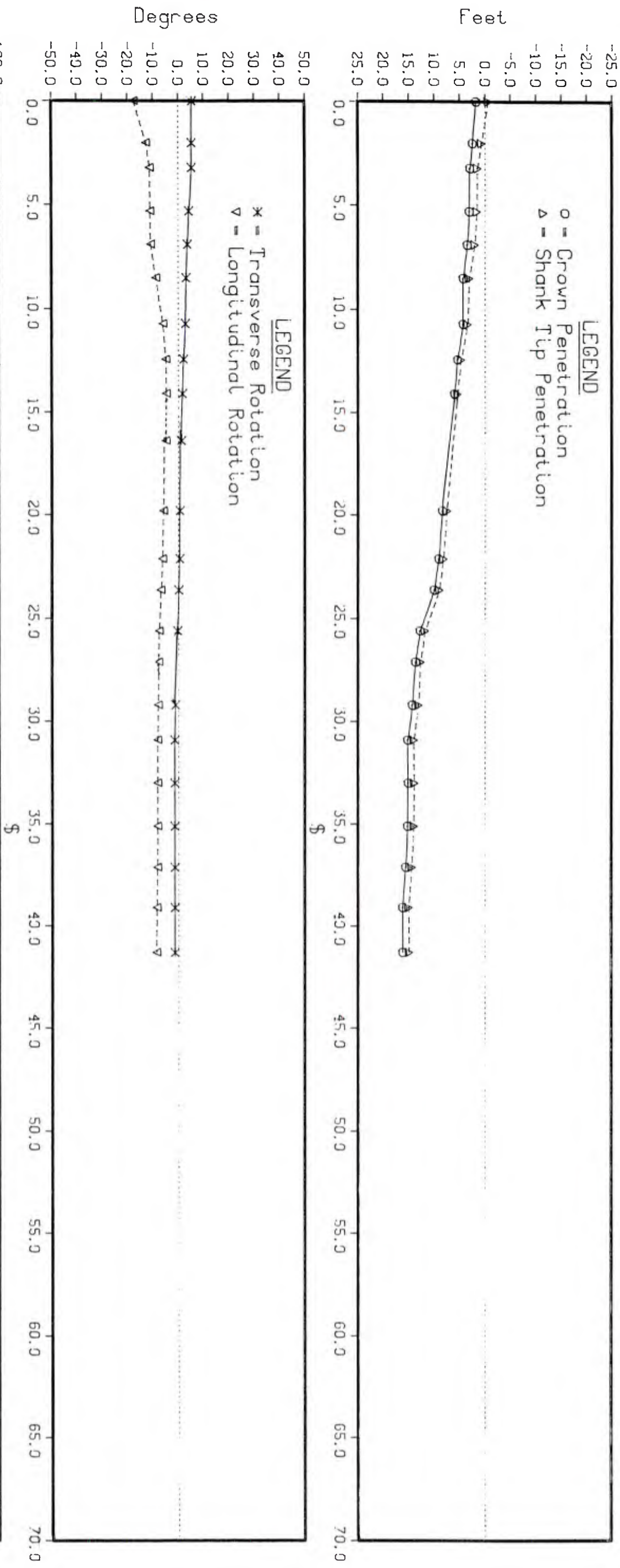
Degrees



KIPS



Day # = 172 INDIAN ISLAND WASHINGTON
 Test No. = 7 stockless 9000lbs.w.stabs, 48 deg fx flukes
 Test Series No. = 0 silt



Day # - 172
 Test No. - 8
 Test Series No. - 0

IND.

STOCKLESS ANCHOR TEST

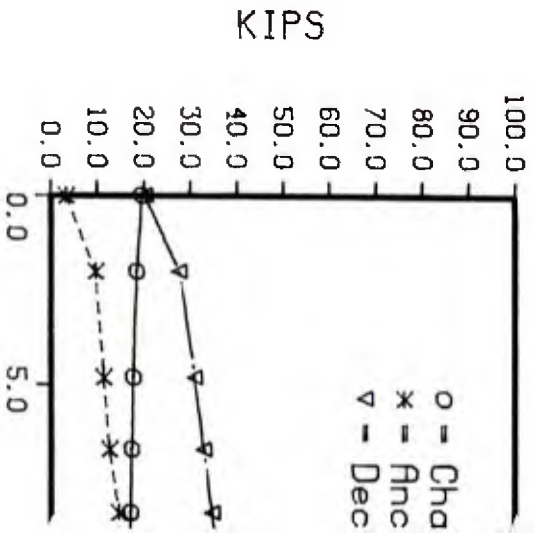
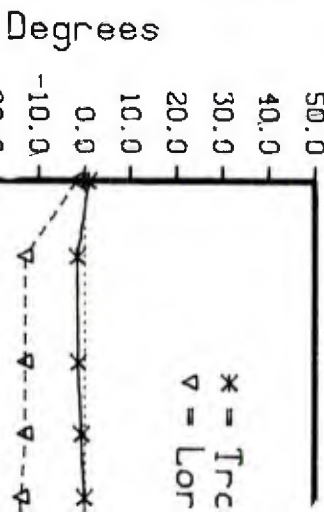
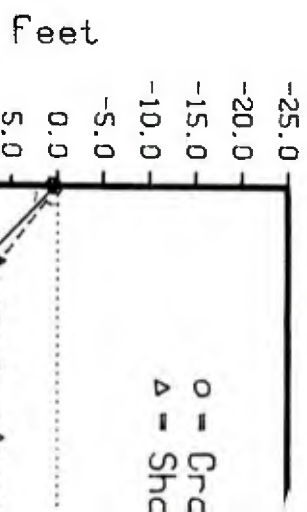
TEST DATE 172
 TEST NO. 8
 TEST RUC E
 TEST AREA INDIAN ISLAND WASHINGTON
 START-END TIMES 1430 - 1447
 SAILOR TYPE SILENT
 STOCKLESS *900LB. STABILIZERS, 48 DEG. POW. FLUERS
 ANCHOR TYPE 11370 LB.
 ANCHOR HEIGHT 48.00 DEG. - 0
 ANCHOR TYPE C-MOV 1-FIX
 ANCHOR HEIGHT 0.00 LB.
 ANCHOR TYPE 0.00 LB.
 ANCHOR HEIGHT 0.00 LB.
 ANCHOR TYPE 90 FT. 2 IN. CHAIN, 300 FT. 2.5 IN. CHAIN, 400 FT. 1 5/8 IN. IMRC ROPE, 346 FT. 2 IN. IMRC ROPE

1. ORAC DISTANCE 5. ROTATION ANGLE
 2. DECK TENSION 6. SHANK ANGLE
 3. ANCHOR TENSION 7. WIRE ROPE ANGLE
 4. PACKAGE DEPTH 8. DECK HORIZ. FORCE 12. ANCHOR SHANK TIP DEPTH
 9. CHAIN LENGTH ON BOTTOM 13. ANCHOR FLUKE TIP DEPTH
 10. CHAIN WEIGHT ON BOTTOM 14. WATER DEPTH
 11. ANCHOR CROWN DEPTH 15. TOTAL BOTTOM WEIGHT

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
FEET	KIPS	KIPS	FEET	DEG	DEG	DEG	KIPS	FEET	LBS	FEET	FEET	FEET	FEET	LBS
0.0	20.9	3.3	91.0	-1.7	-1.9	14.4	20.1	421.9	19909.2	91.2	90.9	99.4	90.8	20846.2
2.0	28.5	9.6	97.7	-1.7	-13.0	12.8	27.7	389.7	18394.5	99.0	97.1	102.3	90.8	19931.5
4.0	31.8	11.4	98.4	-1.4	-13.0	12.8	31.0	389.0	17657.7	99.7	97.8	103.0	90.8	18794.7
6.7	33.7	12.6	97.9	-1.7	-13.0	12.6	32.9	379.2	17365.2	99.2	97.3	102.5	90.8	18306.2
8.4	35.6	14.7	98.7	-1.1	-13.8	12.2	34.8	375.1	17163.5	100.0	98.1	103.5	90.8	18300.5
10.4	37.8	15.9	98.1	0.0	-14.8	12.0	36.9	368.7	16938.8	100.5	98.5	103.7	90.8	17975.8
12.4	39.9	17.7	98.9	0.0	-14.8	11.9	39.0	360.0	16496.1	100.3	98.2	103.5	90.8	17633.1
14.0	41.3	18.7	100.0	0.0	-15.1	11.6	40.4	354.5	16405.1	101.5	98.9	104.6	90.8	17264.6
16.1	43.1	20.5	99.6	-0.3	-15.5	11.5	42.2	352.5	16127.6	101.1	98.9	104.2	90.8	17218.1
17.8	43.2	21.0	100.3	-0.4	-16.0	11.4	43.9	349.5	15880.2	102.0	99.6	104.9	90.8	17017.2
20.0	44.8	23.5	100.5	-0.1	-16.3	11.3	45.0	346.9	15749.6	101.9	99.6	104.9	90.8	16882.6
21.9	45.8	24.0	100.0	-0.1	-16.3	11.3	45.2	346.9	15749.6	102.6	99.6	104.9	90.8	16882.6
24.1	46.1	24.5	100.0	-0.1	-16.3	11.3	45.2	346.9	15749.6	102.6	99.6	104.9	90.8	16882.6
24.9	46.5	24.5	100.5	-0.3	-16.5	11.2	45.0	346.1	15705.1	102.5	99.6	104.9	90.8	16825.1
27.7	48.2	25.8	100.3	-0.4	-16.5	11.1	47.0	339.4	15375.7	102.4	100.6	105.4	90.8	16562.7
30.1	48.6	26.8	101.4	-0.4	-16.5	11.1	46.0	335.4	15270.2	103.0	100.7	106.5	90.8	16487.7
31.8	48.6	26.8	101.4	-0.4	-16.5	11.1	46.0	335.4	15270.2	103.0	100.7	106.5	90.8	16487.7
33.9	48.6	26.8	101.4	-0.4	-16.5	11.1	46.0	335.4	15270.2	103.0	100.7	106.5	90.8	16487.7
35.6	48.6	26.5	101.7	-0.4	-16.4	11.0	46.9	336.9	15244.4	103.3	101.0	106.4	90.8	16381.4
37.7	49.8	27.5	101.8	-0.4	-16.4	11.0	48.2	333.1	15057.5	103.7	101.5	106.7	90.8	16194.5
39.7	51.1	28.0	102.2	-0.4	-16.4	10.9	49.5	330.2	14909.1	104.0	101.7	107.0	90.8	16046.1
41.4	50.4	27.3	102.1	-0.4	-16.5	10.8	51.4	330.7	14933.7	103.8	101.5	106.8	90.8	16070.7
43.6	52.4	29.1	102.4	-0.4	-16.5	10.7	51.8	329.1	14855.6	104.2	101.9	107.2	90.8	15992.6
45.4	52.6	29.6	102.2	0.0	-16.6	10.7	52.4	329.1	14855.6	104.2	101.9	107.2	90.8	15992.6
47.4	53.3	30.3	102.6	0.0	-16.6	10.6	52.0	330.8	14942.1	104.1	101.8	107.1	90.8	16079.1
49.4	53.0	30.3	102.5	-0.3	-16.6	10.6	52.0	330.8	14942.1	104.1	101.8	107.1	90.8	16079.1

DISTANCE RANGE TRAVELLED 50.0
 DISTANCE RANGE TRAVELLED 49.4

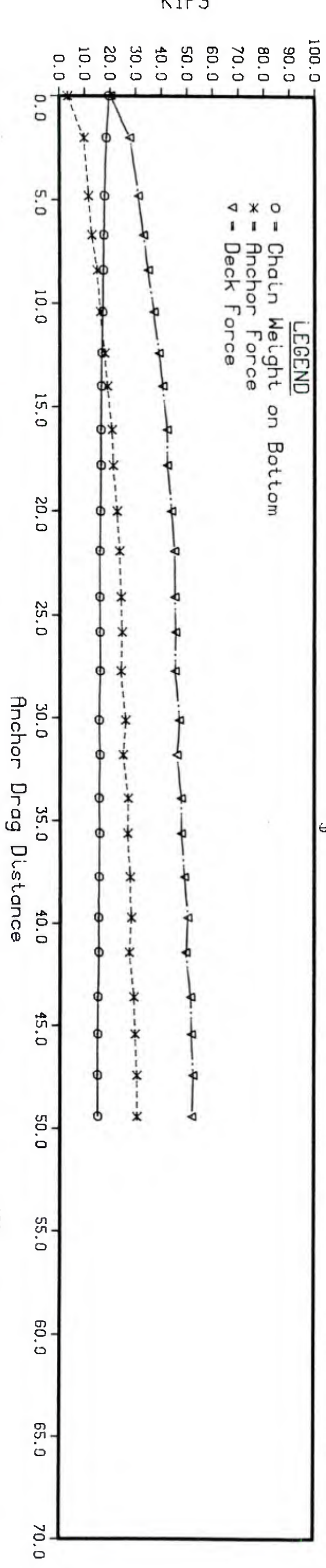
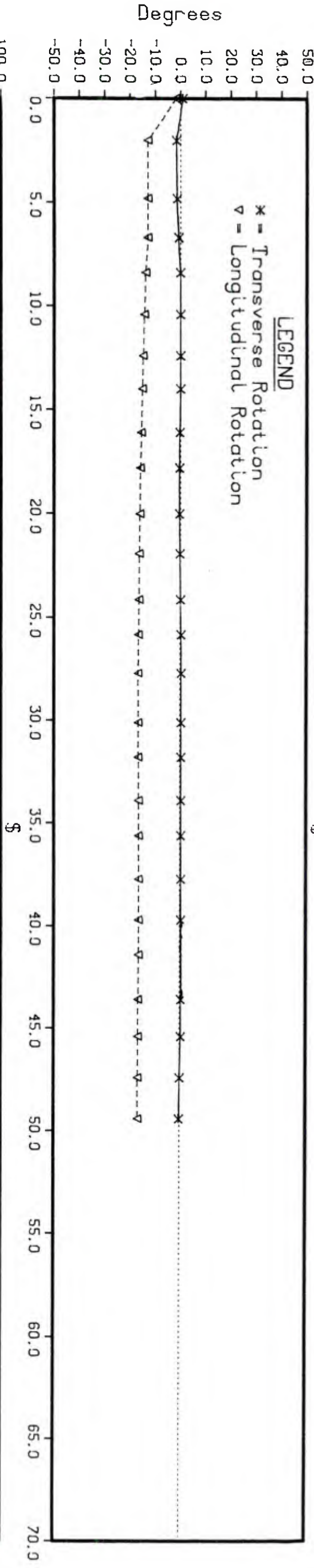
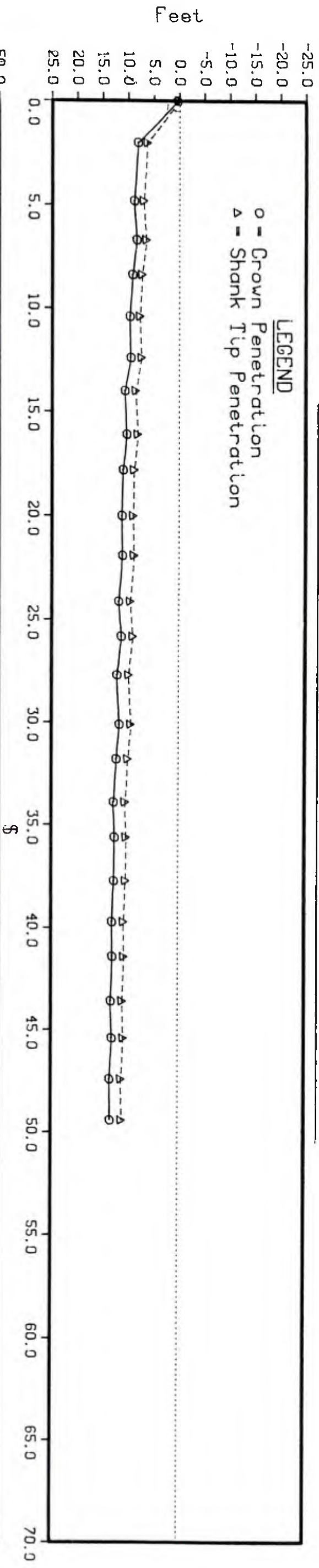
NOTE - POSITIVE SHANK ANGLE INDICATES SHANK TIP BELOW CROWN



