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SEABEE PRETEST RESULTS OF THE JOINT LOGISTICS-OVER-THE-SHORE (LOTS) TEST AND EVALUATION PROGRAM(U) ORI INC SILVER SPRING MD H KNIGHT ET AL.

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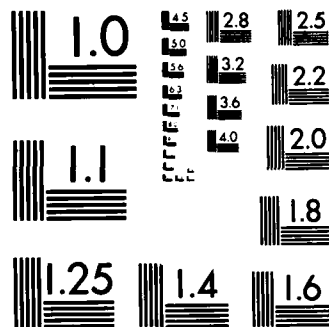
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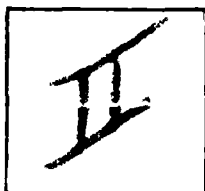


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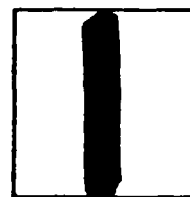
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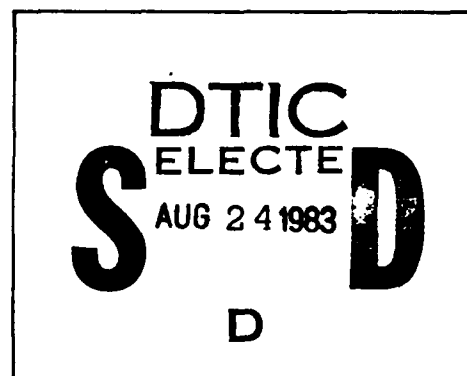
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Silver Spring, Maryland 20910

SEABEE PRETEST RESULTS OF THE JOINT  
LOGISTICS-OVER-THE-SHORE (LOTS)  
TEST AND EVALUATION PROGRAM

7 DECEMBER 1977

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## ABSTRACT

The SEABEE was selected as a candidate ship for the pretest program but its availability and mechanical problems precluded its involvement during the pretest phase completed in 1976. The ship was offered for bargeship operations during the LOTS main test, however, scheduling difficulties forced a last minute cancellation. Following the LOTS test a special SEABEE test was conducted during the period of 15-18 September 1977 in the Hampton Roads, Virginia vicinity to satisfy most of the original pretest objectives.

The primary objective was to determine the capability of the Services to use the vessel for deploying selected heavy, outsized LOTS equipment to a site where fixed port facilities do not exist. Of special interest was the loading of a DeLong B barge with a 300-ton capacity crane on it, which is used as a barge-temporary container discharge facility (TCDF). The SEABEE is the only ship with the lift potential to deploy this item.

The gross tonnage of each individual item of equipment was well within the designed capacity of the ship's elevator and barge handling equipment. However, the width of some of the loads, the unsymmetrical weight distribution of the longer loads on the elevator, and the forces imposed on the loads themselves required a detailed evaluation. Emphasis was placed upon the validation of procedures and modifications, and upon the suitability of the ship's barge handling system to deploy LOTS equipment.

The execution of the SEABEE test shows that with container adapter frames properly dunnaged the Services can use the ship for deploying outsized and heavy items of LOTS equipment. The Services have not completely loaded a DeLong B barge aboard the SEABEE ship. However, the capability in all likelihood exists and could be accomplished with minor ship modifications or the use of manual and mechanical (block and tackle) arrangements. The report recommends that a means be developed and tested to move the barge on and off the elevator. There were no problems in elevating the barge TCDF, to the upper deck.

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| 20. ABSTRACT (Continue on reverse side if necessary and identify by block number)<br><br>The SEABEE was selected as a candidate ship for the pretest program but its availability and mechanical problems precluded its involvement during the pretest phase completed in 1976. The ship was offered for bargeship operations during the LOTS main test, however, scheduling difficulties forced a last minute cancellation. Following the LOTS test a special SEABEE test was conducted during the period of 15-18 September 1977 in the Hampton Roads, Virginia vicinity to satisfy most of the original pretest objectives. (Cont.) |                       |                                                                          |

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19. Key Words (Cont.)

|           |                                        |             |
|-----------|----------------------------------------|-------------|
| LOTS      | Structural                             | Transporter |
| Pedestals | Synchronization                        | Winch       |
| SEABEE    | TCDF                                   |             |
| Stowage   | Temporary Container Discharge Facility |             |

20. Abstract (Cont.)

The primary objective was to determine the capability of the Services to use the vessel for deploying selected heavy, outsized LOTS equipment to a site where fixed port facilities do not exist. Of special interest was the loading of a DeLong B barge with a 300-ton capacity crane on it, which is used as a barge-temporary container discharge facility (TCDF). The SEABEE is the only ship with the lift potential to deploy this item.

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The execution of the SEABEE test shows that with container adapter frames properly dunnaged the Services can use the ship for deploying outsized and heavy items of LOTS equipment. The Services have not completely loaded a DeLong B Barge aboard the SEABEE ship. However, the capability in all likelihood exists and could be accomplished with minor ship modifications or the use of manual and mechanical (block and tackle) arrangements. The report recommends that a means be developed and tested to move the barge on and off the elevator. There were no problems in elevating the barge TCDF, to the upper deck.

The use of container adapter frames was satisfactory in providing the required support for LOTS items that are not compatible with the barge handling equipment. Additional modifications to the ship should be considered for lashing adapters to the elevator as well as eliminating adapter buoyancy. The details of the adaptation and use of these frames in addition to the loading and unloading procedures are also contained in this report.

This reports augments ORI Technical Report No. 1148 published 15 June 1977 when it appeared unlikely that a SEABEE would be available for the Joint Logistics-Over-The-Shore Test and Evaluation Program.

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## I. INTRODUCTION

### BACKGROUND

During FY 75, a joint test was designed by ORI<sup>1</sup> to initiate a program to evaluate the ability of the Services to conduct LOTS operations. Part of the study task was to identify the requirements for individual preliminary tests (pretests) to verify main test concepts and to minimize the risks of major interruptions or delays in the main test execution. These pretests were intended to validate the feasibility of deploying heavy and/or outsized LOTS equipments on certain types of merchant ships.

The SEABEE was listed as a candidate for such testing, as it clearly has desirable capabilities for the military lifts envisioned. Its self-sustaining potential both in-port and off-shore could satisfy the requirements for sealifting military contingency supplies and equipment to a LOTS operating objective area. The ship had never been used by the Services in such a capacity.

The SEABEE is potentially the only ship with the capability of deploying the DeLong "B" barge equipped with a 300-ton capacity crane (used as a Barge Temporary Container Discharge Facility or Barge TCDF and referred to hereinafter as a TCDF). Although there are only three such vessels in service, their unique heavy-lift capabilities make them important candidates for a LOTS deployment evaluation.

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<sup>1</sup>Operations Research, Inc., Feasibility and Definition of a Joint Logistics-Over-The-Shore (LOTS) Operational Test, ORI Technical Report No. 913, 30 April 1975.

The SEABEE was originally selected as a candidate ship for the pretest program, but its availability and mechanical problems precluded its involvement during the pretest phase which was completed in 1976. The ship was offered for bargeship operations during the LOTS main test in August, 1977, but scheduling difficulties forced a last minute cancellation. Subsequent to the main test, a SEABEE test was negotiated and conducted to satisfy most LOTS pretest objectives.

#### CANCELLATION OF THE ORIGINAL SEABEE PRETEST

The originally scheduled pretest had special restrictions because of a litigation between the ship owners and building contractors over defects in the ship's elevator hoisting mechanisms. The owners, therefore, would not permit the test deployment of the TCDF. Because the other equipment scheduled as candidate lifts had been successfully deployed on other types of ships, it was concluded that without the test lift of a TCDF, a SEABEE pretest would be of limited value. Therefore, the pretest was cancelled. For details on the vessel, its barge handling system, the planned LOTS equipment loads, and modifications required for the ship and container adapter frames, see ORI Technical Report No. 1148, 15 June 1977.<sup>2</sup>

At that time several deployment questions were left unresolved. They were:

- The capability of the elevator to lift the heaviest LOTS equipment (TCDF).
- The capability to synchronize the SEABEE barge transporters.
- The feasibility design and subsequent fabrication of modifications to container adapter frames.
- The ability to use the modified container adapter frames in lifting selected LOTS equipment.

#### SEABEE DROPPED FROM MAIN TEST

Initial plans for the main test included the use of one of the two available types of bargeship. In June 1977 the SEABEE was selected for the test via competitive bidding. The test schedule at that point, however, did not include the deployment of the TCDF since the elevator restrictions were still in effect. Subject to the restrictions, the SS ALMERIA LYKES (See Figure 1) was offered and tentatively accepted provided that it would be available within a certain time frame during the LOTS main test. This time frame was based on the fact that the primary emphasis in the main test was on the unloading of a non-self-sustaining containership.

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<sup>2</sup>Operations Research, Inc., Report on the Cancelled SEABEE Pretest of the Joint Logistics-Over-The-Shore (LOTS) Test and Evaluation Program, ORI Technical Report No. 1148, 15 June 1977.

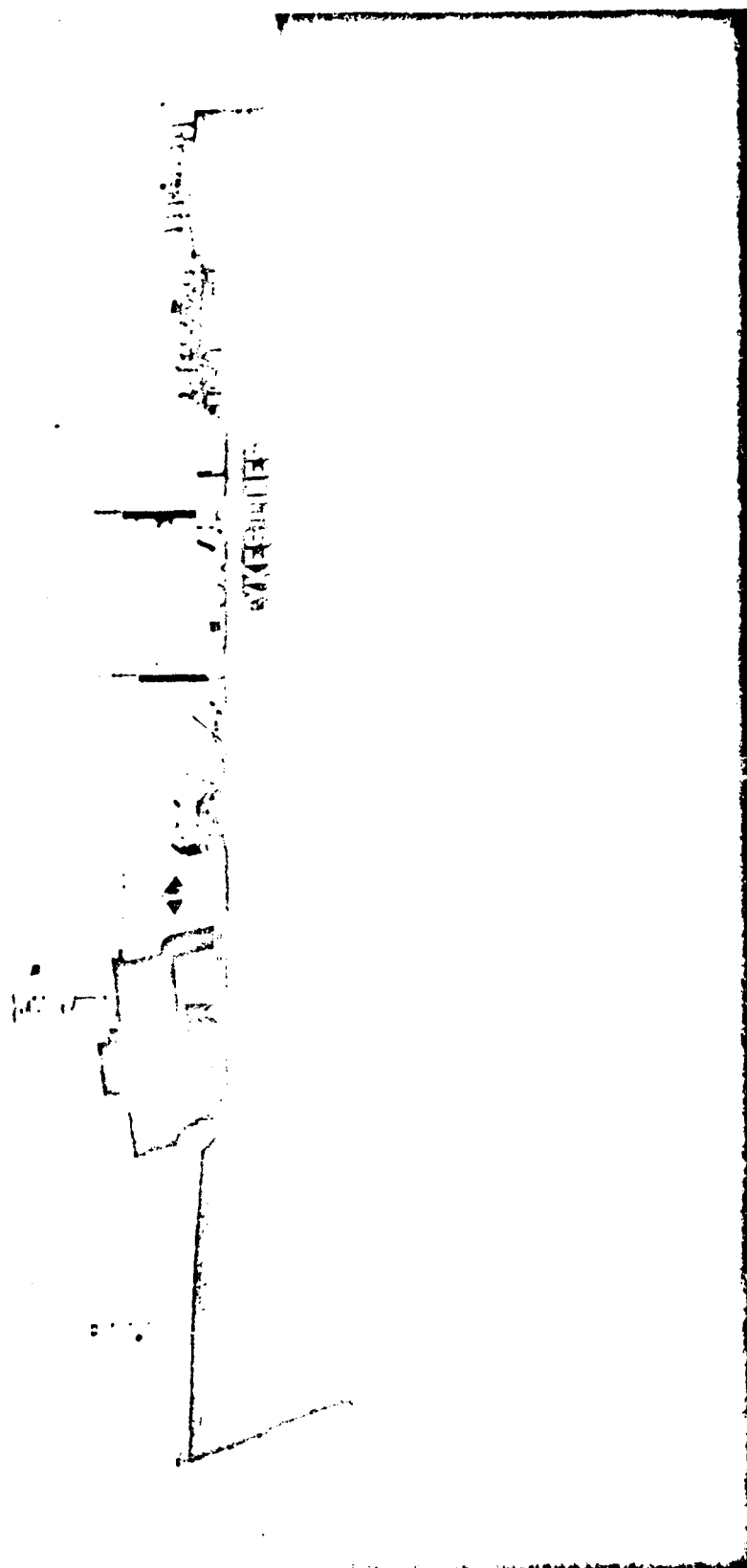


FIGURE 1. SS ALMERIA LYKES

All scheduling for the main test was predicated upon the operational availability of the containership. The availability of the SS ALMERIA LYKES in the Hampton Roads vicinity was centered around an upkeep period at Newport News, Virginia. When it became apparent that the SEABEE's availability would seriously delay the main test schedule, its participation was dropped from the main test.