Day # - 172 INDIAN ISLAND WASHINGTON

Test No. - 8 stockless, 9000lb. stabilizers, 48 deg. mov. flukes

Test Series No. - 0 silt



Day # - 172
Test No. - 9
Test Series No. - 0

INDI

STOCKLESS ANCHOR TEST

TEST DATE 172
TEST NO. 9
TEST RUN 0
TEST AREA INDIAN ISLAND WASHINGTON
START-END TIMES 1638 - 1657
SEAFLOOR TYPE SILT
ANCHOR TYPE STOCKLESS 9000LB. STABILIZERS, 40 DEG. FX, FLUKES
ANCHOR HEIGHT 5950.00 LB.
FLUKES ANGLE-TYPE 48.00 DEG. - 1 C-MOV 1-FIX
ANCHOR TYPE 0.00 LB.
ANCHOR HEIGHT 0.0 LB.
PAIN-205 ANCHOR SEPARATION 90 FT. 2 IN. CHAIN, 360 FT. 2.5 IN. CHAIN, 400 FT. 1 5/8 IN.
DEPRESSORS, NO. - M-EACH-TOTAL WT. 1000 LB. ROPE, 346 FT. * 2 IN. 1000 LB. ROPE

1. DRAG DISTANCE	2. DECK TENSION	3. ANCHOR TENSION	4. PACKAGE DEPTH	5. ROTATION ANGLE	6. SHANK ANGLE	7. SHANK ANGLE	8. SHANK ANGLE	9. CHAIN LENGTH ON BOTTOM	10. ANCHOR CROWN DEPTH	11. ANCHOR SHANK TIP DEPTH	12. ANCHOR FLUKE TIP DEPTH	13. WATER DEPTH	14. TOTAL BOTTOM WEIGHT	15. TOTAL BOTTOM WEIGHT
FEET	KIPS	KIPS	FEET	DEG	DEG	DEG	DEG	KIPS	FEET	FEET	FEET	FEET	FEET	FEET
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0.0	18.1	12.2	92.2	24.0	-19.6	15.6	12.5	428.1	198.1	93.4	91.2	93.4	92.2	22081.9
2.0	18.0	12.2	92.2	24.0	-19.5	15.7	12.4	428.1	198.1	93.4	91.3	93.4	92.2	22766.1
3.7	18.8	12.2	92.4	24.6	-19.5	15.3	18.2	426.6	197.5	93.5	91.4	93.5	92.2	22762.6
5.5	19.0	12.2	92.5	24.5	-19.5	15.1	18.4	426.6	197.5	93.5	91.5	93.5	92.2	22762.6
7.1	20.2	12.2	92.5	24.5	-19.5	14.7	19.5	423.9	196.0	93.7	91.7	93.7	92.2	22762.6
9.2	21.1	12.2	92.7	24.0	-19.5	14.5	20.4	420.5	194.0	93.7	91.7	93.7	92.2	22762.6
10.7	21.2	12.2	92.7	23.0	-18.6	14.2	20.5	422.3	195.8	93.7	91.7	93.7	92.2	22762.6
13.0	22.4	12.2	93.1	22.1	-17.7	14.1	21.7	417.2	192.3	94.0	92.2	96.4	92.2	22762.6
14.5	22.8	12.2	93.2	20.3	-16.9	14.0	22.1	416.2	192.3	94.1	92.3	96.5	92.2	22762.6
16.8	24.4	12.2	93.6	17.5	-15.7	13.6	23.7	411.5	189.6	94.7	92.9	97.1	92.2	22762.6
19.1	26.3	12.2	94.1	13.9	-14.8	13.5	25.6	403.8	186.0	95.4	93.3	97.5	92.2	22762.6
20.7	26.7	12.2	94.6	9.8	-13.9	13.0	27.6	398.6	183.9	95.7	94.1	98.1	92.2	22762.6
22.8	28.3	12.2	94.9	6.8	-13.8	12.9	29.2	392.9	180.9	96.1	94.5	98.8	92.2	22762.6
24.9	30.0	12.2	95.3	3.4	-12.0	12.5	31.3	386.1	178.1	96.0	94.6	99.6	92.2	22762.6
26.6	32.0	12.2	95.3	2.0	-11.3	11.9	33.7	382.6	175.7	97.0	95.2	100.2	92.2	22762.6
28.2	34.5	12.2	96.1	1.1	-11.3	11.9	37.6	367.8	167.3	97.1	95.8	100.2	92.2	22762.6
30.7	38.4	12.2	96.4	1.1	-11.3	11.9	37.6	367.8	167.3	97.1	95.8	100.2	92.2	22762.6
32.5	38.3	12.2	96.7	1.1	-11.3	11.9	37.6	367.8	167.3	97.1	95.8	100.2	92.2	22762.6
34.8	42.1	12.2	97.2	1.1	-11.3	11.9	41.2	356.2	162.2	97.4	96.6	101.1	92.2	22762.6
36.4	44.2	12.2	97.6	1.1	-11.3	11.9	43.3	351.9	159.0	98.2	97.5	101.6	92.2	22762.6
38.4	45.0	12.2	98.1	1.1	-11.3	11.9	44.1	350.2	159.4	98.7	97.8	101.9	92.2	22762.6
40.6	47.4	12.2	98.4	1.1	-11.3	11.9	46.5	340.7	154.0	99.0	97.8	102.1	92.2	22762.6
42.9	48.1	12.2	98.6	1.1	-11.3	11.9	47.2	339.9	153.6	99.2	98.0	102.1	92.2	22762.6
44.2	50.3	12.2	98.9	1.1	-11.3	11.9	49.8	332.5	150.5	99.9	98.5	102.4	92.2	22762.6
46.2	50.3	12.2	99.2	1.1	-11.3	11.9	49.8	332.5	150.5	99.9	98.5	102.4	92.2	22762.6
48.2	50.6	12.2	99.5	1.1	-11.3	11.9	49.8	332.5	150.5	99.9	98.5	102.4	92.2	22762.6
50.3	52.0	12.2	100.8	1.1	-11.3	11.9	51.0	326.3	147.3	100.6	98.8	102.4	92.2	22762.6
52.4	53.9	12.2	101.3	1.1	-11.3	11.9	52.0	326.3	147.3	100.6	98.8	102.4	92.2	22762.6
54.4	53.9	12.2	101.3	1.1	-11.3	11.9	52.0	326.3	147.3	100.6	98.8	102.4	92.2	22762.6
56.2	53.9	12.2	101.3	1.1	-11.3	11.9	52.0	326.3	147.3	100.6	98.8	102.4	92.2	22762.6
57.3	54.4	12.2	101.7	1.1	-11.3	11.9	53.5	331.0	149.1	102.8	100.3	104.9	92.2	20941.6

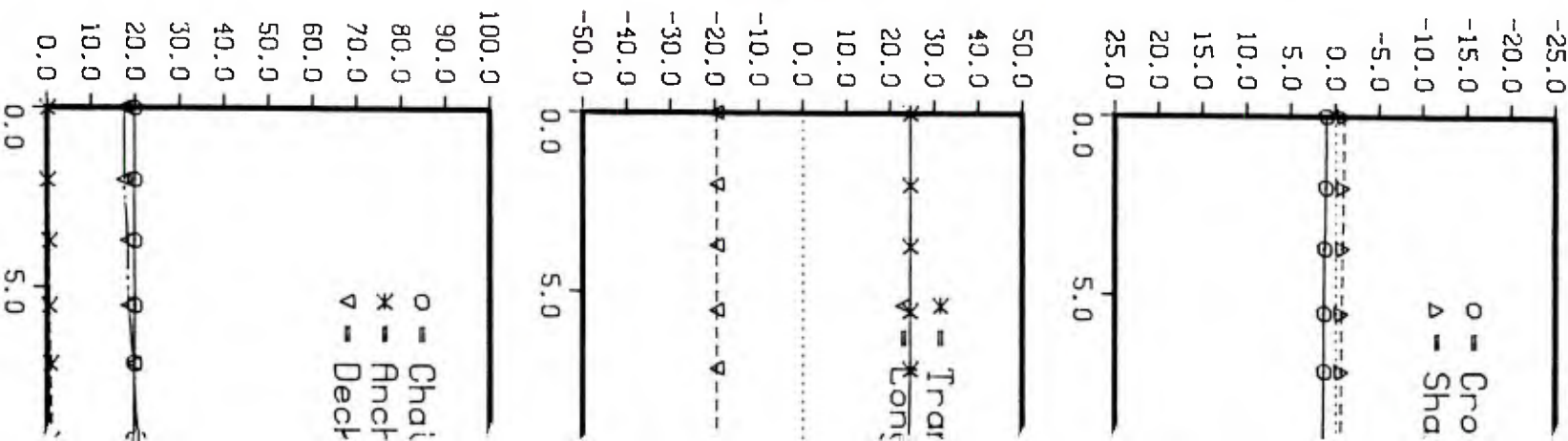
CISTANCE BARGE TRAVELLED 60.0
DISTANCE ANCHOR TRAVELLED 57.3

NOTE - POSITIVE SHANK ANGLE INDICATES SHANK TIP BELOW CROWN

Feet

Degrees

KIPS

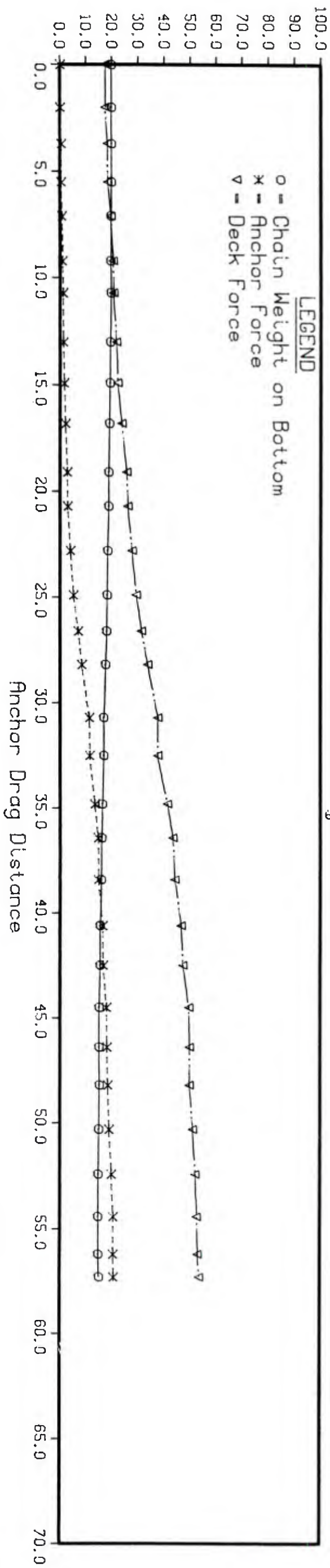
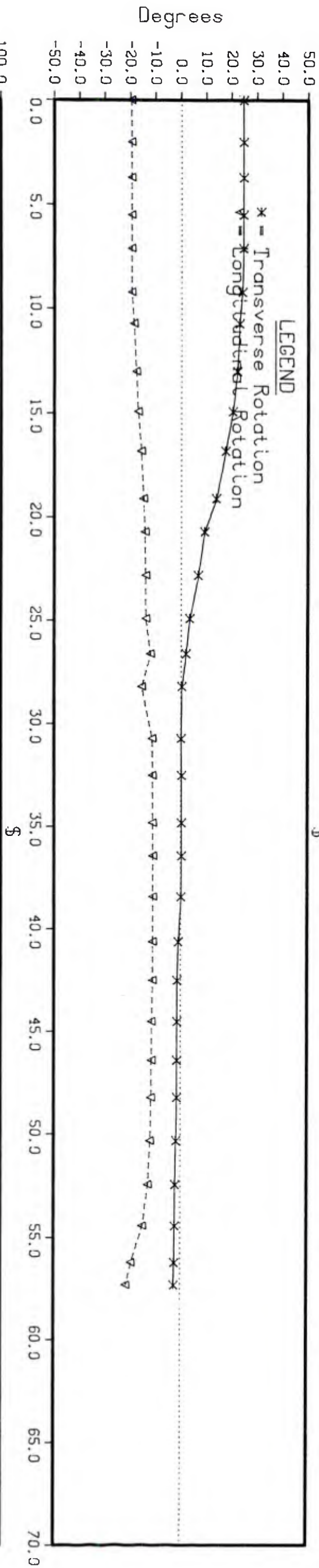
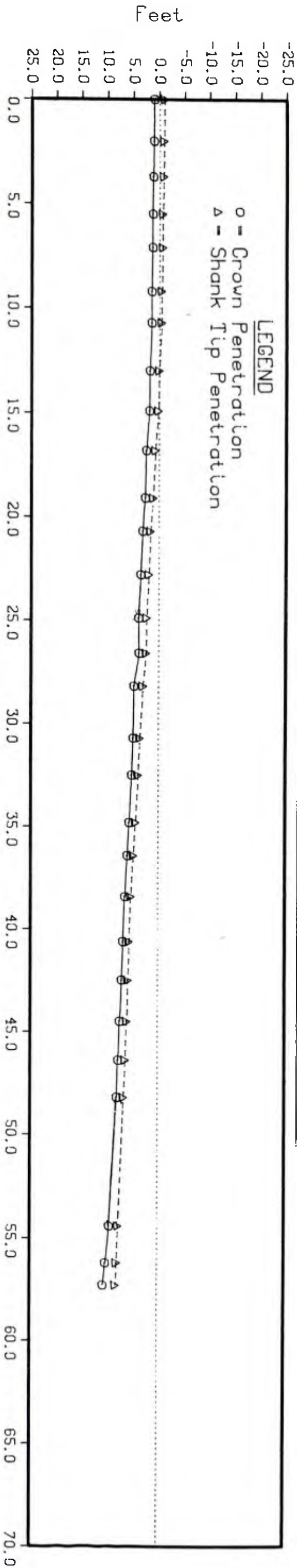