#### RESCHEDULED SEABEE PRETEST

When it became apparent that the SEABEE would not be in the main test, negotiations were opened for a special test. It was agreed that a test could be conducted during a four-day period in September, 1977. This test not only included all of the main test scheduled lifts but also hoisting the TCDF to the upper deck of the ship and raising it on the transporters. Because a transporter synchronization system was not yet available, no horizontal movement of the TCDF was permitted.

Scheduling of the test was to coincide with the end of the ship's upkeep period. Accordingly, the test was conducted during the period 15-18 September 1977 and loading commenced at the embarkation terminal at the Norfolk Naval Supply Center. The test was scheduled to conclude with the off-loading of equipment at an anchorage area off Fort Story. However, due to difficulties encountered with the lift of the TCDF in port, it became necessary to re-lift it after the off-load of the rest of the equipment. This final lift was accomplished on the fourth day of the test at an anchorage off Sewell's Point, Norfolk, Virginia.

## II. SEABEE PRETEST

### PURPOSE

The purpose of the test was to evaluate the capability of the SEABEE to embark, transport, and off-load selected heavy and/or outsized LOTS equipment. Emphasis was to be placed upon the validation of the procedures and modifications, and upon the suitability of the ship's barge handling system to deploy LOTS equipment.

### BACKGROUND

To utilize the SEABEE as a self-loading and discharge vessel it is necessary to use the 2,000-long ton capacity elevator at the stern. The elevator submerges so that barge cargo can be floated over it for hoisting. For stowage the barges must be moved horizontally on one of the ship's three stowage levels (lower, upper, and main deck) and this is done with barge transporters. A barge transporter may be described as a low-profile series of hydraulic jacks that have a 2,000-long ton lifting capacity for lifting the barges approximately 3-4 in. and a means for carrying them to forward stowage locations. Only two barge transporters (one for each side of the ship) service the SEABEE and they must be positioned on each level as required. The transporters are not submersible; therefore, barges—when loaded—rest on pedestals high enough and wide enough so that the transporters can pass underneath. The distances separating the pedestals (the width) is fixed. The width of the LOTS equipment tested varied, but generally it was less than the width between pedestals. Hence, this was the greatest problem behind stowage of LOTS equipment. Wheeled vehicles, such as the LARC-LX, could drive forward and needed no assistance from a transporter.

For items of LOTS equipment not compatible with the pedestal width and requiring movement by the SEABEE's barge transporter, it was possible to re-adapt container adapter frames. Container adapter frames were designed for use on the upper deck of the ship to accommodate the stowage of 20- and 40-foot containers (see Figure 2). They had never been used as an adaptive device for the ship's elevator to accommodate non-standard barges or lighters with irregularly shaped bottoms (in comparison to a SEABEE barge). In commercial operations the adapters support twelve 40-foot containers. Some on-deck re-positioning of adapters (loaded, if required) is accomplished by the barge transporters with the same facility they handle barges. In commercial operations the adapters are loaded onto the main deck support pedestals by a shoreside crane. In the LOTS test they were loaded onto the elevator support pedestals by a floating crane. They were then fastened to the elevator deck with tie-down equipment so that the elevator could be submerged for loading. Considerable tie-down effort was necessary because the adapters had a positive buoyancy factor estimated at about five tons.

These problems were anticipated, described, and analyzed in the report published regarding the cancellation of the original SEABEE pretest.<sup>1</sup> The report discusses each LOTS item in depth.

#### PRETEST REQUIREMENTS

Six container adapter frames were used for this test. Relatively minor modifications made to the adapters, consisting of dunnage and in some instances the fabrication of special support features, were helpful and sometimes necessary to assist in alignment of and to provide the support for the item being lifted. In one case, the modification was necessary so that the imposed force from the bearing structure of the lifted item was transferred to the bearing structures of the frames.

In four instances, the frames were needed to make two lifts. Therefore, modifications for the second lift either had to be removable or located so they wouldn't interfere with the first lift. All the modifications (described in Appendix A) were designed by a naval architectural firm and approved by the ship's owners.

One of the modified adapters did require an early check test with the LACV-30. Difficulties in aligning the craft onto the adapter were anticipated because of the visual obstruction caused by the craft's skirts. The purpose of this test was to orient the Army divers and other support personnel on the specific alignment requirements and to confirm the feasibility of the modifications designed to support the LACV-30's four landing pads. Five days before the formal test, the LACV-30 was test lifted onto the adapter frame modified for it. The test was conducted at Pier 4, Naval Supply Center, Norfolk. The LACV-30 was successfully lifted without incident by a Navy YD floating crane onto the frame which was located on the pier.

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<sup>1</sup>Operations Research, Inc., Report on the Cancelled SEABEE Pretest of the Joint Logistics-Over-The-Shore (LOTS) Test and Evaluation Program, ORI Technical Report No. 1148, 15 June 1977.

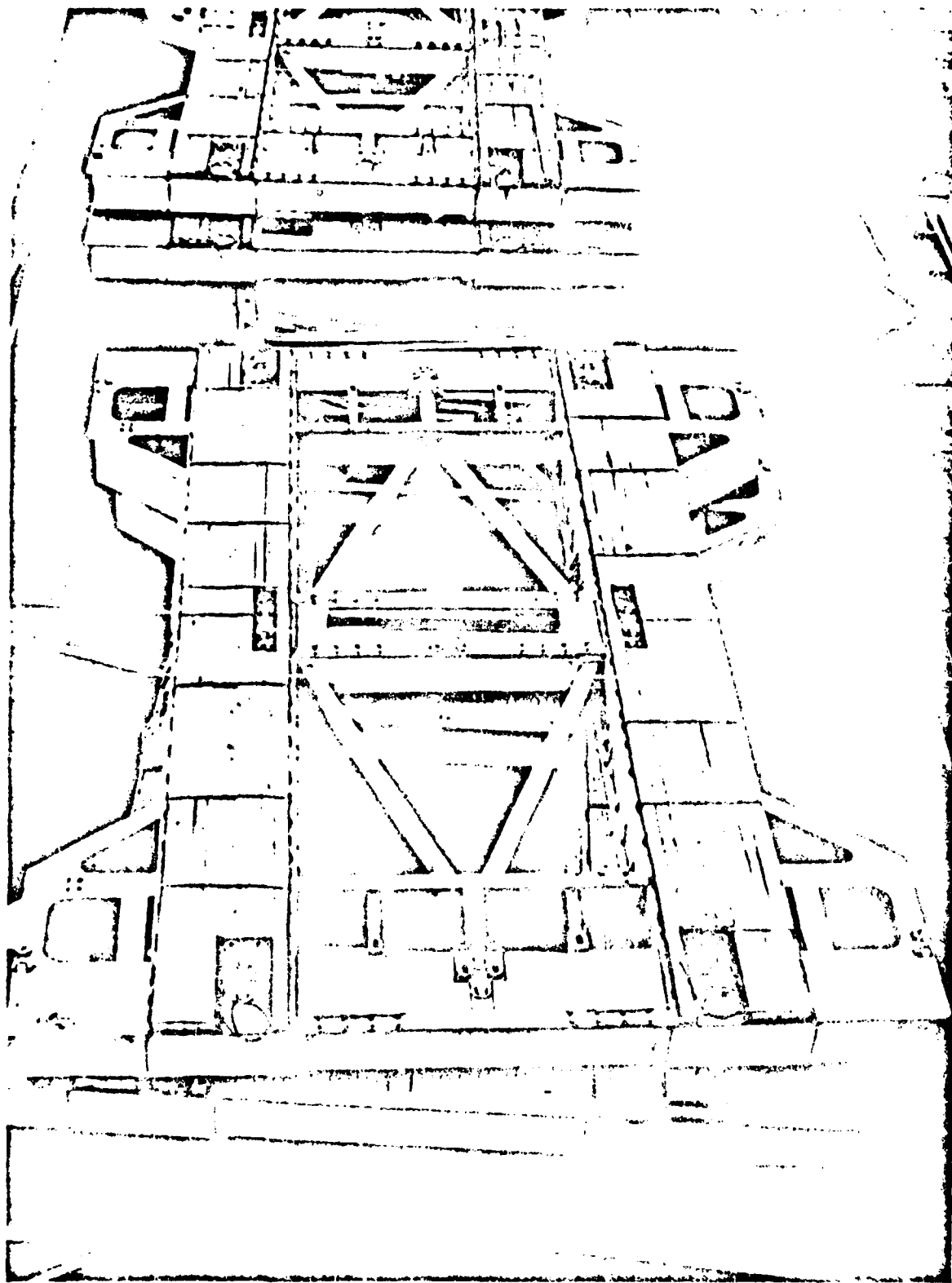


FIGURE 2. CONTAINER ADAPTER

Owing to the varied characteristics of the equipment to be lifted, the method of delivery to the ship's elevator varied for each item. Maneuvering and warping assistance was provided as required by two Army tug boats and two Navy LCM-6 tender boats.

Additional test equipment and support included:

- Diving barge with equipment—provided for both embarkation and debarkation phases.
- Environmental instrumentation deployed in an Army LCU during the debarkation operation and during the second TCDF lift.
- Sufficient personnel by each Service to execute the test for their equipment in terms of:
  - Command and control
  - Data collecting
  - Cargo handling.
- Contract stevedores, supervisors, and lashing materials from the Naval Supply Center during the embarkation.

## EMBARKATION

### General

All equipment scheduled for embarkation was loaded aboard the ship at Pier 4, Naval Supply Center, Norfolk, Virginia during the period of 15-16 September, 1977. Sunny skies, warm temperatures (70° - 85°), and calm seas provided favorable conditions for the loading operations. General characteristics of the equipment loaded or test lifted (in the case of the TCDF) are shown in Table 1. The equipment is listed by loading sequence.

The loading sequence was, in part, dictated by the limited number of adapter frames available. The TCDF required four adapter frames which also had to be used to lift other equipment. Therefore, the TCDF had to be test lifted first so that those adapters could be modified for subsequent lifts. Also considered in the load sequence planning was the anticipated problem of aligning the LACV-30. This item was loaded last so as not to jeopardize other lifts if time became a limiting factor.

### Operations

Loading operations, for the most part, went smoothly considering that this was the first attempt at loading this type of equipment on a SEA-BEE. Numerous administrative delays were experienced between lifts to allow for elevator and transporter repositioning, adapter frame modifications,

TABLE 1  
EQUIPMENT SELECTED FOR THE SEABEE TEST

| ITEM                                                                                    | QUANTITY<br>LOADED | LENGTH | WIDTH | HEIGHT | WEIGHT<br>(SHORT TONS) |
|-----------------------------------------------------------------------------------------|--------------------|--------|-------|--------|------------------------|
| SEABEE Barge                                                                            | 2                  | 97'6"  | 35'0" | 16'11" | 186.02                 |
| Adapter Frames                                                                          | 6                  | 47'6"  | 33'5" | 2'6"   | 33.95                  |
| TCDF*                                                                                   | 1                  | 150'0" | 60'0" | 10'0"  | 777.8                  |
| Causeway (3x15)                                                                         | 1                  | 90'0"  | 21'0" | 5'0"   | 67.5                   |
| LCU (1646 Class)                                                                        | 1                  | 135'3" | 29'0" | 17'0"  | 185                    |
| LCU (1466 Class)                                                                        | 1                  | 119'0" | 34'0" | 17'8"  | 201.6                  |
| LARC-LX                                                                                 | 1                  | 52'6"  | 26'7" | 18'0"  | 97.5                   |
| LCM-8                                                                                   | 1                  | 73'8"  | 21'0" | 13'0"  | 65                     |
| LACV-30                                                                                 | 1                  | 76'3"  | 33'0" | 21'6"  | 31                     |
| *Length does not include boom overhang and height does not include crane and foundation |                    |        |       |        |                        |

crew breaks, and tying adapters and equipment down. One transporter broke down and caused considerable delay. In addition, one SEABEE barge, which had a hole in it, was allowed to drain before being stowed.