Day # - 172 INDIAN ISLAND WASHINGTON

Test No. - 9

Test Series No. - 0

stockless, 5000lb. stabilizers, 48 deg. fx. flukes
silt



INDEX

Feet

Degrees



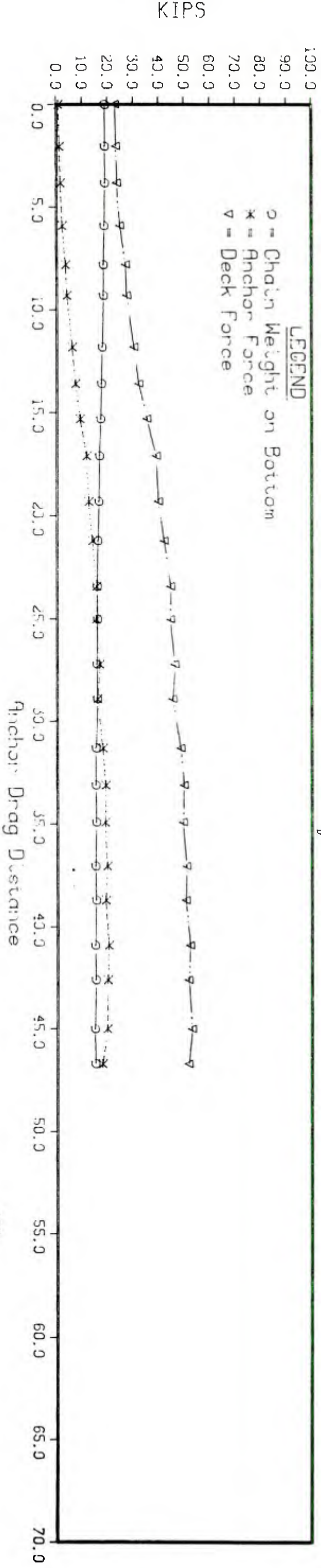
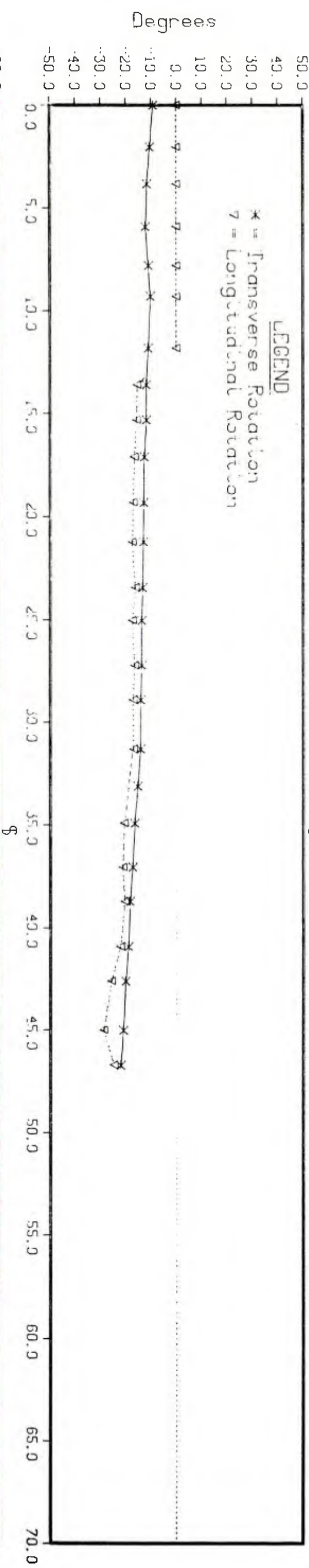
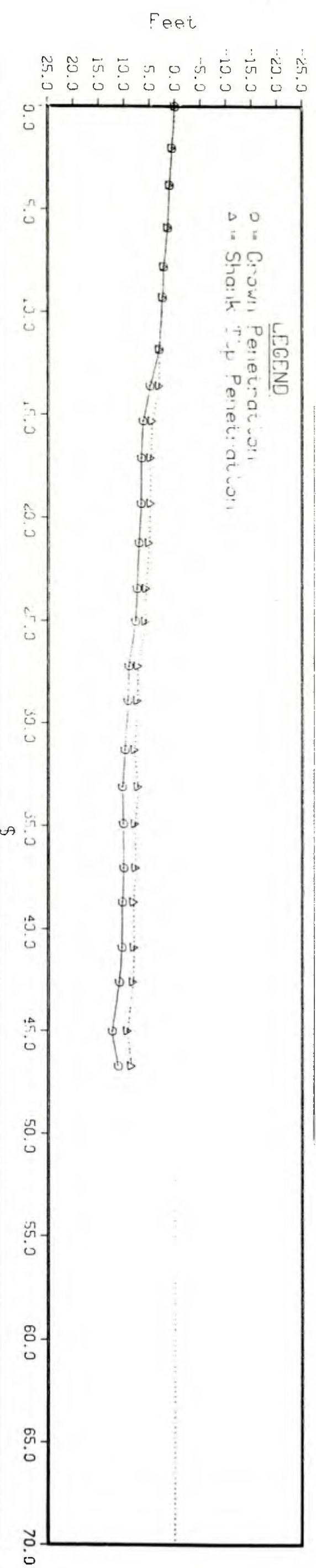
Day # = 172

INDIAN ISLAND WASHINGTON

Test No. = 10

Test Series No. = 0

stockless, 5000lb. stabilizers, 48 deg. fx. flukes
slit



Anchor Drag Distance

Day # = 173
 Test No. = 11
 Test Series No. = 0

INDIF

STOCKLESS ANCHOR TEST

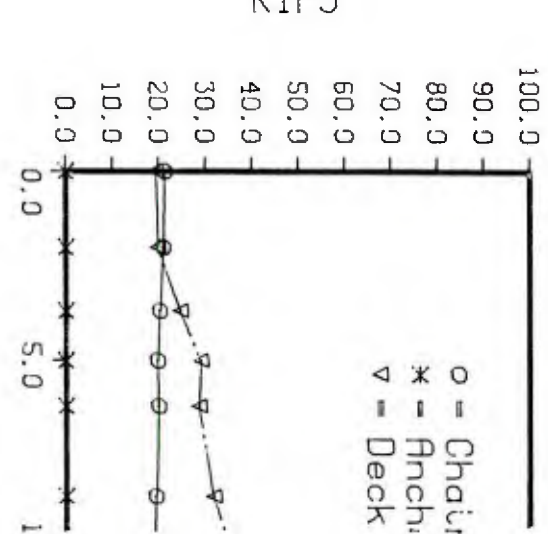
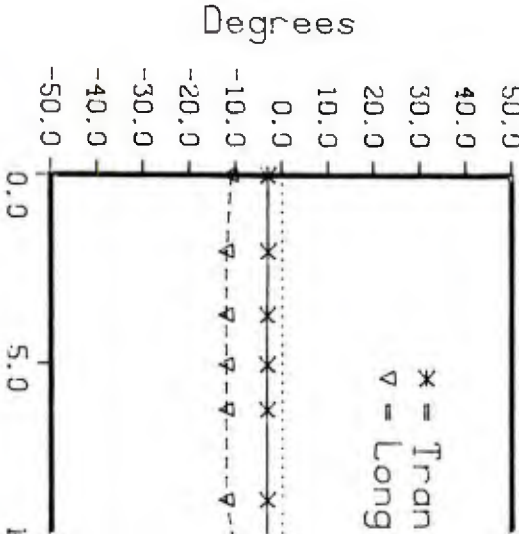
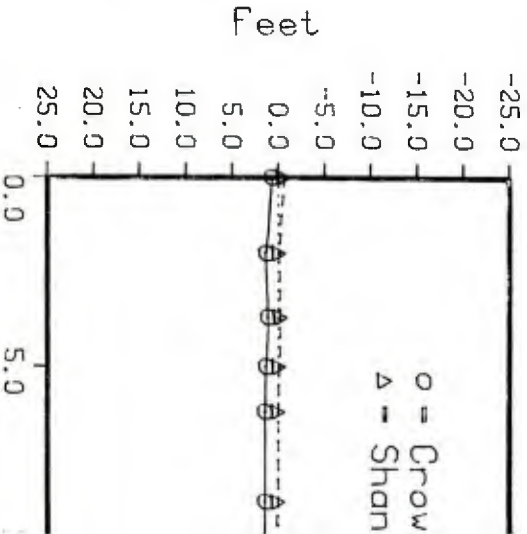
TEST DATE 173
 TEST RUN 11
 TEST AREA 0
 START-END TIMES 1300 - 1600
 SEAL/DOR TYPE 5117
 ANCHOR TYPE STOCKLESS *5000LB. TAND SHANK-SHACKLE-STAB5+40 DEG FX FLUKES
 ANCHOR HEIGHT 9950.00 LB.
 FLUKES ANGLE-TYPE 48.00 DEG. - 1 0-NOV 1-FIX
 AUX. ANCHOR TYPE 9950.00 LB.
 AUX. ANCHOR HEIGHT 135.00 FEET
 MAIN-AUX ANCHOR SEPARATION 0 - 0.0 LB.
 DEPRESSORS-NO.-MT-EACH-TOTAL MT. 135FT. ZIN. CHAIN ATTD TO (ENBD ANCHOR SHANK) 2-5IN
 MOORING LINE DESCRIPTION CHAIN, 400 FT. 1 5/8 IN. 14RC ROPE, 346 FT. 2 IN. 14RC ROPE

1. DRAG DISTANCE	2. DECK TENSION	3. ANCHOR TENSION	4. PACKAGE DEPTH	5. ROTATION ANGLE	6. SHANK ANGLE	7. WIRE ROPE ANGLE	8. DECK HORIZ. FORCE	9. CHAIN LENGTH ON BOTTOM	10. CHAIN WEIGHT ON BOTTOM	11. ANCHOR CROWN DEPTH	12. ANCHOR SHANK TIP DEPTH	13. ANCHOR FLUKES TIP DEPTH	14. WATER DEPTH	15. TOTAL BOTTOM WEIGHT
FEET	KIPS	KIPS	FEET	DEG	DEG	DEG	KIPS	FEET	LBS	FEET	FEET	FEET	FEET	LBS
0.0	20.0	40.0	97.7	-3.1	-11.1	14.2	19.4	473.4	2126.5	98.4	97.1	101.2	97.7	3316.5
2.0	20.0	40.0	97.7	-3.1	-12.0	14.6	19.4	467.5	2096.5	98.0	97.6	101.8	97.7	3266.5
3.7	25.4	40.0	98.1	-3.2	-12.0	13.5	24.7	457.6	2022.7	98.0	97.4	101.6	97.7	3212.7
5.0	25.4	40.0	98.3	-3.2	-12.0	12.5	29.0	442.6	1972.2	99.0	97.6	101.8	97.7	3162.2
6.2	25.2	40.0	98.4	-3.2	-12.0	12.1	28.6	436.3	2006.4	99.1	97.7	101.9	97.7	3190.4
8.0	32.5	40.0	98.4	-3.2	-12.0	11.3	35.2	436.1	1939.7	99.1	97.7	101.9	97.7	3129.7
10.0	37.9	1.0	98.7	-3.2	-10.1	10.4	42.7	419.1	1834.1	99.3	98.1	102.2	97.7	3024.1
11.2	43.4	1.4	98.7	-3.2	-9.0	10.1	45.1	410.4	1810.1	100.1	98.1	102.9	97.7	3000.1
13.0	46.9	3.0	99.6	-3.2	-8.0	10.1	46.0	407.8	1773.6	100.4	98.4	103.5	97.7	2987.5
15.1	46.9	3.8	100.9	-3.2	-8.0	9.8	50.2	398.1	1740.9	101.4	99.4	104.1	97.7	3030.8
18.9	50.8	5.2	101.0	-3.9	-8.0	9.6	50.3	400.1	1740.9	101.4	100.4	104.5	97.7	3030.8
20.7	51.0	5.6	101.2	-3.9	-8.0	9.4	50.8	392.4	1631.4	102.4	101.7	105.7	97.7	3026.1
22.8	57.6	8.8	102.1	-3.8	-6.4	9.3	59.8	376.1	1631.4	103.0	102.3	106.5	97.7	2826.0
24.7	60.6	11.0	102.7	-3.8	-6.4	9.3	59.8	376.1	1631.4	103.7	103.0	106.5	97.7	2781.2
26.6	64.9	13.2	103.4	-3.1	-6.5	9.1	64.1	366.6	1591.2	105.0	104.3	108.2	97.7	2754.4
30.0	70.3	17.6	104.7	-2.5	-6.5	8.6	69.5	361.4	1564.4	105.1	104.4	108.3	97.7	2721.1
32.2	72.1	18.6	104.8	-2.5	-6.5	8.6	70.1	359.2	1531.1	105.5	104.8	108.7	97.7	2704.2
34.1	70.9	18.4	104.8	-2.5	-6.5	8.6	71.3	354.6	1531.1	105.5	104.8	108.7	97.7	2704.2
36.3	73.2	21.4	105.2	-2.5	-6.5	8.6	74.4	345.8	1486.5	105.8	105.1	109.4	97.7	2726.5
38.0	73.2	21.4	105.2	-2.5	-6.5	8.6	74.4	345.8	1486.5	106.0	105.2	109.4	97.7	2726.5
40.0	75.4	22.2	106.0	-1.8	-6.6	8.4	74.5	349.1	1508.1	106.3	105.5	109.7	97.7	2698.1
41.9	76.3	22.6	106.2	-1.8	-6.6	8.4	75.5	349.4	1504.8	106.5	105.6	109.8	97.7	2694.5
44.0	77.8	24.0	106.3	-1.8	-6.6	8.4	79.2	337.7	1446.3	106.6	106.2	110.2	97.7	2663.0
46.1	80.0	24.6	106.7	-1.8	-6.6	8.3	81.0	335.8	1436.7	107.3	106.5	110.5	97.7	2626.7
49.9	81.9	25.2	107.0	-1.8	-6.6	8.3	82.1	335.8	1436.7	107.3	106.5	110.5	97.7	2626.7
53.6	81.8	24.4	107.2	-1.5	-6.6	8.2	80.9	338.9	1432.7	107.5	106.7	110.9	97.7	2642.7
55.8	83.9	25.6	107.4	-0.9	-6.6	8.1	80.9	338.9	1432.7	107.5	106.7	110.9	97.7	2642.7
58.0	86.8	27.0	107.7	-0.6	-6.6	8.2	85.9	323.3	1374.0	108.0	107.3	111.2	97.7	2564.0

DISTANCE RANGE TRAVELLED 62.0

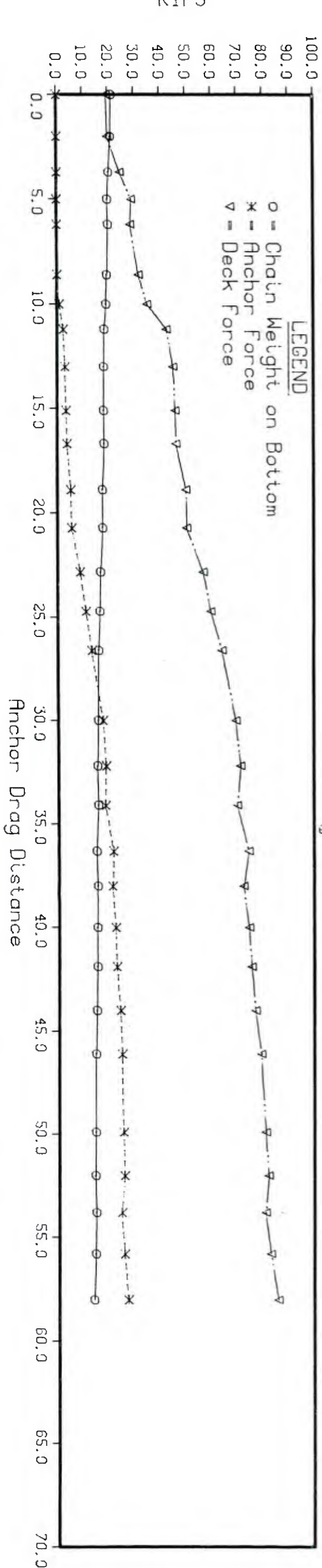
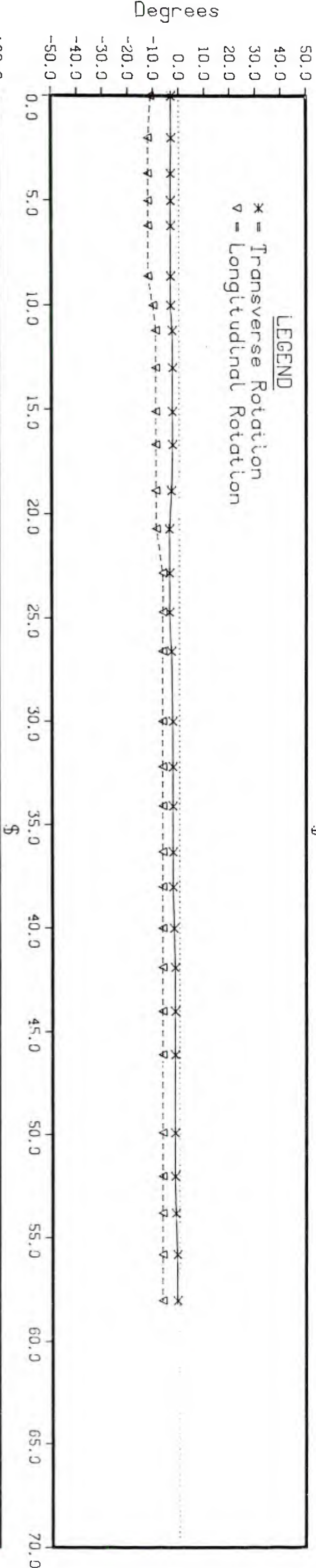
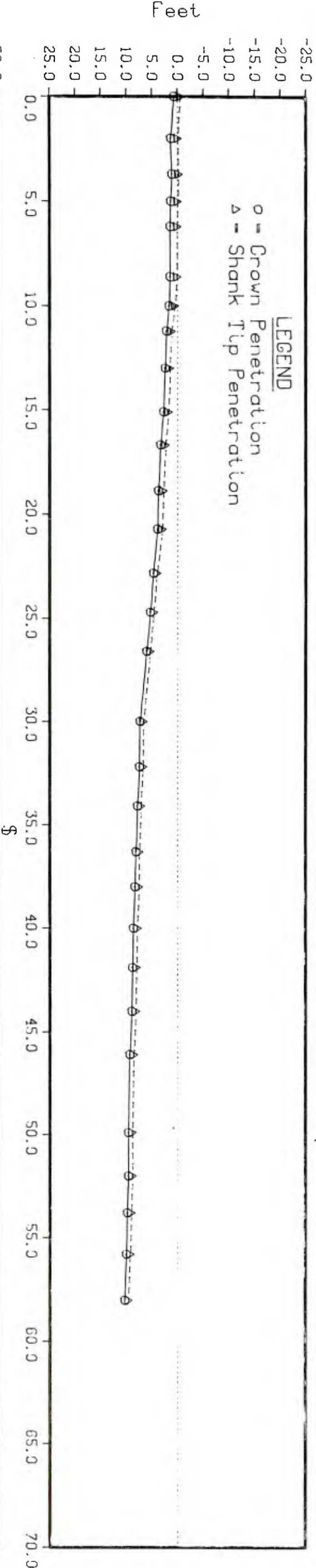
DISTANCE ANCHOR TRAVELLED 58.0

NOTE - POSITIVE SHANK ANGLE INDICATES SHANK TIP BELOW CROWN



Day # = 173 INDIAN ISLAND WASHINGTON

Test No. = 11 stockless, 5000lb. tand shank-shackle, stabs, 48 deg fx flukes
Test Series No. = 0 silt



Day # = 174
Test No. = 12
Test Series No. = 0

INDIA

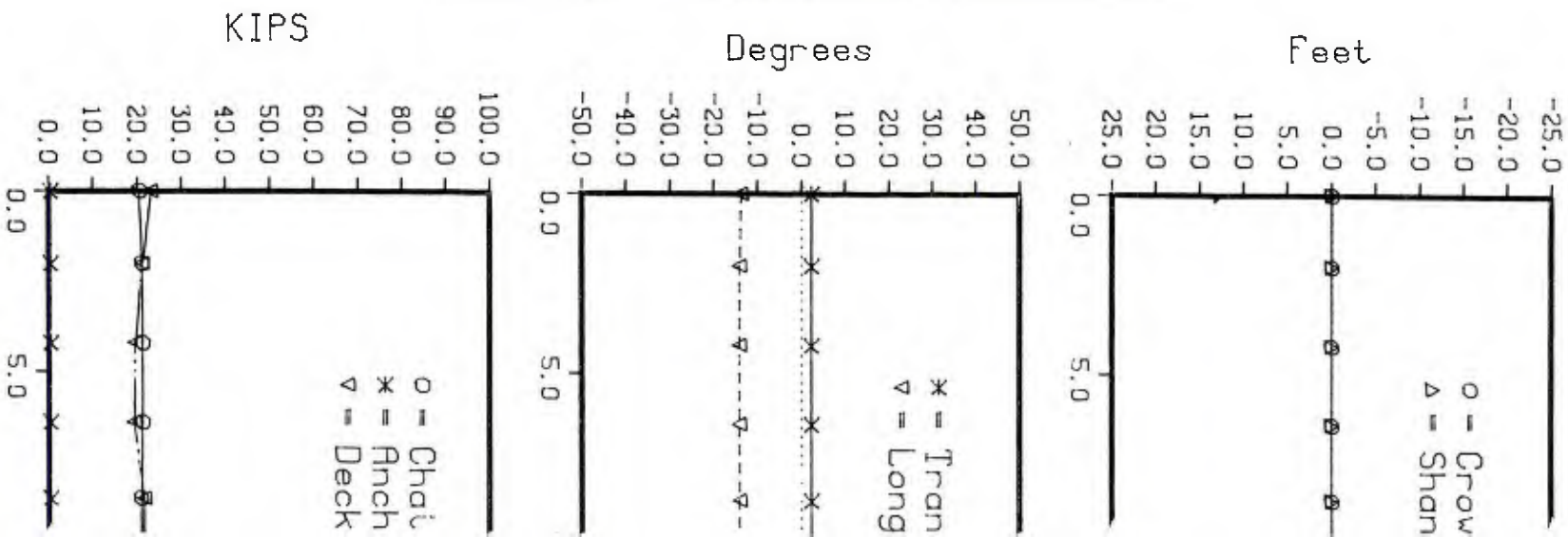
STOCKLESS ANCHOR TEST

TEST DATE 174
TEST NO. 12
TEST AREA INDIAN ISLAND WASHINGTON
START-END TIMES 1005 - 1040
SEA/CLUT TYPE SILE
ANCHOR WEIGHT STOCKLESS 5000LB, TAND CROWN-SHACKLE, STABS, 48 DEG FX FLURES
FLURE ANGLE TYPE 5950.00 LB.
AUX ANCHOR WEIGHT 48.00 DEG. - 1
MAIN ANCHOR WEIGHT 5950.00 LB.
DEPRESSORS AND HI-EACH-TOTAL MT. 0-MOV 1-FIX
MOORING LINE DESCRIPTION 135.0 FEET - 0.0 LB.
135FT. 210. CHAIN ATT'D TO INBRD ANCHOR SHANK, 300FT. 2.5IN CHAIN, 400 FT. 1 5/8 IN. LARC ROPE, 376 FT. 2 IN. LARC ROPE

1. DRAG DISTANCE	2. DECK TENSION	3. ANCHOR TENSION	4. PACKAGE DEPTH	5. ROTATION ANGLE	6. SHANK ANGLE	7. WIRE ROPE ANGLE	8. DECK MORITZ FORCE	9. CHAIN LENGTH ON BOTTOM	10. ANCHOR WEIGHT ON BOTTOM	11. ANCHOR CROWN DEPTH	12. ANCHOR SHANK TIP DEPTH	13. ANCHOR FLURE TIP DEPTH	14. WATER DEPTH	15. TOTAL BOTTOM WEIGHT
FEET	KIPS	KIPS	FEET	DEG	DEG	DEG	KIPS	FEET	LBS	FEET	FEET	FEET	FEET	LBS
6.0	23.0	4	00000	2.3	-13.0	13.5	23.1	459.8	20581.9	00000	00000	00000	91.7	32483.5
2.0	21.0	4	00000	2.3	-14.1	14.1	19.5	473.1	21251.3	00000	00000	00000	91.7	32934.3
4.2	20.1	4	00000	2.3	-14.1	14.1	19.5	473.1	21251.3	00000	00000	00000	91.7	33151.3
6.4	19.9	4	00000	2.3	-14.1	14.1	19.5	473.1	21251.3	00000	00000	00000	91.7	33150.8
8.5	22.1	4	00000	2.3	-14.0	13.8	21.5	465.7	20682.0	00000	00000	00000	91.7	32782.0
10.4	22.3	4	00000	2.4	-14.1	13.7	21.6	460.8	20637.0	00000	00000	00000	91.7	32774.2
11.9	24.4	4	00000	2.4	-14.0	13.1	23.8	460.8	20637.0	00000	00000	00000	91.7	32737.0
14.2	25.3	4	00000	2.4	-14.1	13.0	24.7	456.8	20431.6	00000	00000	00000	91.7	32333.6
15.6	27.5	4	00000	2.4	-14.2	12.4	26.8	453.3	20259.7	00000	00000	00000	91.7	32159.7
17.7	29.0	4	00000	2.4	-14.2	12.2	28.9	446.2	19904.6	00000	00000	00000	91.7	31854.6
19.4	29.5	4	00000	2.4	-14.2	12.1	28.8	447.4	19962.0	00000	00000	00000	91.7	31852.1
21.6	31.4	4	00000	2.4	-13.9	11.5	33.5	435.2	19351.1	00000	00000	00000	91.7	31621.6
23.4	37.4	4	00000	2.4	-14.4	11.3	36.9	425.4	18761.0	00000	00000	00000	91.7	30661.0
25.2	37.8	4	00000	2.4	-14.4	11.1	39.1	418.7	18251.9	00000	00000	00000	91.7	30421.9
27.3	40.1	4	00000	2.4	-14.5	10.9	40.3	418.7	18251.9	00000	00000	00000	91.7	30421.9
29.3	40.8	4	00000	2.4	-14.5	10.8	39.6	420.5	18450.4	00000	00000	00000	91.7	30421.9
31.0	40.3	4	00000	2.3	-14.4	10.5	41.9	415.9	18381.8	00000	00000	00000	91.7	30300.1
32.8	42.6	4	00000	2.3	-14.6	10.4	43.6	410.4	18106.5	00000	00000	00000	91.7	30261.8
34.9	44.4	4	00000	2.3	-14.6	10.3	49.4	390.6	17135.0	00000	00000	00000	91.7	30008.5
37.2	50.2	1.2	00000	3.1	-14.5	10.3	52.0	390.6	17135.0	00000	00000	00000	91.7	30008.5
38.6	52.7	1.4	00000	3.8	-14.3	9.7	52.9	390.2	17096.0	00000	00000	00000	91.7	29879.7
40.3	52.8	1.6	00000	1.0	-14.3	9.7	52.9	390.2	17096.0	00000	00000	00000	91.7	29879.7
42.4	53.7	1.6	00000	4.8	-14.3	9.7	52.9	390.2	17096.0	00000	00000	00000	91.7	29879.7
44.4	57.1	3.2	00000	4.8	-14.3	9.7	52.9	390.2	17096.0	00000	00000	00000	91.7	29879.7
46.5	61.9	3.2	00000	4.8	-14.3	9.7	52.9	390.2	17096.0	00000	00000	00000	91.7	29879.7
47.7	62.7	3.6	00000	4.8	-14.3	9.7	52.9	390.2	17096.0	00000	00000	00000	91.7	29879.7
50.1	67.4	5.0	00000	4.8	-14.3	9.7	52.9	390.2	17096.0	00000	00000	00000	91.7	29879.7
51.8	69.2	6.2	00000	4.8	-14.3	9.7	52.9	390.2	17096.0	00000	00000	00000	91.7	29879.7
53.9	70.8	8.0	00000	4.8	-14.3	9.7	52.9	390.2	17096.0	00000	00000	00000	91.7	29879.7
55.8	75.4	10.4	00000	4.8	-14.3	9.7	52.9	390.2	17096.0	00000	00000	00000	91.7	29879.7
57.6	74.4	10.0	00000	4.8	-14.3	9.7	52.9	390.2	17096.0	00000	00000	00000	91.7	29879.7
59.3	74.4	13.0	00000	4.8	-14.3	9.7	52.9	390.2	17096.0	00000	00000	00000	91.7	29879.7
61.4	79.4	13.2	00000	4.8	-14.3	9.7	52.9	390.2	17096.0	00000	00000	00000	91.7	29879.7

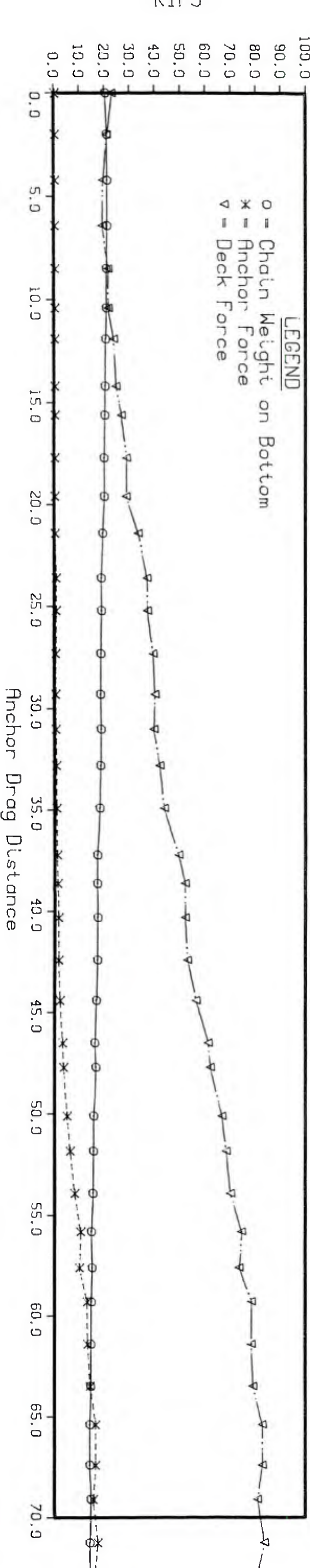
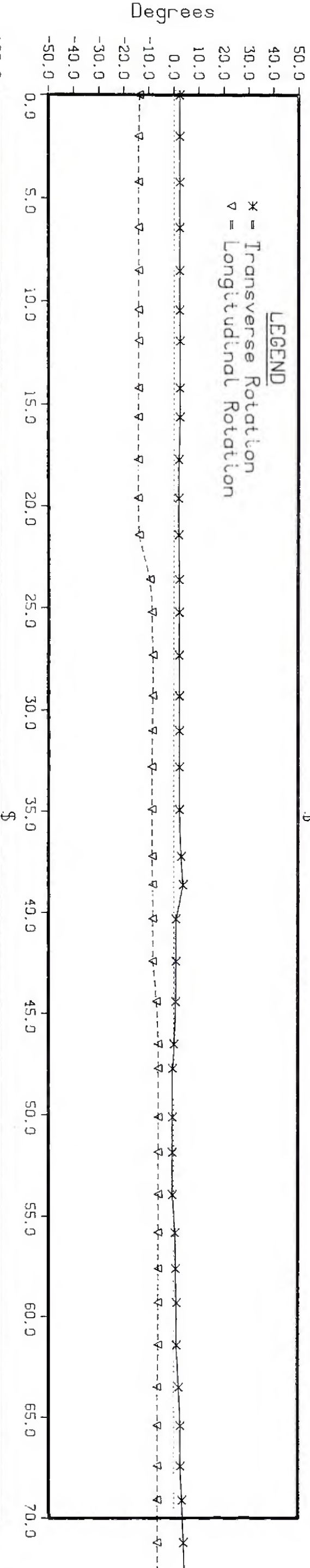
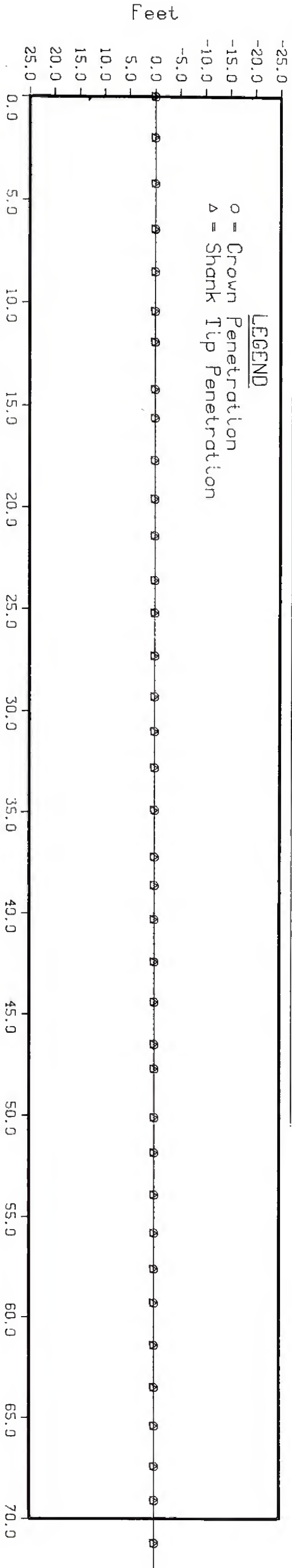
1. DRAG DISTANCE	2. DECK TENSION	3. ANCHOR TENSION	4. PACKAGE DEPTH	5. ROTATION ANGLE	6. SHANK ANGLE	7. WIRE ROPE ANGLE	8. DECK MORITZ FORCE	9. CHAIN LENGTH ON BOTTOM	10. ANCHOR WEIGHT ON BOTTOM	11. ANCHOR CROWN DEPTH	12. ANCHOR SHANK TIP DEPTH	13. ANCHOR FLURE TIP DEPTH	14. WATER DEPTH	15. TOTAL BOTTOM WEIGHT
FEET	KIPS	KIPS	FEET	DEG	DEG	DEG	KIPS	FEET	LBS	FEET	FEET	FEET	FEET	LBS
63.5	79.0	14.2	00000	2.0	-14.2	8.4	79.0	337.6	14453.7	00000	00000	00000	91.7	26353.7
65.4	83.7	16.4	00000	2.7	-14.2	8.3	82.8	330.3	14090.5	00000	00000	00000	91.7	25990.5
67.4	81.8	15.4	00000	2.7	-14.2	8.2	80.9	339.2	14536.9	00000	00000	00000	91.7	26036.9
69.1	81.8	15.4	00000	3.2	-14.2	8.1	83.7	331.8	14165.5	00000	00000	00000	91.7	26036.9
71.2	80.0	17.4	00000	4.5	-14.2	8.4	79.5	330.5	14402.4	00000	00000	00000	91.7	26302.4
73.2	85.0	17.4	00000	4.5	-14.2	8.4	79.5	330.5	14402.4	00000	00000	00000	91.7	26302.4
75.2	85.0	17.4	00000	4.5	-14.2	8.4	79.5	330.5	14402.4	00000	00000	00000	91.7	26302.4
77.2	85.0	17.4	00000	4.5	-14.2	8.4	79.5	330.5	14402.4	00000	00000	00000	91.7	26302.4
79.0	85.0	17.4	00000	4.5	-14.2	8.4	79.5	330.5	14402.4	00000	00000	00000	91.7	26302.4
80.8	85.0	17.4	00000	4.5	-14.2	8.4	79.5	330.5	14402.4	00000	00000	00000	91.7	26302.4
83.1	89.7	21.0	00000	8.1	-14.2	7.9	88.0	324.7	14007.5	00000	00000	00000	91.7	25907.5
85.8	89.7	21.0	00000	8.1	-14.2	7.9	88.0	324.7	14007.5	00000	00000	00000	91.7	25907.5
87.2	89.7	21.0	00000	9.4	-14.2	8.1	89.0	319.7	13559.9	00000	00000	00000	91.7	25459.9
89.2	89.7	22.0	00000	9.4	-14.2	8.1	89.0	319.7	13559.9	00000	00000	00000	91.7	25459.9