Considerable use was made of two barge positioning winches located on top of each wingwall. Each winch has two lines which pass through fairleads on the elevator side. These four lines are attached to rings which fit over the barge mooring bitts. The winches provide a powered tag line capability to position SEABEE barges over the submerged elevator. Winch operations usually maneuver the barges independently by applying various amounts of tension on those lines. Most of the LOTS equipment was positioned in the same manner as barges, but with varying degrees of success. In most cases, the relatively light weight of the equipment (27-180 long tons) compared to barges (150-900 long tons) resulted in radical alignment changes when different line tension was applied.

Specific elevator and barge transporter loading times varied with each test load. The maximum speed of the elevator is 4 ft per minute and that of the transporter is 80 ft per minute. Table 2 is a breakdown of loading times by equipment.

The fastest item to be loaded was the LARC-LX. It required 22 minutes and was simply floated into position over the elevator, the elevator was raised to the lower deck, and the LARC-LX was driven forward to its stowage location. The LARC-LX did have to drive over an obstruction on deck, which required placing some dunnage down, but this was only a minimal delay. The LARC-LX's fit was quite close since its width was comparable to the width between the pedestals.

The lift which came closest to failure was the TCDF. The elevator easily lifted the amount of weight required and the stern overhang of the barge did not appear to cause problems. The surprise was when six rails were discovered on the bottom of the DeLong barge, four of which were pressing into the adapter frames. This caused a concentration of weight (approximately 778 short tons) over four relatively small areas, each of which was about 2.2 sq ft. This was considered an excessive risk for the elevator and barge, even though the elevator had already lifted the TCDF approximately 8 ft out of the water. The lift to the top and the hoisting by the barge transporters were aborted.

One lift, the 1466-class LCU, was wide enough and was capable of being lifted by the barge transporter without the use of a container adapter. It was discovered during the lift that a considerable amount of stress was being placed at two points on the LCU's bottom. These points were somewhat lower than others and, to relieve this stress, the LCU was lowered to the pedestals where it had rested satisfactorily. The hydraulics to the jacks at the critical points were disconnected and the lift was again made but without these two jacks. This time the load was more widely distributed and the lift was made more safely.

A very significant problem during the loading phase was observed to be the buoyancy of the container adapters. The elevator was not designed for tying anything down. It was possible, however, to lash the adapter to pedestals on the elevator deck. For the most part, this approach was successful except that some of the adapters did loosen. There was no wave or sea activity in the well to aggravate the stress of loose adapters on the elevator so none of the tie-downs ever came completely loose.

The remaining lifts (discussed in Appendix A) were made without incident or great difficulty. Some of the adapter modifications, such as the vertical guides for the causeway, LCM-8, and the 1646-class LCU, were not as effective as had been anticipated. In fact, the 1646-class LCU on one approach bent its guides and had to dock without them.

#### DEBARKATION

All debarkation operations were started and completed on the third day of the test, 17 September 1977, approximately 2,900 yd off Green Beach, Fort Story, Virginia. Weather during the day was cloudy with intermittent showers. Winds were out of the east at 10-20 knots. At the beginning of the day, there were moderate sea swells which caused the ship to roll a maximum of 5 degrees (2-3 degrees each side of upright). Because of this situation, only the equipment scheduled for immediate off-load was permitted to be unlashed.

Weather and sea conditions during the off-loading operations were significantly different from those experienced during pierside loading. Showers, at times were very heavy, and the intermittent moderate sea swells made operations more difficult than in the harbor. The sea conditions over the flooded elevator platform were moderately turbulent. This was primarily caused by a 2-knot current running aft through the elevator well in addition to the 2-3 ft swells at the stern.

The six items of LOTS equipment would have been off-loaded much faster except that problems were experienced with the adapter frames coming loose from their lashings on the elevator. In the seaway currents and swell activity combined with the buoyancy of the adapters to stress the make-shift lashing arrangements. For example, as a test item was lowered and it began to float, the lashings on the adapter frames began to break by the surging effects of the sea. Generally, the elevator was raised before all of the lashings broke loose, but in one instance all lashings broke loose and the adapter frame began floating around inside the well. The elevator was raised, the powered tag lines were attached, and the elevator was lowered again. Then, using the powered tag lines the adapter was repositioned over the pedestals and the elevator was raised for the next load.

A summary of the debarkation times is provided in Table 3. Again, it should be noted that the times were not continuous as administrative delays were experienced between cycles for transporter and elevator repositioning, weather, and crew breaks. Appendix B provides a more detailed discussion of the off-loading phase.

TABLE 2  
EMBARKATION TIMES  
(Minutes)

| ITEM                                      | ENTRY                              | ELEVATOR              | TRANSPORTER                                                                                       | TOTAL                                     |
|-------------------------------------------|------------------------------------|-----------------------|---------------------------------------------------------------------------------------------------|-------------------------------------------|
| SEABEE BARGE #1                           | 1. Docking<br>2. Wait For 2D Barge | 9<br>21<br><u>30</u>  | 1. Onto Elevator<br>2. To Stowage Site                                                            | 4<br>14<br><u>18</u><br>86                |
| SEABEE BARGE #2<br>(loaded with barge #1) | 1. Docking<br>2. Wait For Elevator | 3<br>3<br><u>6</u>    | 1. Onto Elevator<br>2. To Stowage Site<br>3. Breakdown<br>4. Con't To Stowage Site                | 4<br>3<br>18<br>11<br><u>202</u><br>215   |
| CAUSEWAY                                  | 1. Docking<br>2. Wait For Elevator | 5<br>1<br><u>6</u>    | 1. Onto Elevator<br>2. Connect Power<br>3. Move To Stowage<br>4. Breakdown<br>5. Con't To Stowage | 7<br>5<br>5<br>9<br>10<br><u>36</u><br>62 |
| LCU<br>(1646 Class)                       | 1. Docking<br>2. Reposition        | 17<br>67<br><u>84</u> | 1. Onto Elevator<br>2. Connect Power<br>3. Move To Stowage                                        | 4<br>4<br>27<br>35<br><u>147</u>          |
| LCU<br>(1466 Class)                       | 1. Docking<br>2. Wait For Elevator | 41<br>3<br><u>44</u>  | 1. Wait for Transporters<br>2. Transporters In Position<br>3. Move To Stowage                     | 13<br>43<br>11<br>11<br><u>67</u><br>182  |
| LARC-LX                                   | 1. Docking                         | 4                     | 1. Drive To Stowage<br>(Self-Propelled)                                                           | 5<br><u>22</u>                            |
| LCH-8                                     | 1. Docking                         | 12                    | 1. Unlash Adaptors<br>2. Onto Elevator<br>3. To Stowage                                           | 12<br>2<br>8<br><u>22</u><br>70           |
| LACV-30                                   | 1. Docking                         | 7                     | 1. Onto Elevator<br>2. Connect Power<br>3. Move To Stowage                                        | 5<br>4<br>8<br><u>17</u><br>108           |

TABLE 3  
DEBARKATION TIMES  
(Minutes)

| ITEM                 | TRANSPORTER                                                     | ELEVATOR          | EXIT                                 | TOTAL                |
|----------------------|-----------------------------------------------------------------|-------------------|--------------------------------------|----------------------|
| LACV-30*             | 1. Onto Elevator<br>2. Disconnect Power<br>3. Wait for Elevator | 7<br>2<br>1<br>10 | 1. Lash Adapters<br>2. Clear Ship    | 21<br>2<br>23<br>60  |
| LCU*<br>(1666 Class) | 1. Onto Elevator<br>2. Disconnect Power                         | 6<br>1<br>1<br>7  | 1. Wait for LACV<br>2. Tow From Well | 21<br>13<br>34<br>81 |
| CAUSEWAY             | 1. Onto Elevator                                                | 16                | 1. Lash Adapters<br>2. Tow From Well | 16<br>8<br>24<br>53  |
| LCU<br>(1666 Class)  | 1. Onto Elevator                                                | 9                 | 1. Lash Adapters<br>2. Clear Ship    | 88<br>3<br>91<br>135 |
| LCM-8*               | 1. Onto Elevator                                                | 7                 | 1. Lash Adapters<br>2. Clear Well    | 62<br>1<br>63<br>78  |
| LACV-LX*             | 1. Drives Onto Elevator*                                        | 6                 | 1. Clear Well                        | 1<br>70              |

\*Offloaded Together  
\*Offloaded Together  
\*Transporter Not Used

The easiest item to off-load, of course, was the LARC-LX which was merely driven onto the elevator, the elevator lowered, and the LARC-LX driven off. However, an LCM-8 was also included in the same lift and more than an hour was lost lashing the LCM-8 to the elevator.

The second easiest item was the 1466-class LCU which had no adapters to lash down but required 81 minutes. The 1466-class LCU was delayed by a companion lift on the elevator, the LACV-30, and the necessity to reposition the barge transporters to the main deck. Together these delays cost about 50 minutes.

The 1646-class LCU required the most time to be off-loaded. Most of the time to off-load this LCU was consumed with the lengthy process (about 1½ hr) of lashing the adapters. This was precipitated by the lashing failures on the equipment off-loaded (3 x 15 causeway) immediately preceeding this LCU.

#### TCDF REPEAT LIFT

##### Preparation

With one day left on the SEABEE charter, a second attempt was made to load the Army's TCDF. Following the first TCDF lift failure additional dunnage was ordered and as soon as the adapters were free from other loads Army personnel began further modifications to the frames. In order to accommodate the TCDF with the rails projecting from its otherwise flat bottom, the four adapter frames required additional dunnage to be added except where the rails had made contact. This additional work provided the flat support surface required for the DeLong barge. The extra dunnage used amounted to about 3,720 running feet of 4 in. by 6 in. timbers. Note Figure 3.

Each adapter was secured to the elevator platform with six turn-buckle/wire rope combinations in the same manner as for the LCM-8 adapter. However, each wire, looped around a support pedestal, was now fastened with four wire rope clips, and all nuts were tightened with an impact wrench. In addition, timbers were arranged between the wire and the pedestals, to permit the turnbuckles to be tightened without bending.

All turnbuckles were fastened to the adapter and the elevator at an angle of approximately 45 degrees from the vertical. It appeared that less slack and stress might result if shorter turnbuckles were used permitting them to be installed nearer to 90 degrees (straight down) from the adapters. More than 2 hr were required for the lashing.

##### Execution

The ship was anchored in Hampton Roads off Sewell's Point. Weather conditions in the harbor were favorable and sea state one conditions prevailed. There was no noticeable ship motion.