NOTE - POSITIVE SHANK ANGLE INDICATES SHANK TIP BELOW CROWN



Day # = 174
INDIAN ISLAND WASHINGTON

Test No. = 12
Test Series No. = 0
stockless, 5000lb. land crown-shackle, stabs, 48 deg fx flukes
silt



Day # - 74
 Test No. = 13
 Test Series No. - 0

INC

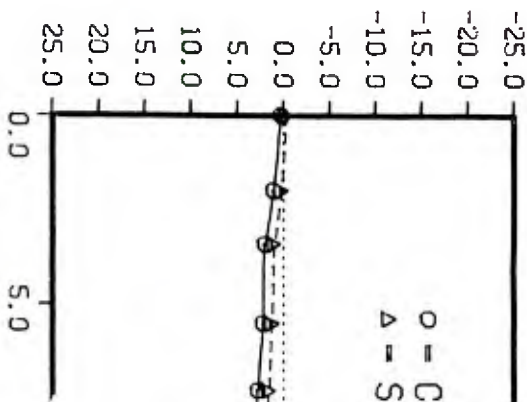
TEST DATE 74
 TEST NO. 13
 TEST AREA INDIAN ISLAND WASHINGTON
 START-END TIMES 1255 - 1326
 SEAFLOOR TYPE SILT
 ANCHOR TYPE STOCKLESS 5000LBS. WITH STABS. MOVABLE FLUMES 48 DEG.
 ANCHOR HEIGHT 5950.00 LB.
 FLUME ANGLE-DEG. 48.00 DEG. - 0
 FLUME ANCHOR TYPE 0-MOV 1-FIX
 MAIN-ANCHOR HEIGHT 0.00 LB.
 DEPRESSORS-NO.-WT-EACH-TOTAL WT. 135 FT. 2 IN. CHAIN-360 FT. 2.5 IN. CHAIN-400 FT. 1 5/8 IN.
 MOORING LINE DESCRIPTION IMC ROPE 3/46 FT. * 2 IN. IMC ROPE

1. DRAC DISTANCE	2. DECK TENSION	3. ANCHOR TENSION	4. PACKAGE DEPTH	5. ROTATION ANGLE	6. SHANK ANGLE	7. WIRE ROPE ANGLE	8. DECK HORIZ. FORCE	9. CHAIN LENGTH ON BOTTOM	10. CHAIN WEIGHT ON BOTTOM	11. ANCHOR CRANK DEPTH	12. ANCHOR SHANK TIP DEPTH	13. ANCHOR FLUME TIP DEPTH	14. WATER DEPTH	15. TOTAL BOTTOM WEIGHT
0.0	20.2	26.0	28.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.0	20.2	26.0	28.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.0	20.2	26.0	28.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.0	20.2	26.0	28.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.0	20.2	26.0	28.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.0	20.2	26.0	28.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6.0	20.2	26.0	28.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7.0	20.2	26.0	28.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8.0	20.2	26.0	28.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9.0	20.2	26.0	28.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10.0	20.2	26.0	28.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11.0	20.2	26.0	28.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12.0	20.2	26.0	28.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13.0	20.2	26.0	28.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14.0	20.2	26.0	28.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.0	20.2	26.0	28.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16.0	20.2	26.0	28.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17.0	20.2	26.0	28.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18.0	20.2	26.0	28.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19.0	20.2	26.0	28.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20.0	20.2	26.0	28.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21.0	20.2	26.0	28.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22.0	20.2	26.0	28.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23.0	20.2	26.0	28.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24.0	20.2	26.0	28.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.0	20.2	26.0	28.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26.0	20.2	26.0	28.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27.0	20.2	26.0	28.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28.0	20.2	26.0	28.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29.0	20.2	26.0	28.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30.0	20.2	26.0	28.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31.0	20.2	26.0	28.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32.0	20.2	26.0	28.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33.0	20.2	26.0	28.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34.0	20.2	26.0	28.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.0	20.2	26.0	28.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36.0	20.2	26.0	28.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37.0	20.2	26.0	28.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38.0	20.2	26.0	28.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39.0	20.2	26.0	28.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40.0	20.2	26.0	28.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

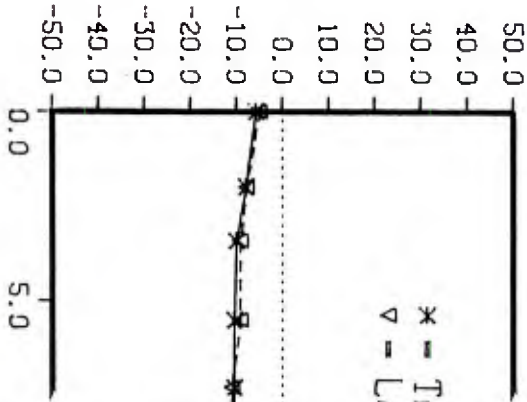
DISTANCE BARGE TRAVELLED 36.0
 DISTANCE ANCHOR TRAVELLED 36.5

NOTE - POSITIVE SHANK ANGLE INDICATES SHANK TIP BELOW CROWN

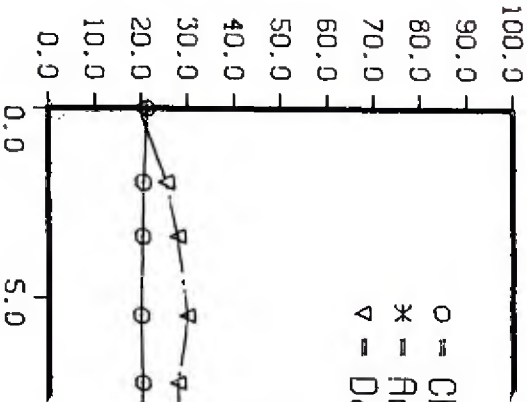
Feet



Degrees



KIPS



Day # - 74

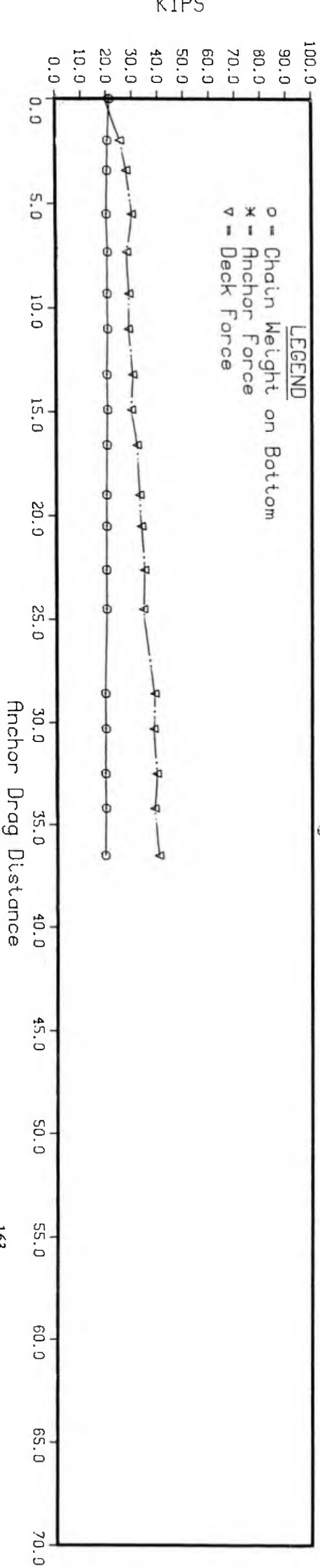
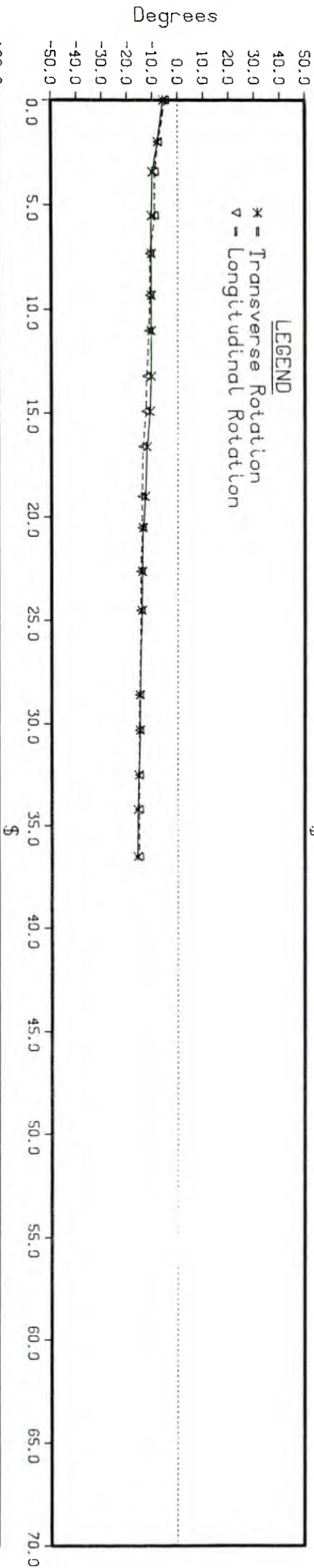
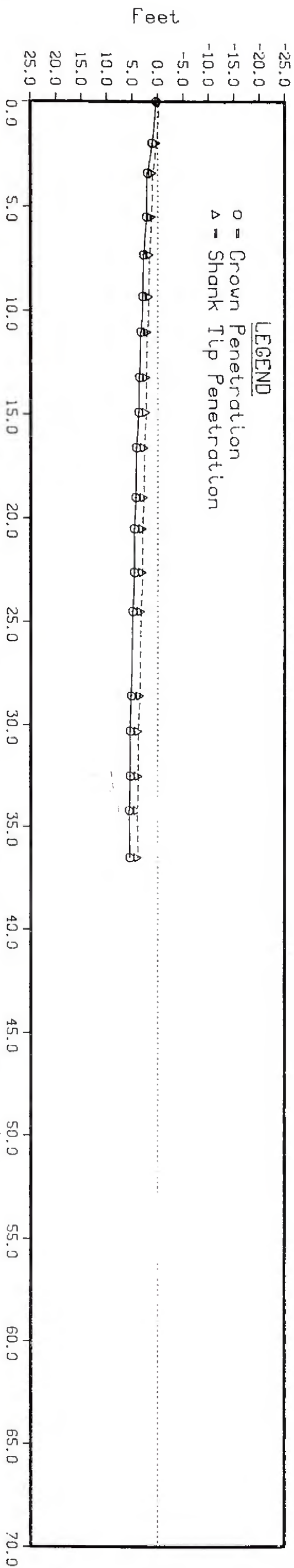
INDIAN ISLAND WASHINGTON

Test No. = 13

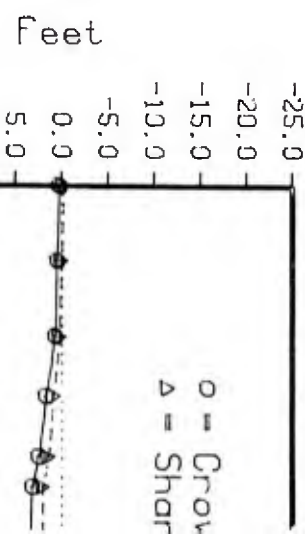
stockless 5000lbs. with stabs, movable flukes 48 deg.

Test Series No. - 0

silt

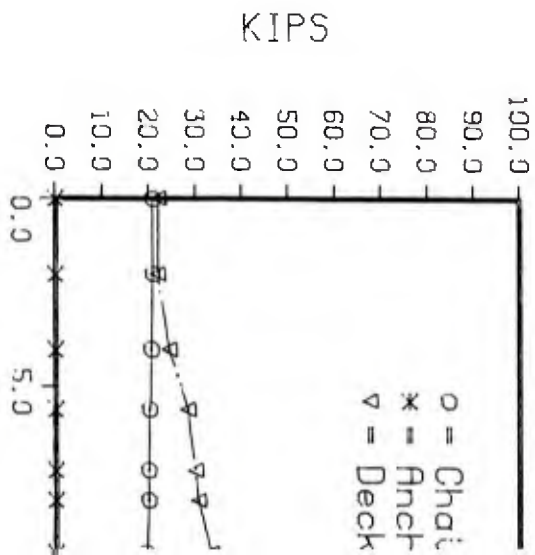
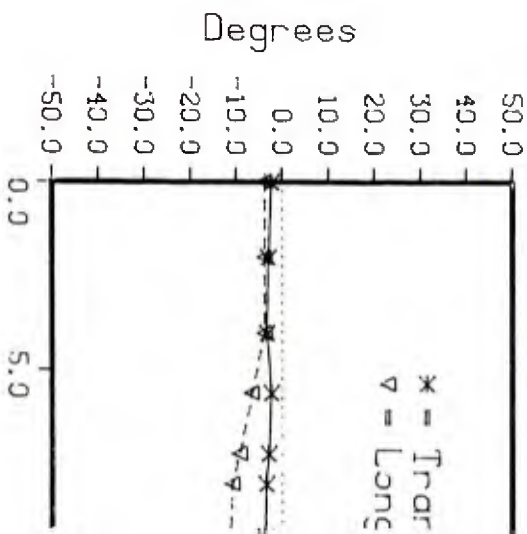


Day # = 174 INDI
Test No. = 14
Test Series No. = 0



1. DRAG DISTANCE	2. DECK TENSION	3. ANCHOR TENSION	4. PACKAGE DEPTH	5. ROTATION ANGLE	6. SHANK ANGLE	7. WIDE ROBEZ. FORCE	8. DECK HORIZ. FORCE	9. CHAIN LENGTH ON BOTTOM	10. ANCHOR HEIGHT ON BOTTOM	11. ANCHOR CROWN DEPTH	12. ANCHOR SHANK TIP DEPTH	13. ANCHOR FLUME TIP DEPTH	14. WATER DEPTH	15. TOTAL BOTTOM WEIGHT
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
FEET	KIPS	KIPS	FEET	DEG.	DEG.	DEG.	KIPS	FEET	LBS.	FEET	FEET	FEET	FEET	LBS.
C-0	22.6	0000	88.9	-3.4	-3.9	13.2	22.2	467.0	20944.7	869.2	88.7	92.5	88.9	24899.4
2.0	22.6	0000	89.1	-3.1	-3.9	13.2	22.0	460.7	20628.6	869.4	88.9	92.7	88.9	24899.4
4.0	25.1	0000	89.3	-3.3	-3.9	12.7	22.5	450.0	20141.5	869.6	89.1	92.9	88.9	24578.2
5.0	29.1	0000	90.2	-3.4	-6.6	11.9	28.5	451.0	20032.0	90.0	88.9	93.6	88.9	26091.9
7.2	30.0	0000	90.8	-3.0	-9.3	11.5	30.0	449.0	20014.5	90.6	90.3	94.4	88.9	25982.5
8.0	31.3	0000	91.5	-3.0	-10.9	11.3	30.7	448.1	19994.8	92.1	90.9	95.1	88.9	25943.6
9.4	34.2	0000	91.6	-3.0	-11.4	11.3	33.5	437.8	19903.6	92.3	90.9	95.1	88.9	25943.6
11.0	36.2	0000	92.0	-3.0	-12.8	10.9	35.6	433.7	19325.4	92.7	91.3	95.5	88.9	25275.4
12.1	37.2	0000	92.2	-3.7	-13.6	10.6	36.5	430.7	19229.5	93.0	91.4	95.7	88.9	25279.3
15.0	38.7	0000	92.3	-3.2	-13.8	10.6	38.5	428.7	18924.2	93.1	91.5	95.8	88.9	24870.2
16.9	39.7	0000	92.7	-3.4	-14.4	10.6	37.6	426.7	18706.9	93.5	91.9	96.2	88.9	25000.0
19.1	40.1	0000	92.7	-3.6	-14.4	10.6	38.5	426.7	18706.9	93.5	91.9	96.2	88.9	25218.8
20.9	39.4	0000	92.9	-3.6	-14.5	10.3	38.5	423.6	18076.4	93.7	91.5	96.2	88.9	24709.4
22.4	41.1	0000	93.0	-3.5	-14.5	10.3	38.8	423.6	18076.4	93.7	92.1	96.4	88.9	24709.4
24.0	41.1	0000	93.2	-3.0	-14.4	10.3	40.4	423.2	18049.8	93.6	92.1	96.4	88.9	24709.4
26.4	41.1	0000	93.2	-3.5	-14.4	10.1	40.7	426.2	18049.8	94.0	92.4	96.7	88.9	24709.4
28.8	41.0	0000	93.2	-3.5	-14.4	10.1	40.7	426.2	18049.8	94.0	92.4	96.7	88.9	24709.4
30.3	42.7	0000	93.5	-3.5	-13.2	10.1	41.6	423.0	18794.1	94.4	92.6	96.9	88.9	24681.3
34.5	42.7	0000	93.5	-3.5	-13.2	10.2	42.0	420.1	18594.5	94.4	92.6	96.9	88.9	24681.3
36.8	42.6	0000	93.8	-10.7	-13.2	10.2	43.1	421.3	18654.2	94.7	92.8	97.2	88.9	24604.0
38.5	43.5	0000	93.7	-11.5	-13.2	10.2	43.2	418.0	18554.1	94.0	92.8	97.2	88.9	24376.1
41.2	43.2	0000	93.6	-13.0	-13.2	10.1	44.2	420.4	18082.9	94.7	93.0	97.2	88.9	24376.1
46.7	44.2	0000	93.8	-13.4	-13.2	10.1	44.2	415.9	18082.9	94.8	93.0	97.3	88.9	24376.1

NOTE - POSITIVE SHANK
ANGLE INDICATES
SHANK TIP BELOW
CROWN



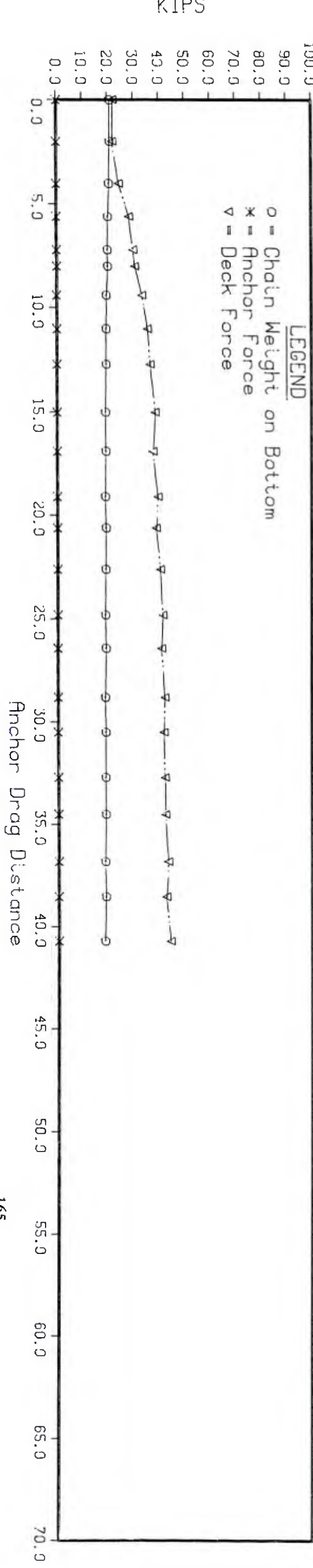
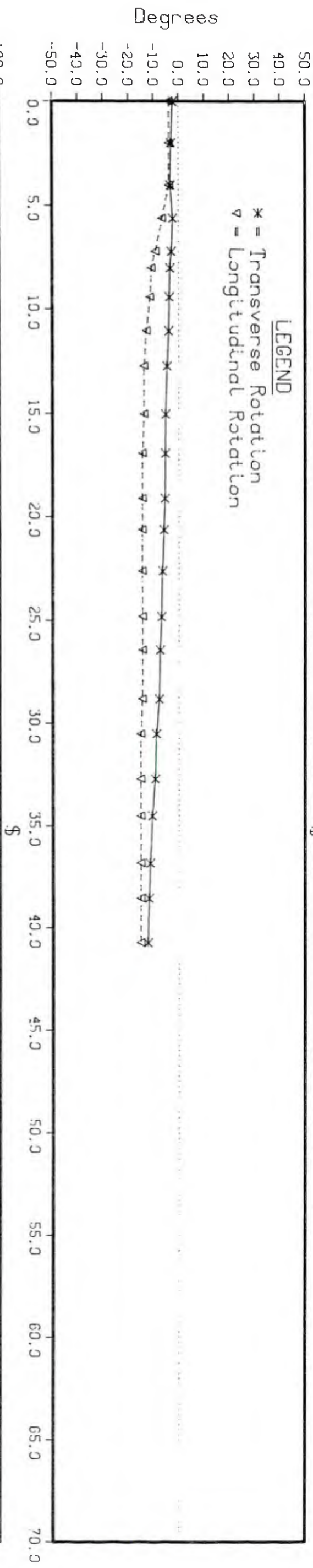
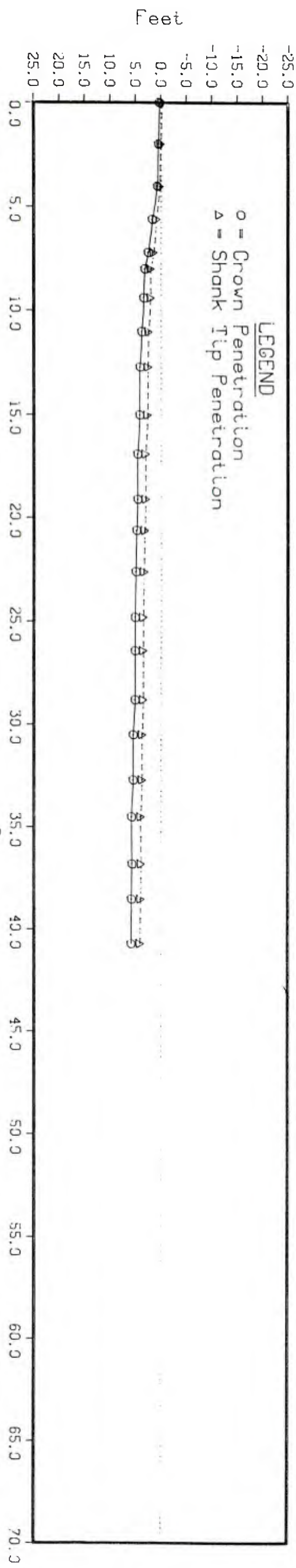
Day # = 174

INDIAN ISLAND WASHINGTON

Test No. = 14

Test Series No. = 0

stockless 5000lbs. with side, movable flukes 48 deg.
silt



Day # = 176
Test No. = 21
Test Series No. = 0

INDI

STOCKLESS ANCHOR TEST

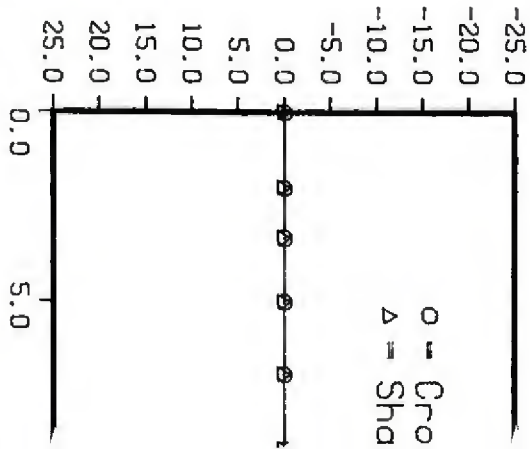
TEST DATE 176
TEST NO. 21
TEST AREA INDIAN ISLAND WASHINGTON
START-END TIMES 830 - 900
SEAFLOOR TYPE SILT
ANCHOR TYPE STOCKLESS, 9000LB. NO STABS. 48 DEC. MOVABLE FLUKES
ANCHOR HEIGHT 10000 LB.
FLUKE ANGLE-TYPE 48.00 DEC. - 0 0-MOV 1-FIX
AUX. ANCHOR HEIGHT 0.00 LB.
AUX. ANCHOR TYPE 0.00 LB.
RAIN-AUX ANCHOR SEPARATION 0.00 LB.
DEPRESSORS-AND-WT. EACH-TOTAL WT. 135 FT. 2 IN. CHAIN, 360 FT. 2.5 IN. CHAIN, 400 FT. 1 5/8 IN. IMRC ROPE, 346 FT. 2 IN. IMRC ROPE

1. DRAG DISTANCE	2. DECK TENSION	3. ANCHOR TENSION	4. PACKAGE DEPTH	5. ROTATION ANGLE	6. SHANK ANGLE	7. MIRE ROPE ANGLE	8. DECK HORIZ. FORCE	9. CHAIN LENGTH ON BOTTOM	10. ANCHOR WEIGHT ON BOTTOM	11. ANCHOR CROWN DEPTH	12. ANCHOR SHANK TIP DEPTH	13. ANCHOR FLUKE TIP DEPTH	14. WATER DEPTH	15. TOTAL BOTTOM WEIGHT
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
FEET	KIPS	KIPS	FEET	DEC	DEC	DEC	KIPS	FEET	LBS	FEET	FEET	FEET	FEET	LBS
0.0	24.9	0000	0000	0000	0000	14.6	24.0	483.9	19272.5	0000	0000	0000	09.5	20857.5
2.0	27.0	0000	0000	0000	0000	14.6	26.1	493.6	19271.6	0000	0000	0000	09.5	20341.6
3.3	28.9	0000	0000	0000	0000	14.2	28.0	429.5	19066.0	0000	0000	0000	09.5	20136.0
5.0	30.1	0000	0000	0000	0000	13.9	29.2	426.3	18904.4	0000	0000	0000	09.5	19974.4
6.9	32.7	0000	0000	0000	0000	13.6	31.8	417.9	18482.9	0000	0000	0000	09.5	19552.9
8.9	32.8	0000	0000	0000	0000	13.6	31.9	417.6	18465.8	0000	0000	0000	09.5	19352.8
11.0	34.7	0000	0000	0000	0000	13.4	33.8	410.3	18104.4	0000	0000	0000	09.5	19174.4
12.6	34.4	0000	0000	0000	0000	13.2	33.5	413.6	18267.6	0000	0000	0000	09.5	19337.6
14.9	36.7	0000	0000	0000	0000	13.2	35.8	404.0	17785.6	0000	0000	0000	09.5	18854.6
16.4	38.7	0000	0000	0000	0000	13.0	35.8	409.6	17865.7	0000	0000	0000	09.5	18835.7
18.6	38.7	0000	0000	0000	0000	12.9	37.7	398.6	17917.7	0000	0000	0000	09.5	18587.7
20.5	39.5	0000	0000	0000	0000	12.8	38.5	396.8	17426.7	0000	0000	0000	09.5	18499.8
22.4	40.3	0000	0000	0000	0000	12.7	39.3	394.4	17304.9	0000	0000	0000	09.5	18374.9
24.2	41.6	0000	0000	0000	0000	12.5	40.6	391.5	17158.6	0000	0000	0000	09.5	18228.6
26.1	41.7	0000	0000	0000	0000	12.4	40.7	391.9	17176.8	0000	0000	0000	09.5	18246.8
28.0	43.8	0000	0000	0000	0000	12.2	42.6	385.6	16665.3	0000	0000	0000	09.5	17935.3
30.0	45.7	0000	0000	0000	0000	12.1	44.6	379.6	16565.5	0000	0000	0000	09.5	17935.5
31.9	46.1	0000	0000	0000	0000	12.1	45.1	378.0	16527.3	0000	0000	0000	09.5	17507.3
33.9	46.7	0000	0000	0000	0000	12.0	45.7	376.5	16465.8	0000	0000	0000	09.5	17475.8
36.1	48.0	0000	0000	0000	0000	12.0	47.0	371.2	16142.8	0000	0000	0000	09.5	17212.8
37.8	47.9	0000	0000	0000	0000	11.9	46.9	369.2	16038.0	0000	0000	0000	09.5	17207.0
39.9	49.0	0000	0000	0000	0000	11.9	47.9	369.2	16038.0	0000	0000	0000	09.5	17109.5
41.3	48.1	0000	0000	0000	0000	11.8	47.0	373.2	16133.9	0000	0000	0000	09.5	17009.5
43.8	48.0	0000	0000	0000	0000	11.8	48.6	367.8	15970.5	0000	0000	0000	09.5	17040.5
45.9	48.8	0000	0000	0000	0000	11.7	47.8	373.3	16247.2	0000	0000	0000	09.5	17317.2