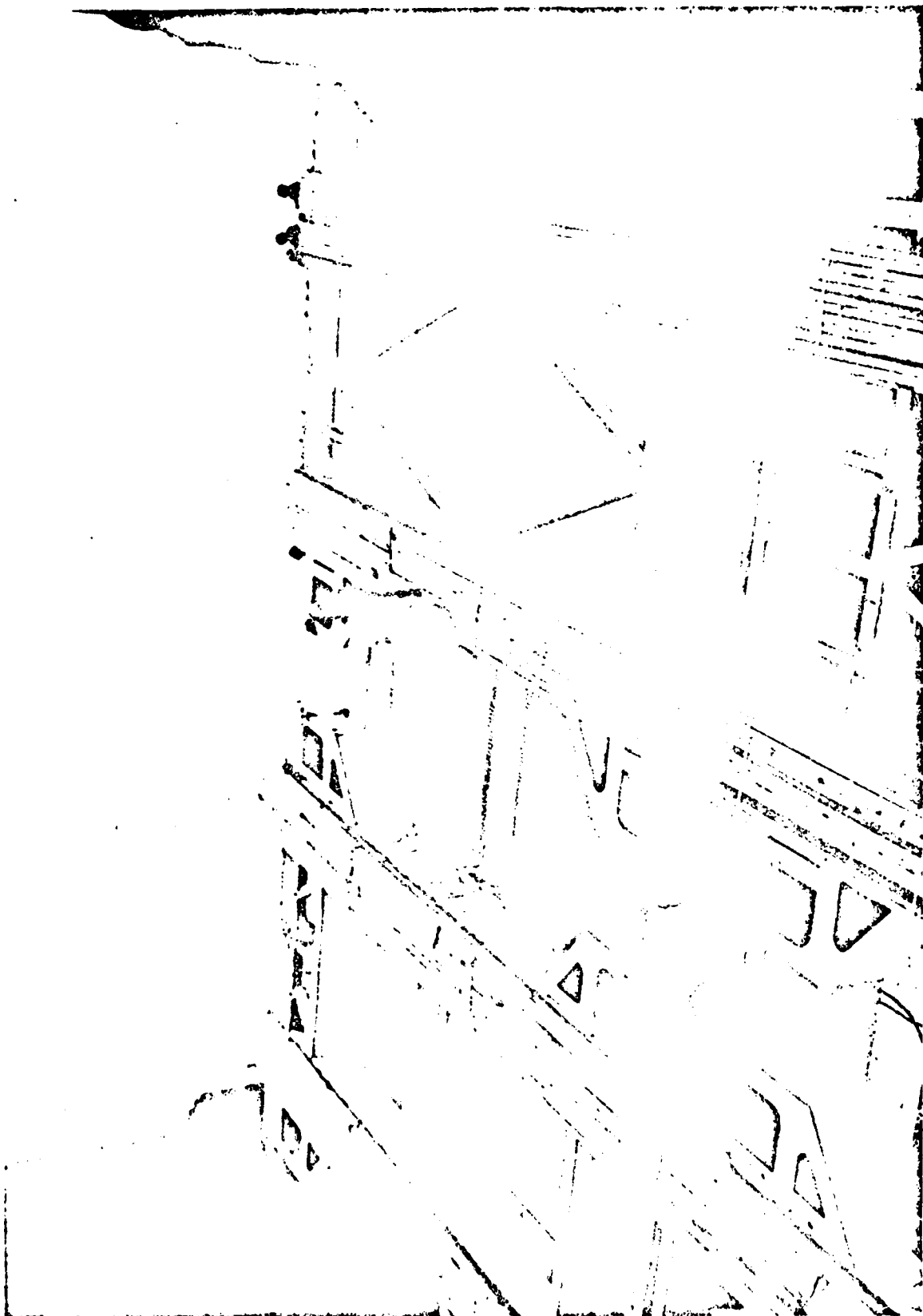


FIGURE 3. TCDF MODIFIED CONTAINER ADAPTER FRAMES

The TCDF was maneuvered into the elevator well without incident. Positioning winch lines were shackled to wire ropes and looped around the barge's mooring bits. These lines functioned effectively in aligning the TCDF over the adapters. Once the elevator was lifted clear of the water, a visual inspection confirmed the proper alignment. Each of the rails were well inside the pockets provided for them by the additional dunnage.

The elevator continued to the upper deck where the adapter frames were unlashed and both transporters were moved under the TCDF. Although not synchronized, both transporters were controlled by one crewman. They appeared to operate at the same rate of speed in moving back under the load.

On signal, both transporters began to lift the TCDF and held the TCDF in the lifted mode for 3.5 minutes. It was noted that both transporters appeared to lift at the same uniform rate. This completed the test lift.

The transporters then lowered the TCDF back onto the support pedestals, whereupon the transporters were removed and the adapters were lashed. The elevator took 16 minutes to lower the TCDF from the upper deck to a point where it was floating. Two tug boats secured lines to the TCDF and pulled it from the elevator well without incident. The total time to dock, elevate, lift and lower by transporter, flood, and retract the TCDF from the ship was 2.1 hr. This concluded the test.

### III. ANALYSIS

#### GENERAL

Some of the equipment selected for the test posed particularly difficult and unique problems for loading on the SEABEE. With the exception of the TCDF and LACV-30, all equipment had been deployed previously in LOTS pretests under varying degrees of disassembly and a variety of loading means. In this test, all equipment was lifted aboard in a fully assembled (operational) mode. Although the military personnel were well versed in handling LOTS equipment, no one had any experience working with a SEABEE vessel.

Overall command, control, and communications appeared to be excellent. Key crew members and military supervisory personnel maintained close liaison throughout the test. All supervisory participants had a good knowledge of the test scenario.

The techniques developed to make the SEABEE an acceptable carrier for LOTS equipment were proven feasible, although slow and sometimes difficult. In some instances obvious courses of action were deferred while other techniques were tried. For example, in the positioning of one load only one powered tag line was used when two seemed to be the logical solution. On the other hand, precedence was justifiably given to personnel and equipment safety where time could have been shortened by more expedient techniques.

Although safety considerations and deliberate stops and checks understandably prevailed throughout the test, most cycle times could be reduced with more experience. Additionally, improvements are needed in loading procedures.

Off-loading deck-stowed rolling stock in a LOTS environment from a SEABEE to lighters would be somewhat different from discharging a Roll-On/Roll-Off (RO/RO) vessel because of a need to use the SEABEE elevator as opposed to a RO/RO ramp. However, this method of discharge was not tested in this pretest or the LOTS main test. On the other hand, SEABEE barges loaded with vehicles were discharged at the DeLong pier and elevated causeway during the LOTS Main Test, but in the early phases of a LOTS operation these facilities may not be available.

Also still untested is a method of moving the TCDF on transporters. It may be possible for a skilled operator to slowly operate both transporters simultaneously without an installed synchronization system. Lifting the TCDF was a step closer to proving the feasibility of its deployment by SEABEE vessel. However, the horizontal movement to a stowage location remains to be successfully demonstrated.

The test did establish that the ship can deploy other heavy, outsized LOTS equipment. However, loading procedures were extremely slow in comparison to other ships used in previous tests to deploy similar cargo. A considerable amount of time was consumed by lashing adapter frames to the elevator. Much time was also used for underwater inspections which proved to be of questionable value, indicating that other visual alignment procedures should be developed and tested.

#### LOADING

The outloading operation was made less difficult in sheltered water at pierside and by more than an ample work force of civilian and military stevedores. Loading in an open roadstead could have been complicated by tidal current, wind, and wave action.

The slowest activities in the loading process were the lashing of adapters and the alignment of equipment over the adapters once the elevator had submerged. If adapter frames were used on the elevator in commercial practice no doubt alterations would be made both to the adapter frames and the elevator so that better and faster lashing was possible. This is now one of the most time-consuming facets of loading. With respect to alignment, other means of insuring proper alignment ought to be investigated in order to reduce the docking time. Horizontal measurements from fixed points in the elevator well to the craft's edges could be predetermined and gauged with preprinted alignment marks.

#### LCU (1466-Class)

This class of LCU does not require the use of container adapter frames because it is relatively compatible with the ship's barge handling system. Visual alignment of the craft over the submerged elevator could have been accomplished in the same manner as for a SEABEE barge.

The difficulties experienced in aligning the transporter jacks to the bearing surfaces of the 1466-class LCU hull were time consuming, but should not pose any problems for future lifts. As soon as it was determined that a

strategically positioned jack ought to be disconnected from the hydraulic lifting system, the load was transported without incident. The craft could be loaded in about half the time required for this test (3 hr) or less, with experience and elimination of the underwater inspection.

#### Causeway

The alignment of the causeway section took the least time of all test items because of its narrow width and hull uniformity. Even so, the degree of precision taken was probably not required. Although vertical positioning beams were affixed to the adapter frames, they were not required for gauging alignment. Painted alignment marks are an adequate alternative. The positioning winches can hold and properly align the load on selected alignment marks. Although only one causeway section was loaded, it would appear reasonable that a second section could be loaded onto the first section, piggyback style, for stowage.

#### LCU (1646-Class)

The vertical positioning beams on the LCU adapter frames were unbraced and did not withstand the contacts made with the craft. The positioning of the craft against these beams was finally accomplished, however, in an acceptable manner. The purpose of the beams was to make proper alignment, not to act as a stopper. None of the beams were heavy enough to buffer the craft's docking maneuvers. All of them were bent before the retaining bolts had snapped off. The use of these guides for docking is questionable and their aid for alignment is suspect since the craft completed its alignment in spite of the failures of the vertical positioning beams.

#### LCM-8

The LCM-8 did not benefit substantially from the use of a modified adapter frame. The cradling blocks placed on the adapter were not large enough to support the LCM-8 so that there was a gap between one of them and the hull, a fault not reported by the underwater swimmers. As with previous lifts, the vertical positioning beams attached to the adapter frame were of questionable value. Although the vertical guides withstood contacts with the craft, positioning could have been attained without them. Again, prepainted alignment marks would have been sufficient.

Had the cradling blocks on the adapter frames been designed larger, the LCM-8 would have grounded out on both of them. This would have provided the designed support which the craft did not have during this test. What stresses were made upon the craft's structural members while it was resting on its skegs and keel are unknown. However, because the craft is designed to beach and rest on those particular areas, it was felt that the stresses were within tolerances.

#### LARC-LX

This piece of equipment was the most readily adaptable test item for a SEABEE deployment. Minimal support and modifications (removal of antennae) were performed before and during loading operations. None of the

ship's barge handling system except the elevator was required as the vehicle was able to move by itself to a stowage position in the ship.

### LACV-30

The overall embarkation time of the LACV-30 (1.8 hr) was too long. Other platform designs and loading methods should be investigated. One possibility is to lift the craft with a floating crane directly onto a platform on the upper deck or the raised elevator. Floating it off in the objective area should pose no problems at all.

The adapter frame modified for this lift (see Figure 4), allowed too little clearance for the alignment with the craft's landing pads. The four elevated platforms (or sockets) indicated by the letter "A" in the figure, had three sides approximately the same size as the LACV-30 landing pads. The fourth or rear side, indicated by the letter "B" in the figure, was removable and about 6 in. longer than the forward side. These platforms provided clearance from D-rings and container fittings on the adapter frame and support for the docked LACV-30's polyurethane landing pads which extend about 1 ft below the craft's hull. The major purpose was to neutralize the effects of lateral forces from the roll or pitch of the ship during sea transit. However, the difficulties involved in the precise positioning of the pads on the platforms were aggravated by the rubber skirts of the LACV-30 which totally obscured both the landing pads and the sockets.

As envisioned in the protest plan, the LACV-30 was to have floated into a position where its landing pads could slide into special sockets on the modified adapter frame. Once the LACV-30 was in position, removable rear sides would be reattached. This procedure was expected to take considerable time and it did (approximately 66 minutes). Even then the removable sides could not be reattached because of minor misalignments.

The misalignment was caused by not perfectly positioning the landing pads in the sockets. It would seem feasible that a larger platform without sockets could be designed for the landing pads. Restraints could be attached after the craft was lifted clear of the water. This would significantly improve the docking time by providing much greater alignment tolerance.

### OFF-LOADING

Even with less than ideal weather and sea conditions the SEABEE test demonstrated its capability for off-loading operations in a LOTS environment. All of the LOTS equipment was discharged with relative ease except for problems associated with the submersion of the adapter frames. The test, of course, did not establish operational limits relative to worsening sea states.

### Adapter Frame Lashing Failure

During the discharge of the causeway section one of the container adapter frames broke loose on one side and partially surfaced while the causeway was being towed from the well. (See Figure 5.) Several theories can be offered to explain why this happened.