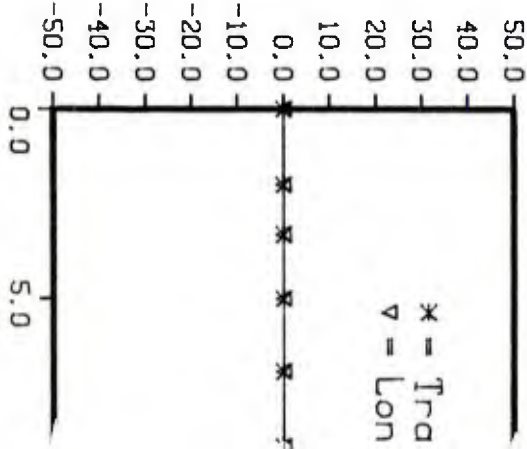
DISTANCE BARGE TRAVELLED 48.0
DISTANCE ANCHOR TRAVELLED 45.4

NOTE - POSITIVE SHANK ANGLE INDICATES SHANK TIP BELOW CROWN

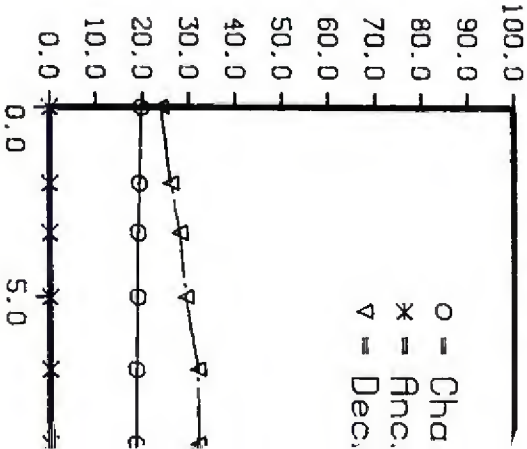
Feet



Degrees



KIPS

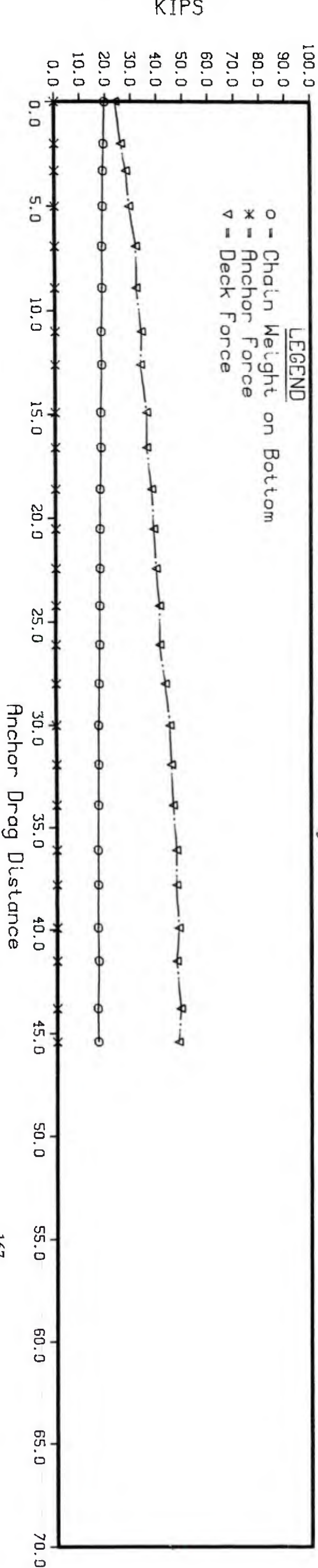
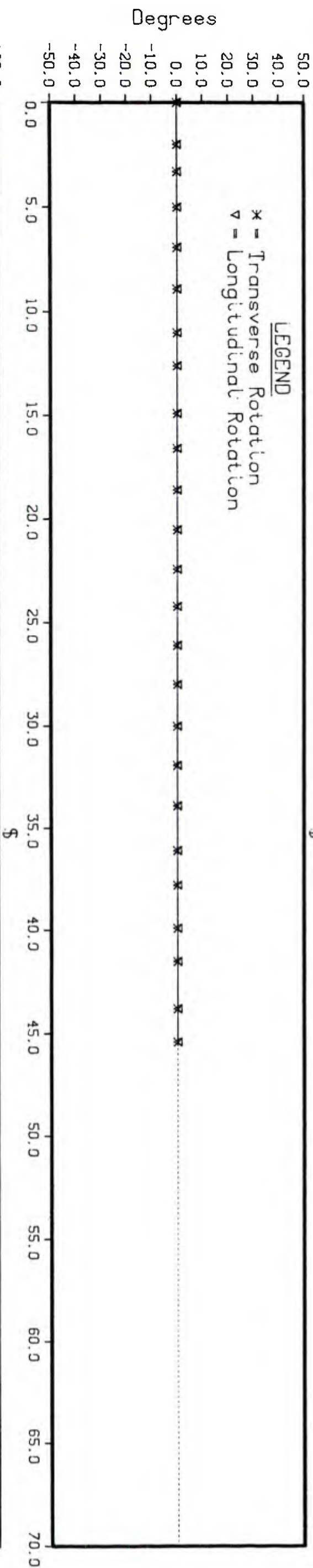
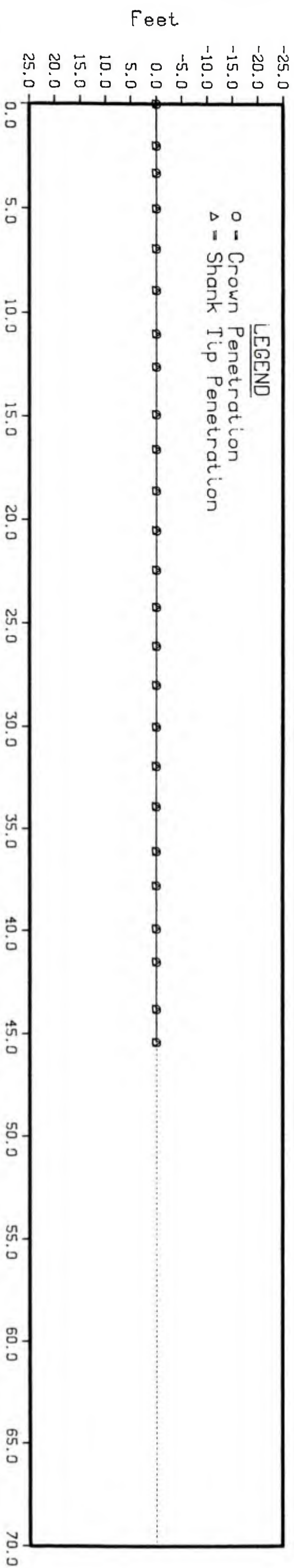


Day # = 176 INDIAN ISLAND WASHINGTON

Test No. = 21

Test Series No. = 0 stockless, 9000lbs., no stabs. 48 deg. movable flukes

silt

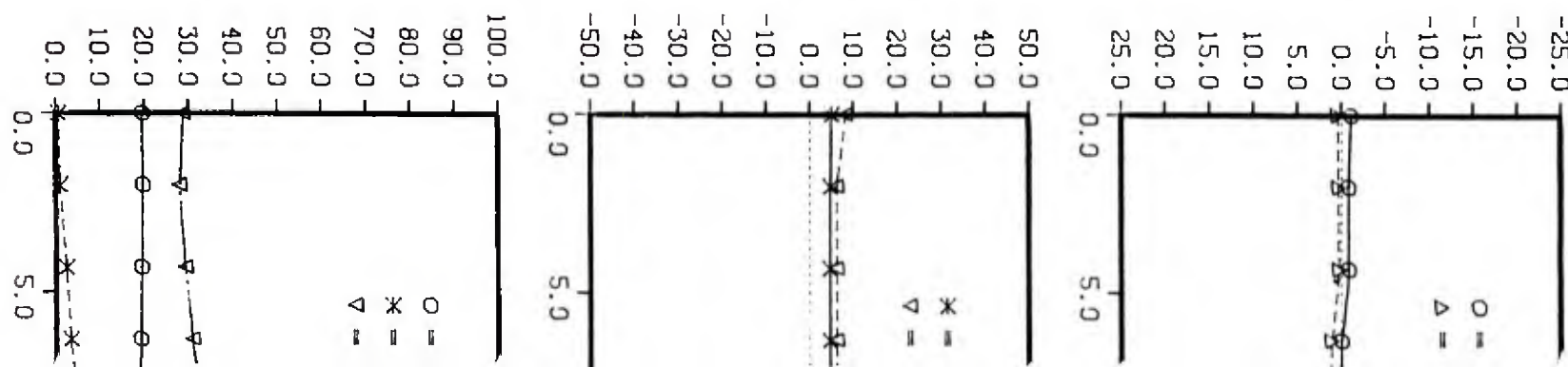


Day # = 176
 Test No. = 23
 Test Series No. = 0

Feet

Degrees

KIPS



TEST DATE
 TEST NO.
 TEST RUN
 TEST AREA
 START-END TIDES
 SEAFLOOR TYPE
 ANCHOR TYPE
 ANCHOR WEIGHT
 FLUXE ANGLE-TYPE
 AUX. ANCHOR TYPE
 MAIN-AUX ANCHOR SEPARATION
 DEPRESSORS+NO-MT-EACH-TOTAL MT.
 MOORING LINE DESCRIPTION

STATO ANCHOR TEST

176
 23
 0
 INDIAN ISLAND WASHINGTON
 1030 - 1100
 Silt
 STATO
 3500.00 LB
 48-00 DEG - 0
 0-MOV 1-FIX
 0-00 LB.
 0 - 0-0
 135 FT. 2 IN. CHAIN+360 FT. 2.5 IN. CHAIN+400 FT. 1 5/8 IN.
 1MRC ROPE+ 346 FT. + 2 IN. 1MRC ROPE

1. DRAG DISTANCE	2. DECK TENSION	3. ANCHOR TENSION	4. PACKAGE DEPTH	5. ROTATION ANGLE	6. SHANK ANGLE	7. WIRE ROPE ANGLE	8. DECK HORIZ. FORCE	9. CHAIN LENGTH ON BOTTOM	10. CHAIN WEIGHT ON BOTTOM	11. ANCHOR CROWN DEPTH	12. ANCHOR SHANK TIP DEPTH	13. ANCHOR FLUXE TIP DEPTH	14. ANCHOR DEPTH	15. TOTAL BOTTOM WEIGHT
FEET	KIPS	KIPS	FEET	DEG	DEG	DEG	KIPS	FEET	LB	FEET	FEET	FEET	FEET	LB
5.0	29.5	1.0	81.9	5.0	8.2	13.1	28.7	437.8	19479.8	80.0	82.3	85.7	81.9	22979.8
4.0	28.0	1.0	81.9	4.2	6.1	13.1	28.0	431.0	19647.3	81.1	82.2	85.9	81.9	23182.3
4.3	30.7	2.4	81.9	4.6	6.1	13.1	29.3	435.4	19358.3	81.0	82.1	85.8	81.9	22878.3
6.4	34.1	5.0	82.7	4.6	6.1	12.9	30.9	429.8	19080.3	81.9	83.0	86.7	81.9	22580.3
10.0	35.8	5.8	83.6	4.6	6.1	12.9	32.2	421.6	18870.3	81.9	83.4	87.7	81.9	22170.3
12.0	38.9	7.2	83.9	4.9	3.8	11.9	38.4	408.6	18926.2	83.4	84.1	88.0	81.9	22014.4
13.7	39.7	8.4	85.0	5.0	2.1	11.9	38.4	408.6	18926.2	83.4	84.1	88.0	81.9	22014.4
15.7	42.6	10.0	85.7	5.3	1.1	11.6	41.7	398.1	17583.9	84.8	85.1	89.3	81.9	21526.2
17.4	49.2	14.2	87.0	5.3	-3.1	11.3	48.3	378.5	16507.9	86.4	87.1	91.5	81.9	21037.3
19.3	52.1	16.2	87.9	5.6	-4.3	10.9	51.1	373.6	16259.4	86.4	87.1	91.5	81.9	21037.3
21.6	57.8	19.6	88.7	7.9	-5.4	10.5	56.7	354.1	15285.8	89.3	88.5	93.5	81.9	19779.4
23.5	69.9	24.0	89.6	8.0	-6.6	10.3	60.6	331.8	14266.2	90.4	89.2	94.4	81.9	18729.6
25.4	69.8	25.6	90.6	8.9	-6.6	10.3	66.5	321.4	13643.6	91.6	90.3	95.4	81.9	17184.2
27.1	67.6	25.4	91.2	8.9	-7.8	10.2	70.9	317.6	13492.6	92.2	90.9	96.0	81.9	17502.3
29.2	72.0	26.6	91.9	8.9	-8.9	10.1	72.9	310.7	13492.6	93.0	91.6	96.8	81.9	16609.0
31.2	74.0	28.8	92.3	8.3	-7.8	10.1	71.5	317.5	13446.6	93.4	92.0	97.2	81.9	16609.0
33.0	72.6	27.6	92.4	7.9	-8.3	10.1	75.6	303.0	12716.6	94.3	92.7	98.1	81.9	16218.6
35.2	76.6	30.6	93.1	7.7	-8.3	9.9	78.4	298.6	12498.9	94.6	93.0	98.4	81.9	15908.9
37.0	79.6	31.2	93.4	7.8	-8.3	9.7	76.2	303.6	12751.7	95.0	93.4	98.0	81.9	16251.7
38.6	81.3	31.2	93.8	7.8	-8.3	9.8	80.6	293.6	12251.6	95.2	93.6	99.0	81.9	15751.6
40.9	81.8	30.0	94.0	7.8	-8.9	9.7	77.8	305.4	12853.1	95.5	93.8	99.2	81.9	16343.1
42.6	88.9	30.2	94.2	7.8	-8.9	9.7	83.2	286.0	11969.3	95.8	94.1	99.5	81.9	15469.3
44.8	88.4	32.8	94.5	7.8	-8.9	9.5	85.4	285.2	11828.1	96.5	94.8	100.2	81.9	15328.1
46.5	86.6	34.4	95.2	8.1	-8.9	9.4	87.4	281.7	11653.4	97.1	95.4	100.8	81.9	15153.4
50.5	88.6	38.2	95.8	8.7	-9.6	9.3	87.4	286.7	11902.6	97.6	95.8	101.2	81.9	15402.6
54.1	88.4	37.4	96.2	9.1	-9.6	9.3	88.2	282.4	11688.7	97.1	95.3	100.7	81.9	15188.7
58.2	89.4	37.0	95.7	9.5	-9.6	9.3	88.2	282.4	11688.7	97.1	95.3	100.7	81.9	15188.7

NOTE - POSITIVE SHANK ANGLE INDICATES SHANK TIP BELOW CROWN

DISTANCE DRAG TRAVELLED 60.0
 DISTANCE ANCHOR TRAVELLED 58.2

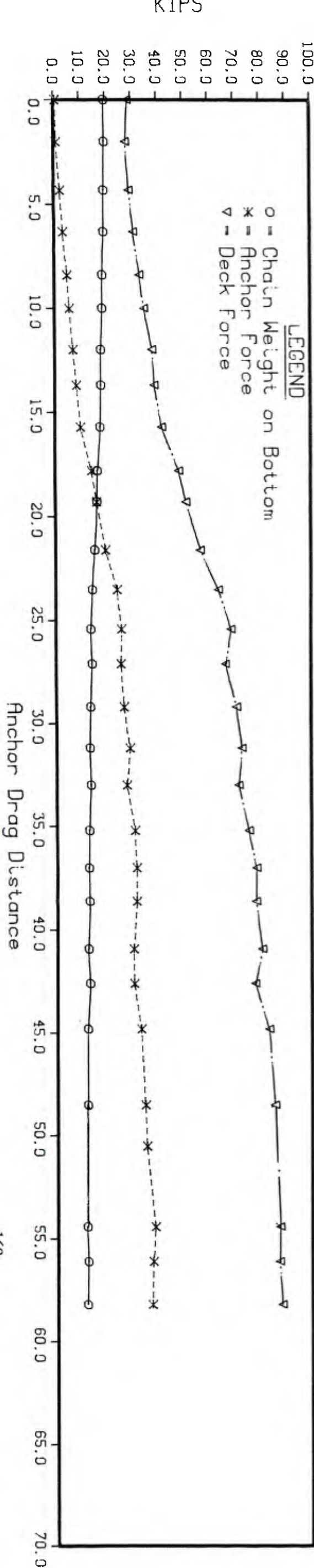
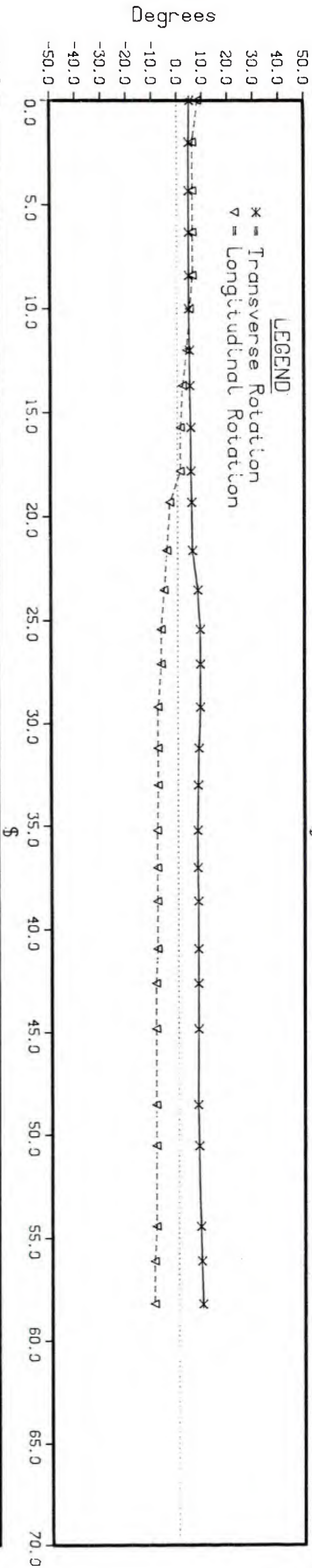
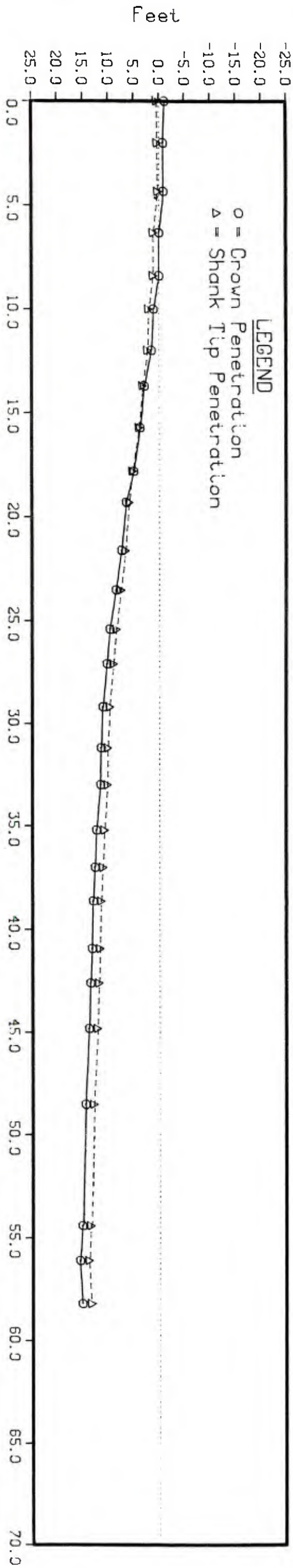
Day # = 176

INDIAN ISLAND WASHINGTON

Test No. = 23

Test Series No. = 0

state , 3000lbs. with 18 inch stabilizer extensions
silt



Day # = 176
 Test No. = 25
 Test Series No. = 0

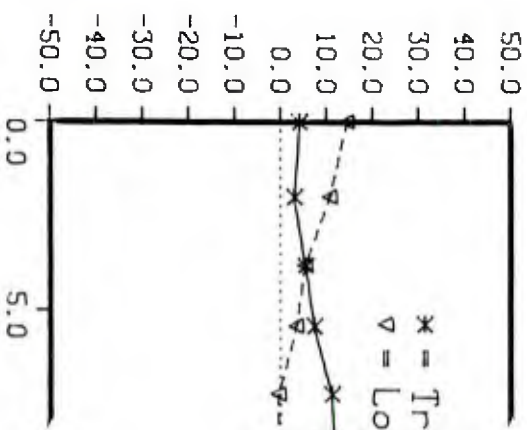
IND

TEST DATE 176
 TEST NO. 25
 TEST RUN C
 TEST AREA INDIAN ISLAND WASHINGTON
 START-END TIMES 1940 - 1015
 SEAFLOOR TYPE SILT
 ANCHOR TYPE STAAD
 ANCHOR HEIGHT 6600 LB.
 FLUXE ANGLE-DEG. 50.00 DEG. - 0
 FLUXE ANCHOR TYPE 0-MOV 1-FIX
 AUX. ANCHOR HEIGHT 0.00 FT.
 RAIN-AUX ANCHOR SEPARATION 0.0 FT.
 DEPRESSORS-NO.-WT.-EACH-TOTAL WT. 135 FT. 2 IN. CHAIN, 360 FT. 2.5 IN. CHAIN, 400 FT. 1.578 IN. IMWC ROPE, 346 FT. 2 IN. IMWC ROPE

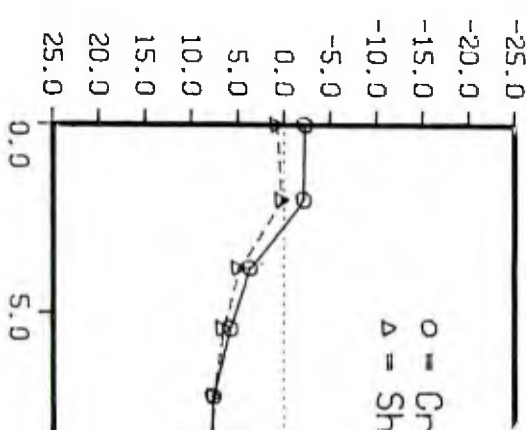
1. DRAG DISTANCE	2. DECK TENSION	3. ANCHOR TENSION	4. PACKAGE DEPTH	5. ROTATION ANGLE	6. SHANK ANGLE	7. WIRE ROPE ANGLE	8. DECK HORIZ. FORCE	9. CHAIN LENGTH ON BOTTOM	10. CHAIN WEIGHT ON BOTTOM	11. ANCHOR CROWN DEPTH	12. ANCHOR SHANK TIP DEPTH	13. ANCHOR FLUXE TIP DEPTH	14. WATER DEPTH	15. TOTAL BOTTOM WEIGHT
FEET	KIPS	KIPS	FEET	DEG.	DEG.	DEG.	KIPS	FEET	LB.	FEET	FEET	FEET	FEET	FEET
1.0	31.5	31.5	89.3	4.2	14.4	13.1	33.6	418.4	10309.2	87.1	90.0	93.5	89.3	24809.2
2.0	31.5	31.5	89.3	2.1	10.7	13.5	30.4	725.1	10886.7	87.2	89.5	93.5	89.3	25346.2
3.0	42.8	42.8	92.8	2.2	3.2	12.6	41.7	393.6	10801.4	92.0	94.1	98.9	89.3	25346.2
4.0	47.8	47.8	95.8	3.5	11.4	11.6	50.9	340.9	10602.2	92.1	94.1	98.9	89.3	25346.2
5.0	55.9	55.9	96.8	11.3	-7.5	11.3	55.5	340.2	15002.7	92.9	95.8	100.8	89.3	25346.2
6.0	56.6	56.6	97.2	11.9	-1.5	11.3	60.3	303.6	14326.2	98.2	97.2	102.7	89.3	25346.2
7.0	61.5	61.5	97.8	13.0	-1.5	11.3	70.2	293.4	12468.7	99.2	98.5	103.2	89.3	25346.2
8.0	71.5	71.5	98.6	15.4	-3.4	10.4	74.4	293.0	12220.3	100.1	99.3	104.2	89.3	25346.2
9.0	75.7	75.7	99.4	17.9	-4.0	10.4	76.9	289.8	12060.7	101.1	100.4	105.9	89.3	25346.2
10.0	83.4	83.4	100.4	20.6	-5.3	10.4	82.1	271.4	11131.7	101.5	100.4	106.6	89.3	25346.2
11.0	84.9	84.9	101.1	23.6	-6.8	10.3	83.5	269.5	11038.5	102.1	101.2	107.1	89.3	25346.2
12.0	90.7	90.7	101.6	25.1	-7.6	10.2	89.3	249.6	10041.7	102.7	101.2	107.1	89.3	25346.2
13.0	92.2	92.2	102.1	26.5	-8.1	10.0	90.8	250.0	10041.7	103.2	101.7	107.1	89.3	25346.2
14.0	97.8	97.8	102.4	28.1	-8.5	10.0	96.4	231.7	9147.4	103.6	102.0	107.9	89.3	25346.2
15.0	98.4	98.4	102.9	30.3	-9.1	9.8	97.0	235.7	8548.1	104.1	102.5	108.4	89.3	25346.2
16.0	103.4	103.4	103.3	32.3	-9.5	9.6	101.9	220.4	8579.4	104.5	102.9	108.7	89.3	25346.2
17.0	103.4	103.4	103.6	35.1	-10.5	9.6	104.0	221.4	8628.5	104.9	103.1	109.0	89.3	25346.2
18.0	105.7	105.7	104.0	36.1	-10.9	9.6	104.3	216.9	8592.5	105.4	103.5	109.3	89.3	25346.2
19.0	105.7	105.7	104.9	38.5	-11.4	9.6	108.0	206.9	7899.3	106.3	104.4	110.1	89.3	25346.2
20.0	105.7	105.7	105.1	41.5	-11.9	9.6	109.5	205.8	7845.0	106.4	104.6	110.3	89.3	25346.2
21.0	110.6	110.6	105.4	42.8	-12.0	9.4	109.1	210.2	8069.1	106.8	104.9	110.6	89.3	25346.2
22.0	110.6	110.6	105.7	42.8	-12.5	9.4	113.1	195.8	7346.2	107.1	105.2	110.8	89.3	25346.2
23.0	117.8	117.8	105.4	42.8	-12.5	9.4	116.2	186.5	6878.4	107.8	105.9	111.5	89.3	25346.2
24.0	118.6	118.6	105.4	42.8	-12.5	9.4	117.0	186.4	6873.4	107.8	105.9	111.5	89.3	25346.2

NOTE - POSITIVE SHANK ANGLE INDICATES SHANK TIP BELOW CROWN

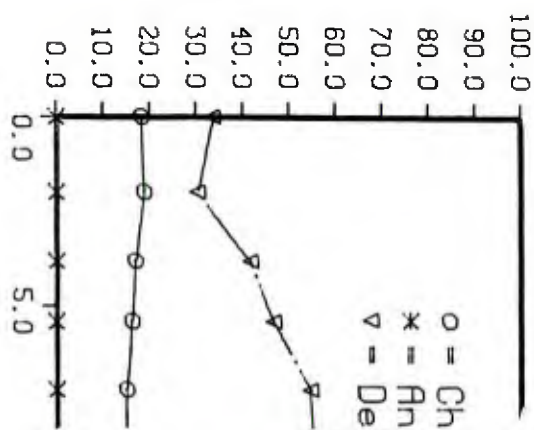
Degrees



Feet

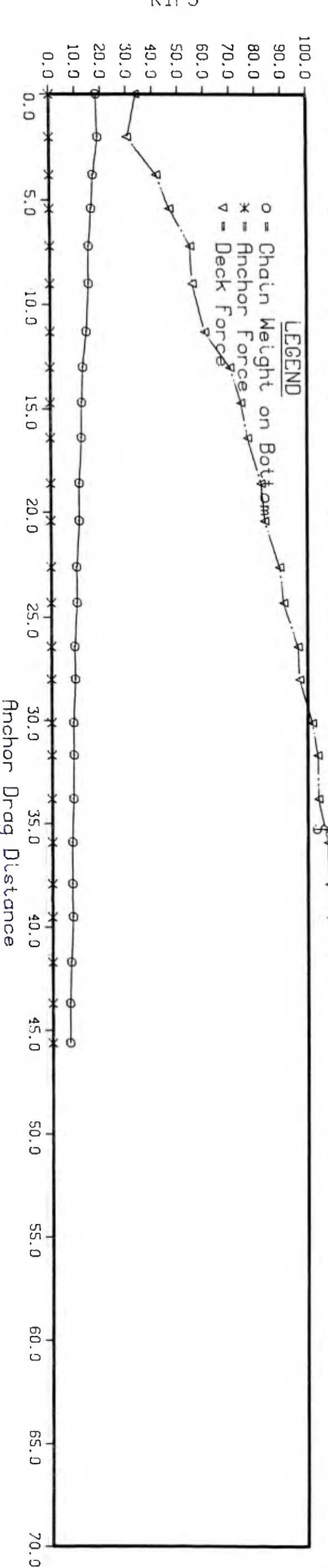
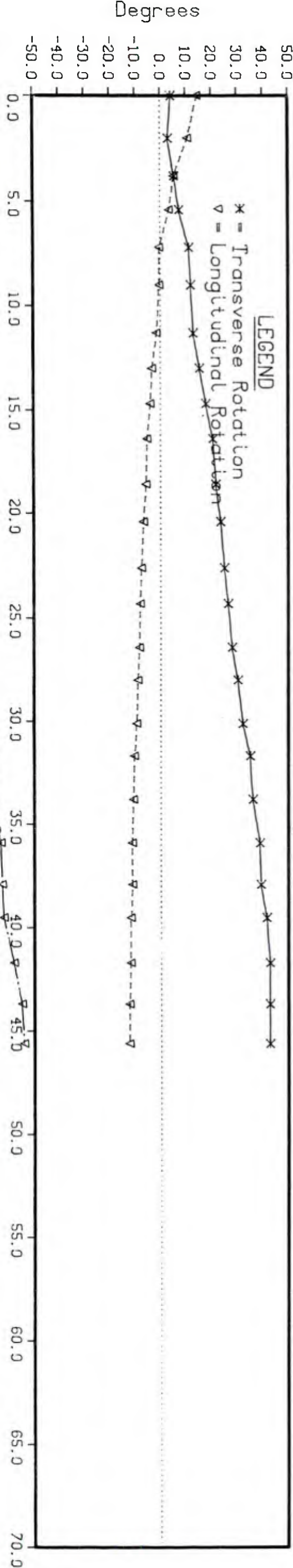
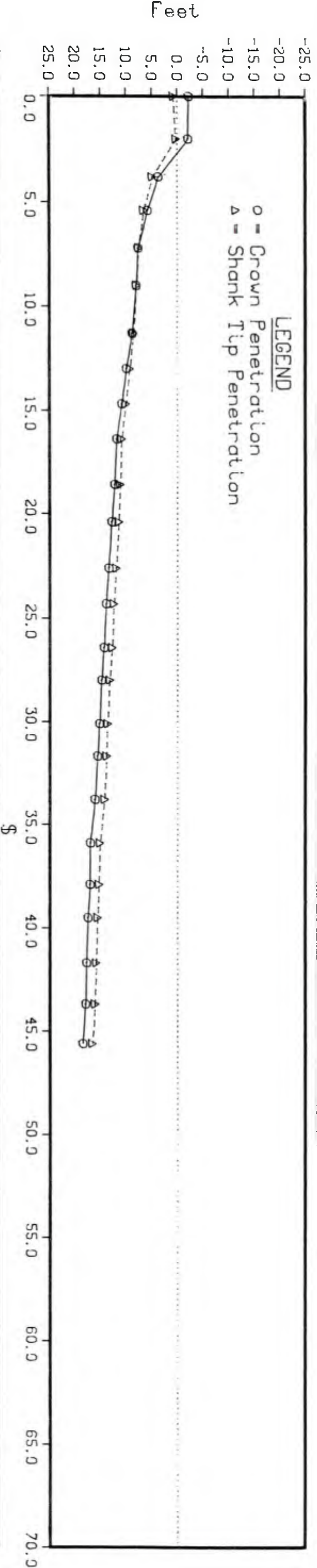


KIPS



INDIAN ISLAND WASHINGTON

Day # = 176
Test No. = 25
Test Series No. = 0
state , 6600lbs. normal stabilizers 50 deg. mov. flukes
silt



Anchor Drag Distance

DISTRIBUTION LIST

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 414, Washington DC; Code OP 97 Washington DC; Code OP 987 Washington DC; Code OPNAV 09B24
 (H); Code OPNAV 22, Wash DC; Code OPNAV 23, Wash DC; OP987J (J. Boosman), Pentagon
 COMCBPAC Operations Off, Makalapa HI
 COMDEVGRUONE San Diego, CA
 COMFLEACT, OKINAWA PWO, Kadena, Okinawa
 COMNAVBEACHPHIBREFTRAGRU ONE San Diego CA
 COMNAVMARIANAS Code N4, Guam
 COMOCEANSYSPAC SCE, Pearl Harbor HI
 COMSUBDEVGRUONE Operations Offr, San Diego, CA
 NAVSURFLANT Norfolk, VA
 NAVSURFPAC San Diego, CA
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 DMAHC Code LAL Washington DC
 DLSIE Army Logistics Mgt Center, Fort Lee, VA
 DNA STTL, Washington DC
 DOE Dr. Cohen
 DTNSRDC Anna Lab (Code 1175) Annapolis MD; Anna Lab (Code 1568) Annapolis MD
 DTNSRDC Code 1706, Bethesda MD; Code 172 (M. Krenzke), Bethesda MD
 DTNSRDC Code 2785 (Bloomquist), Annapolis, MD; Code 284 (A. Rufolo), Annapolis MD
 FMFLANT CEC Offr, Norfolk VA
 FMFPAC CG Pearl Harbor
 GSA Fed. Sup. Serv. (FMBP), Washington DC
 HCU ONE CO, Bishops Point, HI
 MARINE CORPS BASE First Service Support Group Camp Pendleton CA; PWO Camp Lejeune NC; PWO,
 Camp S. D. Butler, Kawasaki Japan

MCAS Facil. Engr. Div. Cherry Point NC; CO, Kaneohe Bay HI; Code PWE, Kaneohe Bay HI; PWO Kaneohe Bay HI
 MCDEC NSAP REP, Quantico VA; P&S Div Quantico VA
 MCRD PWO, San Diego Ca
 MILITARY SEALIFT COMMAND Washington DC
 NAF PWO, Atsugi Japan
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