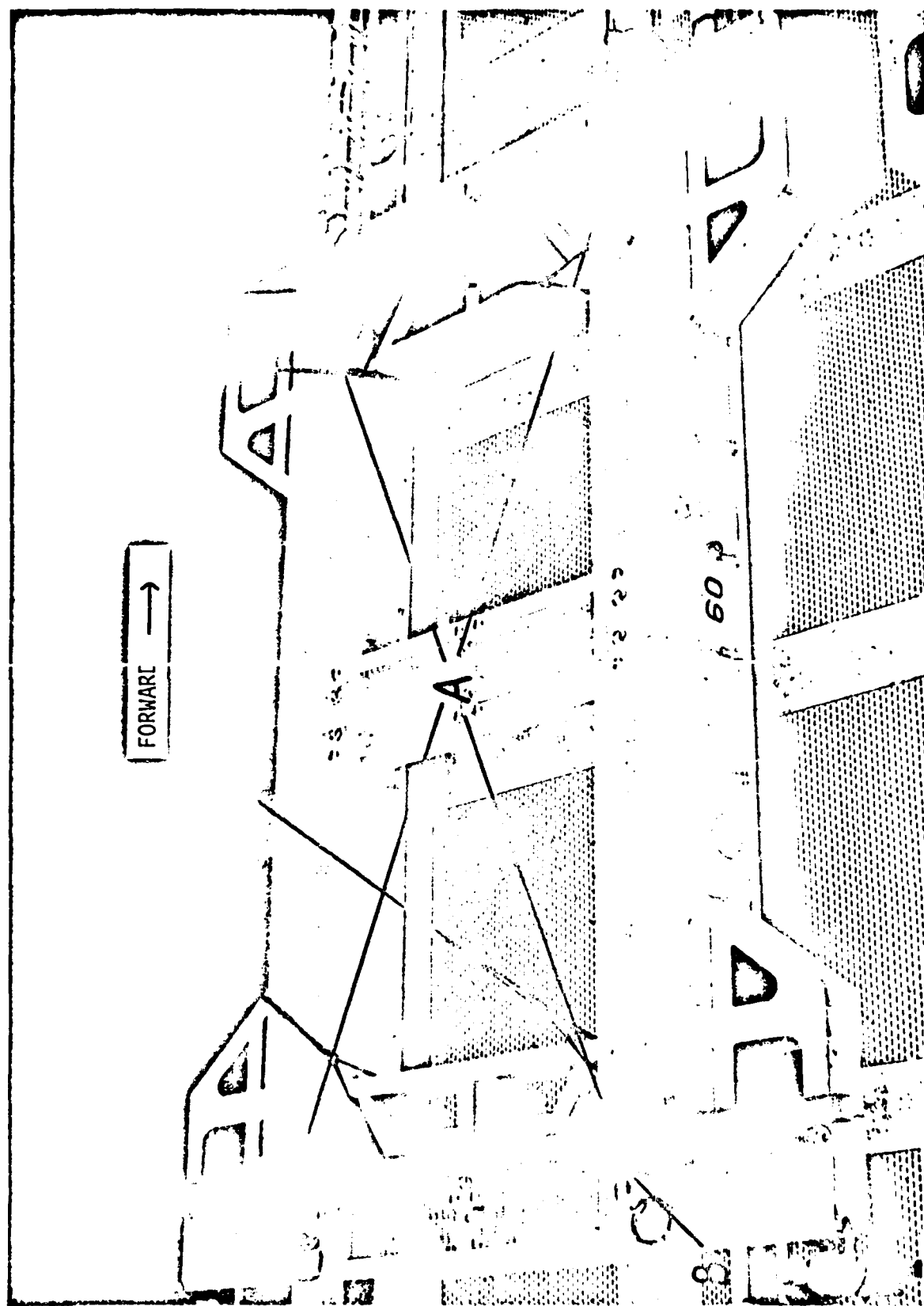


FIGURE 4. LACV-30 MODIFIED CONTAINER ADAPTER FRAME

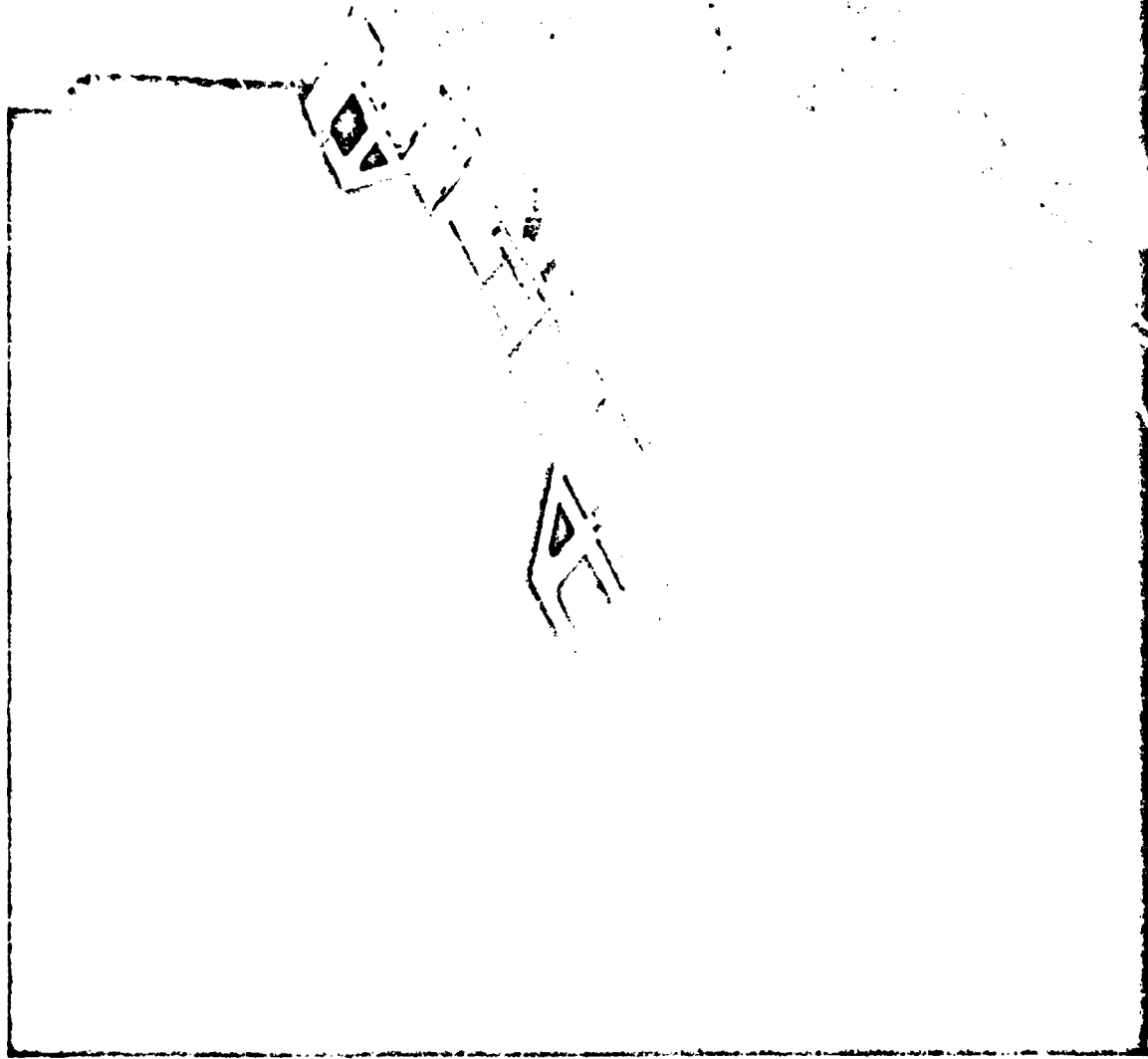


FIGURE 5. ADAPTER FRAME PARTIALLY AWASH

- The 5-ton (or greater) buoyancy feature of the adapter frame was under estimated.
- The turbulent sea conditions in the flooded elevator well were exerting forces against the lashings beyond their designed limits.
- The lashing was not properly installed and could not stand up to the forces from the existing sea conditions.
- There were no suitable elevator platform fittings for lashing down the adapter frames. The jury-rigged lashing around the support pedestals did not provide an adequate restraint.
- Lashing a loaded adapter frame to the support pedestals imposed compressed loading within the pedestals themselves. Between each support pedestal and the elevator platform is a buffer, see Figure 6. These buffers were compressed by the weight of the adapter frame and equipment load when they were lowered onto the support pedestals. When the test item was permitted to float free, the buffers exerted an upward force against the lashing points. If the lashing were perfectly tight, the buffers could in principle exert a force on the lashings as large as the weight of the floated item and the buoyancy factor of the adapter frame.

This last theory coupled with the turbulence in the elevator well and the buoyancy of the adapters appear to be the most plausible. None of the adapters broke loose during loading operations even though they were poorly fastened, as exhibited by some movement during flooding. However, the buffers had only absorbed the weight of an empty adapter and there was negligible water movement in the well. The lashings were adequate to hold the adapters in place at that time.

A number of solutions are possible, but the most effective appears to be a combination of eliminating the frame's buoyancy and installing proper tie-down fixtures on the elevator platform. Decreasing the frame's buoyancy should not be a significant problem. Grated openings at each end of the longitudinal boxed frames could be installed to expedite flooding and draining. Even with a negative buoyancy factor, however, the frames should still be secured to the platform to insure against their accidental loss in a seaway.

The present mode of securing frames to the support pedestals is unsatisfactory. There are no adequate places where hooks can be used. Rigging wire rope loops is time consuming and they are prone to parting. For example, when the LCM-8 was clear of the elevator platform, one of the wire loops parted. The strength of the other lashing attachments precluded them from holding the frame tightly, which caused additional stresses. Eventually, all of the lashings would have either failed or have been damaged.

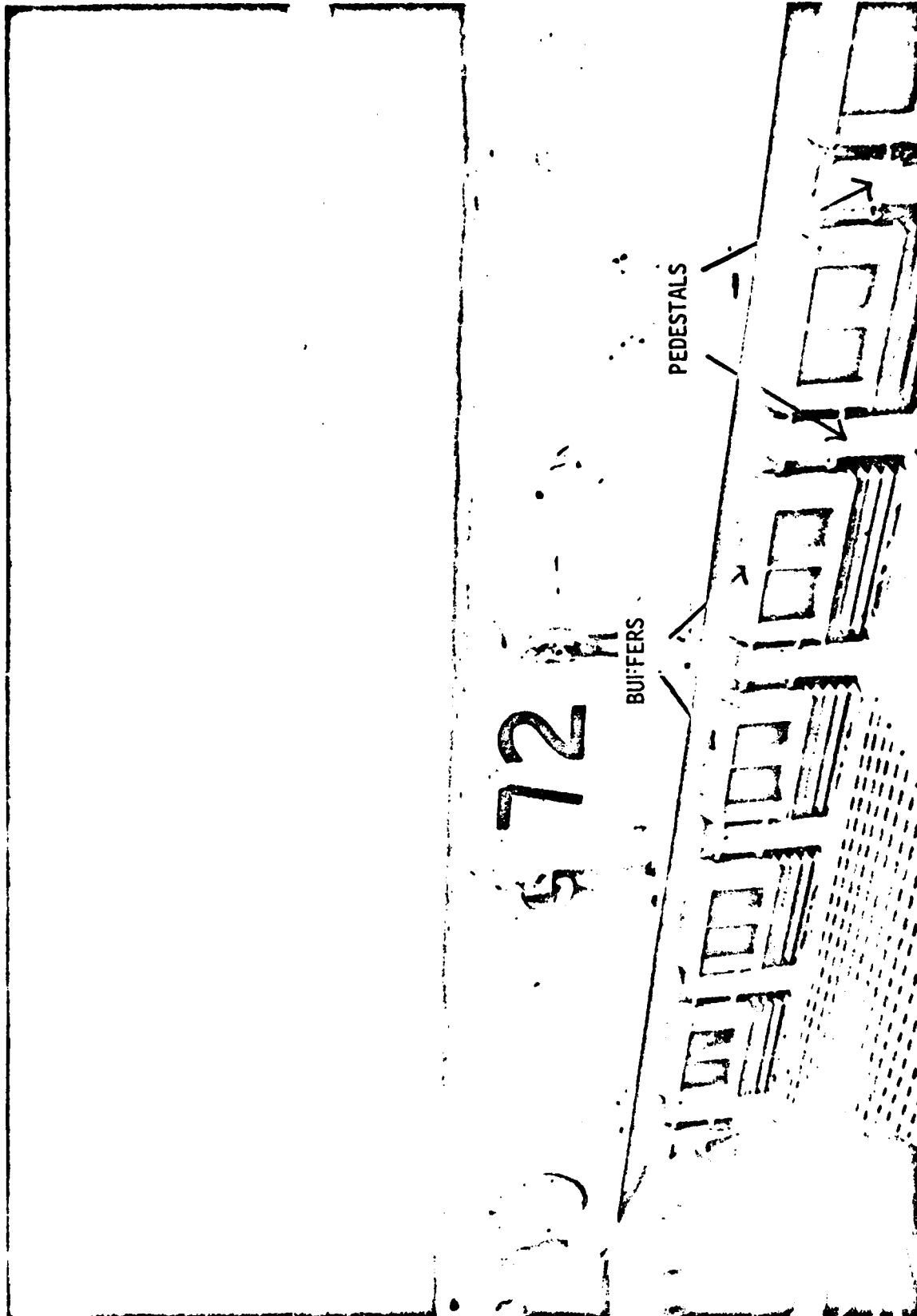


FIGURE 6. SUPPORT PEDESTALS AND BUFFERS

The lashing equipment used was not suitable for the task. Shorter turnbuckles would have permitted a more vertical lead and more resistance to movement. Realistically, if three corners are properly secured, there should be an adequate bond. The fourth corner is essentially an insurance factor to maintain a tri-point lashing feature.

#### TCDF LOAD AND OFF-LOAD

The size, weight, and extensive overhang of the TCDF on the elevator (see Figure 7) constituted an "unusual lift," as defined by the ship's owners. However, its final and successful lift aboard and return to the water was executed in a routine manner. The only operation not performed was the horizontal movement from the elevator to a stowage point. This was not permitted because the transporters were not synchronized. However, on several occasions both transporters were observed moving at the same rate of speed. It appeared that, if an emergency existed, a skilled transporter operator could move the TCDF to a point just clear of the elevator without difficulty.

The docking time for the TCDF could be significantly improved for future loading with direct communications between positioning winch operators and the deck officer. The degree of precision used in positioning the TCDF from side to side is questioned. Some latitude can be permitted because the TCDF is 10 ft narrower than the elevator platform.

Earlier estimates had been made that the TCDF, weighing a total of 778 short tons, could be safely hoisted. It was clearly demonstrated in this test that the ship's hoisting mechanism was adequate for the task. The cantilevered load, which initially had been disallowed because of potential stresses, had no apparent adverse affect on the elevator mechanism. The lift did not exceed the designed limit as evidenced by the non-activation of the snubber system. Subject only to verification of a capability for moving the TCDF to a stowage location, the SEABEE ship proved to be a suitable deployment vessel for this critical LOTS ship unloading system.

The unexpected discovery of the rails on the bottom of the TCDF resulted in the termination of the first attempt. Dunnage had been placed on the frames to avoid metal to metal contact and to distribute the imposed load. Without the dunnage, only the raised container fittings would have provided the contact points. The rails defeated the load distribution feature of the dunnage. Since the rails were attached to and part of the TCDF, it would be reasonable to assume that they could withstand the load. However, due to the uneven pressure at the stern of the cantilevered load, there was the danger of damage to the container adapter frames. Thus, the initial attempt was aborted. The lesson learned was to inspect any future lift of this type for obstructions prior to load out.

As an alternative to synchronizing the transporters, the TCDF could be made to provide its own horizontal motion. This could be accomplished by:

- Disconnecting whatever is necessary on the transporters in order to make them free wheeling.

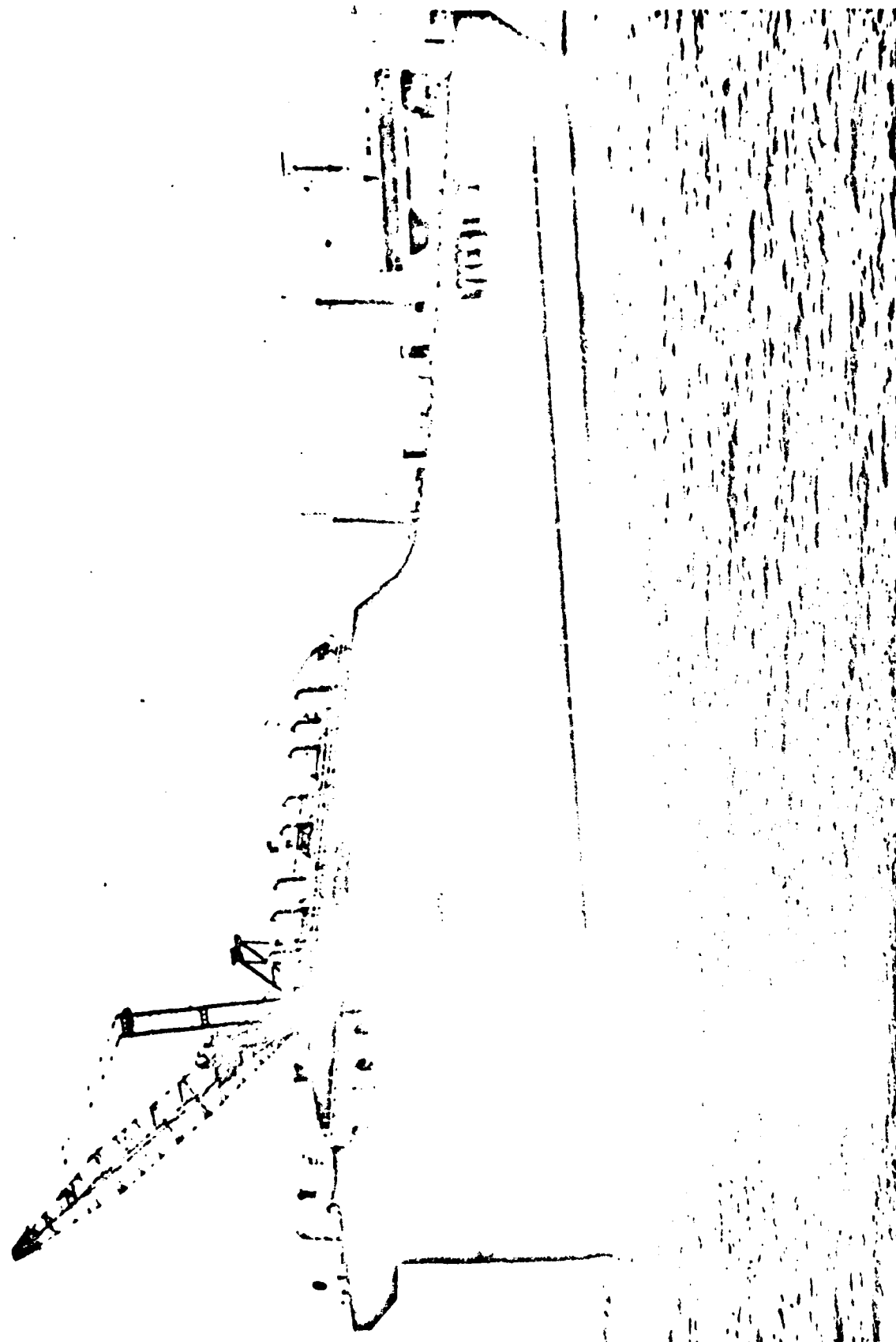


FIGURE 7. TCDF ON SEABEE ELEVATOR

- Placing a double cable from the crane down the center of the deck to a point well forward of the intended stowage point.
- Fairleading these cables to opposite sides of the ship and then back to the outboard sides of the TCDF.
- Using the TCDF crane to take up the cables thus moving in the desired direction.

To return to the elevator, a reverse cabling arrangement would be required.

#### SEABEE AND ADAPTER FRAME AVAILABILITY

Central to the employment of a SEABEE for LOTS equipment deployment is the availability of the ship and its container adapter frames. There are only three SEABEE ships in the U.S. merchant fleet. These ships constitute a unique transportation system that were designed to function together over fixed trade routes on a regular basis (allowing for periodic shipyard maintenance) and using specialized equipment for hauling primarily barge and secondarily containerized cargo. The ships are not part of the Sealift Readiness Program<sup>1</sup> (SRP) because of their limited number and because the system has been "optimized" based upon the number now in existence. Removal of any of the ships from the system for any lengthy period would jeopardize the shipping operation's SEA BARGE concept of operations.

The ships, of course, would be available to DOD in the event of mobilization. Assignment of the SEABEE ships for LOTS support in such a case has not been established by JCS planners. The nomination of the ships for deployment of DeLong pier sections or a B DeLong TCDF will be a matter of priority establishment dependent upon time and circumstance.

Because the SEABEE is a specialized vessel, its suitability for general sealift type missions and its flexibility for accommodating other than barge cargo or containers (as a non-self-sustaining vessel) is limited. As a RO/RO the SEABEE presently would require pier facilities<sup>2</sup> to attain a reasonable turnaround time. As a heavy-lift vessel it requires special adaptive features as described in this report for most cargo.

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<sup>1</sup>The Sealift Readiness Program is a contractual agreement between ship operators and DOD that allows for a timely call-up of certain shipping assets provided certain "tests" are passed and no Military Sealift Command assets are available. In turn, DOD agrees to offer cargo to the operator.

<sup>2</sup>No attempt has ever been made to off-load RO/RO cargo from a SEABEE at anchor. Such a procedure in calm water with some modifications to the elevator for a marriage with ship-to-shore lighterage is conceivable. The procedure, however, is likely to be relatively slow.

SEABEE availability, therefore, ought to be limited to those special lifts which no other ship type can support unless its barges can be used or there are pier facilities and/or dedicated equipment to support its discharge at the objective area. The features that make the SEABEE an efficient, fast turnaround, heavy-lift capable vessel could impose limitations and delays in the delivery of cargo if the ship is not properly utilized. Either the cargo off-loaded must be capable of independent ship-to-shore travel (e.g., LARC-LX), or else roll-on/roll-off techniques should be developed so that the LOTS mobile cargo loads could be discharged into lighters.

For heavy-lifts of the type accomplished in this test the availability of container adapter frames must also be considered. There is a total inventory of 72 frames, none of them modified for use in contingency situations. Leasing small numbers, as in this test, for limited periods probably could be negotiated with Lykes Steamship Company. However, the number of these frames delivered to potential users would normally be limited to those on board the SEABEE vessel itself. The size and weight of the frames preclude highway, rail, and air movement. In addition, up to 48 hr could be lost in a SEABEE loadout while modifications were made to the frames.

Conceivably the ship could carry 76 of these frames, if that many could be marshalled together to deploy LOTS equipment. However, such employment would certainly waste some of the ship's cargo spaces, all of which are primarily configured for barge stowage. Even under optimum loading conditions, valuable deck space would be lost because of the obstructions caused by the support pedestals and, in the case of the lower decks, structural supports at the centerline.

#### IV. CONCLUSIONS AND RECOMMENDATIONS

##### CONCLUSIONS

1. Service planners should not anticipate the availability of a SEABEE for a non-mobilization contingency.
2. The dedication of a SEABEE solely for LUIS equipment deployment even in a mobilization situation should not be expected unless a high priority for the deployment of LOTS equipment is recognized and established by JCS planners.
3. Except for the TCDF and B DeLong section, the heavy-lift breakbulk ship appears more flexible and better suited to deploy LOTS equipment.
4. The capability for employment of the SEABEE remains limited to 1,200 long tons due to elevator defects but this limitation does not affect the deployment of LOTS equipment.
5. The SEABEE elevator is capable of lifting any LOTS equipment in a fully assembled configuration assuming container adapter frames are available for certain lifts.
6. The SEABEE transporters have been proven capable of moving LOTS equipment except for the TCDF. The transporters did, however, lift the TCDF clear of the elevator support pedestals.
7. Until the transporters are synchronized or a manual capability is satisfactorily demonstrated, the TCDF will not have been completely load tested. Use of the transporters for horizontal movement of the TCDF does not appear to be a major obstacle but either a modification to the ship or emergency procedures, such as the use of blocks and tackle, will be necessary.

8. Container adapter frames or a suitable substitute are necessary for most LOTS equipment to permit the use of the ship's barge handling system. Modifications to these frames are within the capabilities of the Services.
9. Container adapter frames should be modified so they have negative buoyancy.
10. A limited number of container adapter frames are available world-wide. The number of adapters available will normally be limited to the number carried on the SEABEE being offered for service. Prior arrangements and lead time will be required for additional adapters.
11. The method of loading used in the test is unacceptably slow. Docking procedures for all equipment items need to be improved.
12. The lashing arrangements for the adapter frames are not acceptable. The elevator platform could accept proper lashing if permanent fixtures for fastening adapter frames were installed as they are on the open deck of the ship.

#### RECOMMENDATIONS

1. Modifications to the container adapter frames or another type platform be designed with negative buoyancy.
2. The Services and/or MARAD design suitable tie-down points for installation on the elevator platform and proper lashing methods.
4. MSC, MARAD, and the Army should investigate the possibility of moving the TCDF on unsynchronized transporters with or without the use of auxiliary mechanical power.
5. Due to the expected non-availability of a SEABEE for a non-mobilization contingency, other means or equipment should be sought for the early deployment of a suitable container handling facility.
6. If the DeLong "B" barge remains essential to timely TCDF operations, consideration should be given to statutory and/or contractual arrangements for priority use of the SEABEE in a contingency situation to include development and installation of necessary ship and adapter modifications and preparation of Service deployment procedures.
7. Service planners involved in strategic mobility planning and operations should be apprised of the limitations on the current usage of the SEABEE and the criticality of container adapter frames to non-barge type lifts.

## APPENDIX A

### LOADING SEQUENCE

#### SEABEE BARGES

Two empty barges were separately positioned in the well and lifted simultaneously to the lower deck for stowage. The docking times for both barges (See Table 2) were comparable to normal commercial operations, which allow 9 minutes per two barges. (Docking time is defined as that time when the load first enters the elevator well until it is positioned for lifting).

The starboard transporter moved onto the elevator and under the barge. In less than one minute, the barge was lifted off the support pedestals and was moved forward. At a point when it was approximately two-thirds off the elevator, the mechanical towing cable and power line parted. More than 3 hr were required to repair the breaks. The crew's general consensus was that the cable became damaged during the ship's recent yard period and was not discovered until the breakdown. After the repairs had been made, no other significant malfunctions were experienced.

The other barge was delayed on the elevator about  $\frac{1}{2}$  hr while water was allowed to drain from a 12 in. puncture located about 15 in. from the bottom of the barge. Once drained, the barge was moved by transporter to a forward position on the lower deck. Overhead clearance for the barge, while on the transporter, is less than 2 ft.

#### SEABEE CONTAINER ADAPTER FRAMES

Six adapter frames had been staged on a Navy YC barge. They were transferred from that barge to the ship's elevator, located at the lower deck

level, by means of a Navy YD floating crane (See Figure A.1). The first adapter frame loaded was spotted on the starboard side of the elevator. However, it could not be moved forward until repairs had been completed on the transporter. Table 2 contains the dimensions of a container adapter frame.

Once the port side of the elevator became clear, the adapter frame for the LACV-30 was loaded and elevated to the main deck. The LACV-30 modifications to the adapter frame are as shown in Figure A.2. Due to the specialized nature of the modifications of the LCM-8 and LACV-30 adapters, they were not used for any other loads.

It was noted here and throughout the test that the transporters cleared the underside of the loads resting on the support pedestals by about 3 in. With a total lift of about 7 in., the transporters lifted their loads about 4 in. above the support pedestals during transit.

The remaining four adapter frames were loaded onto the elevator. (See Figure A.3.) Those on the aft end of the elevator were spaced 15 1/4 in. behind those on the forward end. Each adapter frame was modified with 4 in. by 6 in. dunnage forming an 8-ft wide strip on the top and along the entire length of each side. The dunnage was framed by 3/8 in. steel bands, 2 in. wide, and spot welded to the frame. Steel bands, welded across the dunnage, further secured it in place. The dunnage was fitted around the adapter frames container fittings and shackle points to prevent loads from contacting these obstructions. In addition to the dunnage, 5/8-in. bolts had been spot welded at selected points on all the frames for a later conversion to lift a 1646-class LCU and causeway (3 x 15).

To prevent the adapter frames from floating, each had to be secured to the elevator. Two 4-ft turnbuckles were attached to D rings on each side of each frame and to wire ropes which had been secured to load bearing members of the support pedestals. Each wire rope was looped around a pedestal and joined with two wire rope clips. Figure A.4 illustrates the lashing arrangement.

When the elevator was submerged for the first lift of the TCDF, some motion was noted among the container adapter frames. This indicated that some of the frames were not fastened tightly. However, none of the frames broke free nor did they hamper the subsequent TCDF loading operation.

#### INITIAL LIFT OF THE TCDF

Two Army tugs assisted in docking the TCDF. The docking time was affected by the size of the TCDF (See Table 1) and the considerable amount of caution exercised by all supervisory personnel. Alignment adjustments were continually made during this time. Once the elevator began to lift, it ran at the standard speed until it was stopped at the lower deck level.

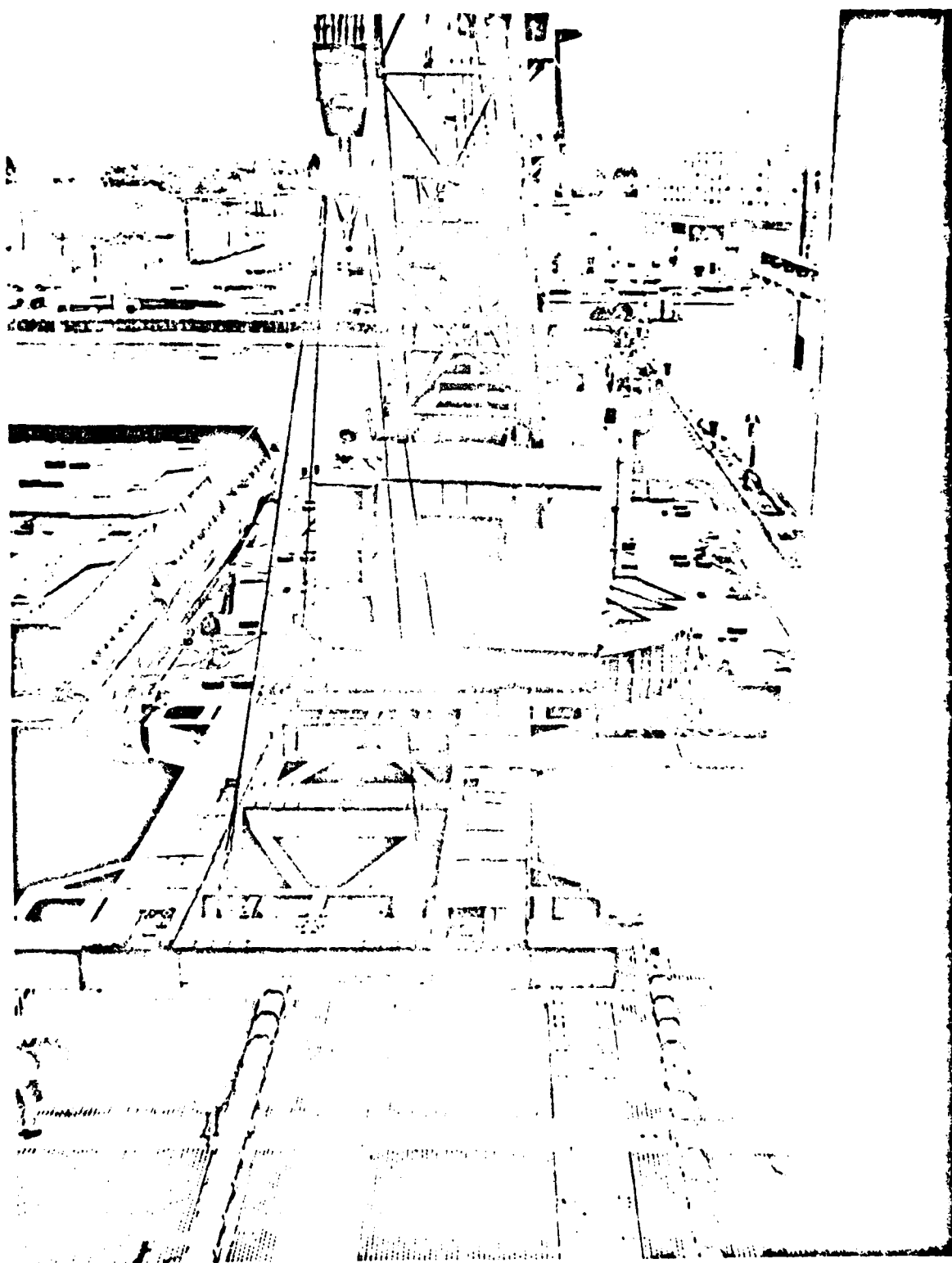


FIGURE A.1. ADAPTER FRAME BEING LOADED ONTO THE SEABEE

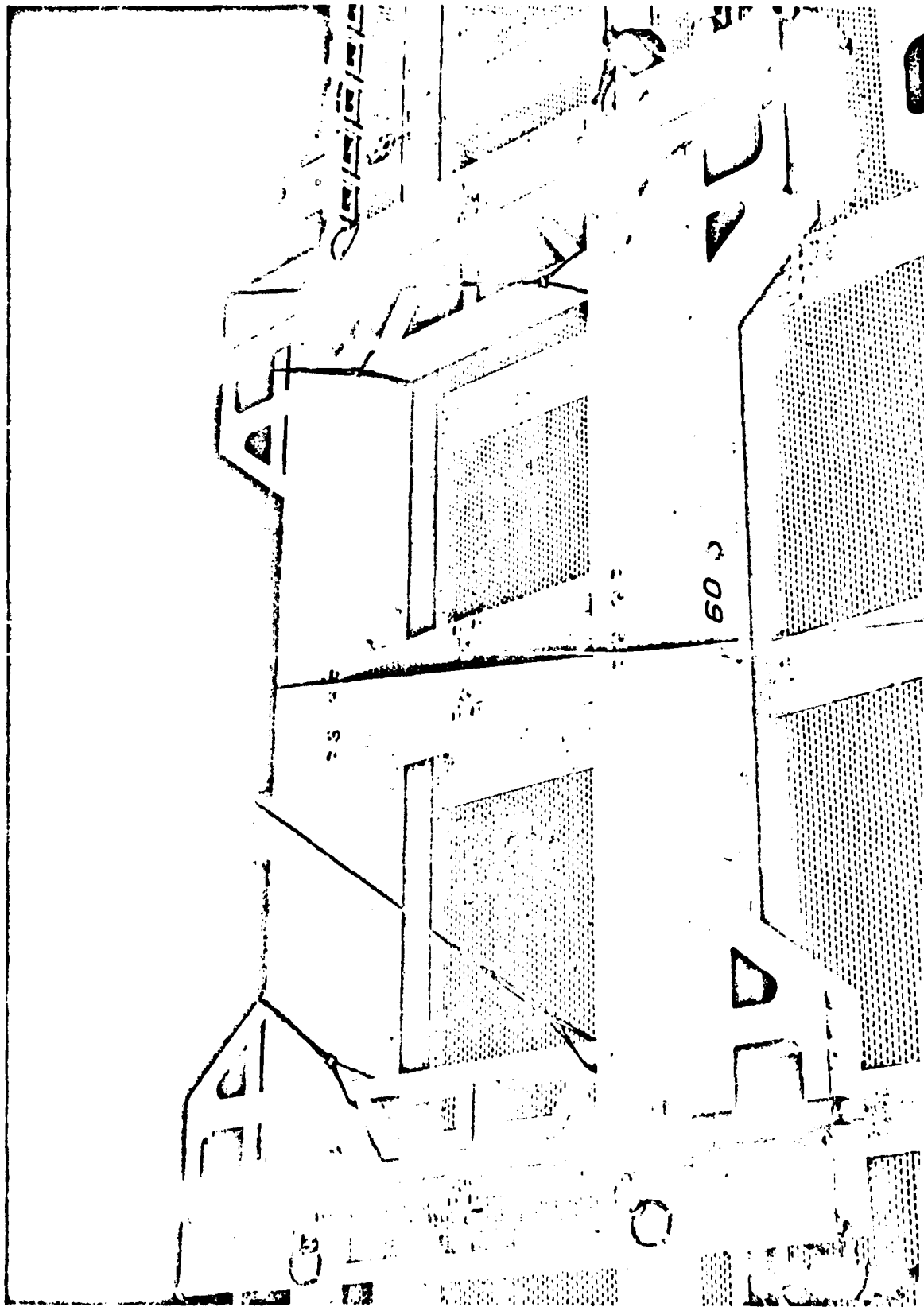


FIGURE A.2. MODIFIED CONTAINER ADAPTER FRAME FOR LOADING THE LACV-30

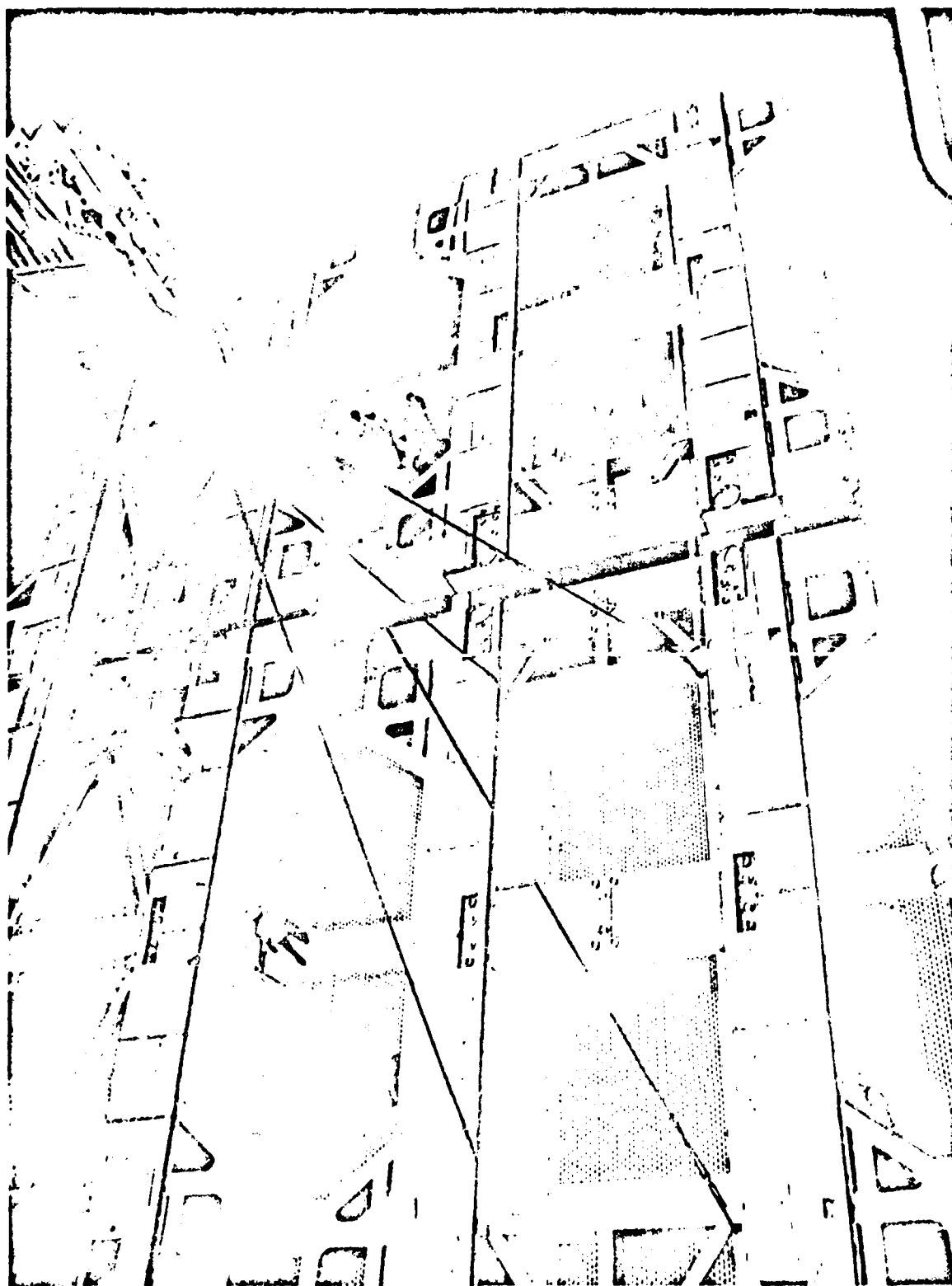


FIGURE A.3. ADAPTER FRAMES POSITIONED ON THE ELEVATOR

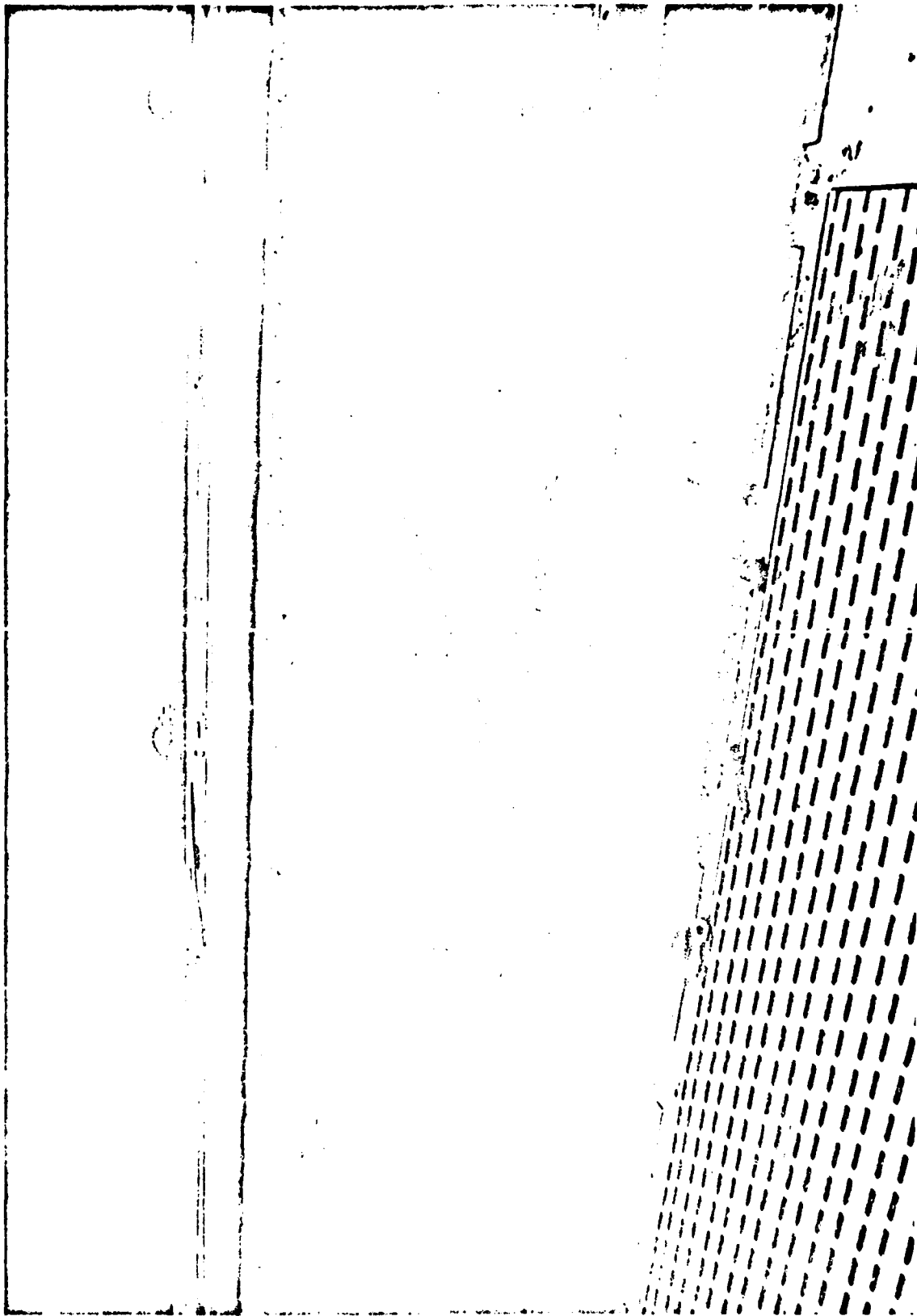


FIGURE A.4. ADAPTER FFAME LASHING

An inspection of the TCDF (see Figure A.5) revealed that it was not resting on its flat bottom as planned. Longitudinal metal rails, 6 in. by 6 in. by 8 ft 9 in., not shown on available drawings, caused the interference. Two were located 18 ft aft of the forward edge of the DeLong barge. A second set was located on each side of the midpoint of the barge. These rails were deeply imbedded into the dunnage. A third pair of rails was on the overhanging section about 18 ft from the aft edge. As a result, the forward-most rails offered two relatively small contact surfaces. The middle rails were less effective because some weight (and, surface contact) was noted on the aft edge of the aft adapter frames. Although the TCDF in this position could probably have been safely made, there appeared to be severe stresses at the contact points along the aft end of the adapter frames. These stresses, unknown in magnitude, could have caused significant damage to the frames which had a purchase price in 1972 of almost \$30,000 each. Accordingly, the TCDF test lift was terminated at this point. After an investigation of the alternatives, a decision was made to add dunnage to the adapter frames to accommodate the rails rather than try to remove them from the bottom of the barge. If time permitted at the conclusion of the debarkation exercises, another TCDF lift would be attempted. The TCDF was lowered into the water and retracted by the tugs without any incident.

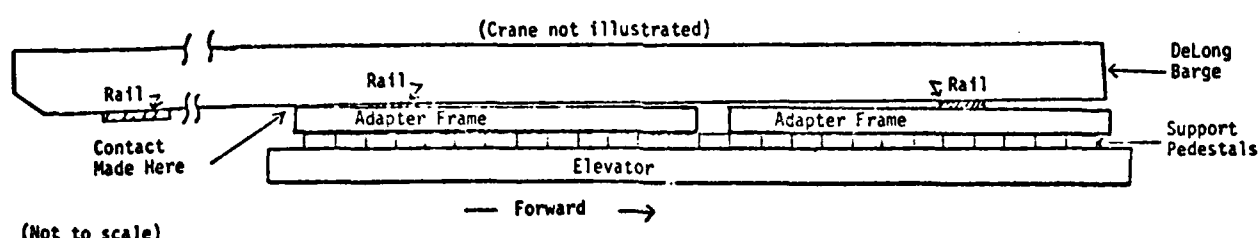


FIGURE A.5. TCDF'S POSITION ON THE ELEVATOR

During the time when the TCDF was lifted clear of the water, none of the snubbers<sup>1</sup> in the hoisting mechanisms were activated. Not only was the weight of the TCDF less than half of the designed capacity of the elevator, but the weight distribution appeared within limits because the snubbers did not move to redistribute the load.

<sup>1</sup> Operations Research, Inc., Report on the Cancelled SEABEE Pretest of the Joint Logistics-Over-The-Shore (LOTS) Test and Evaluation Program, ORI Technical Report No. 1148, 15 June 1977, page 19.

## CAUSEWAY

For the causeway, additional modifications were required on two of the adapter frames that had previously been used for the TCDF. Three vertical positioning beams were bolted to the outboard sides of the adapters as illustrated in Figure A.6.

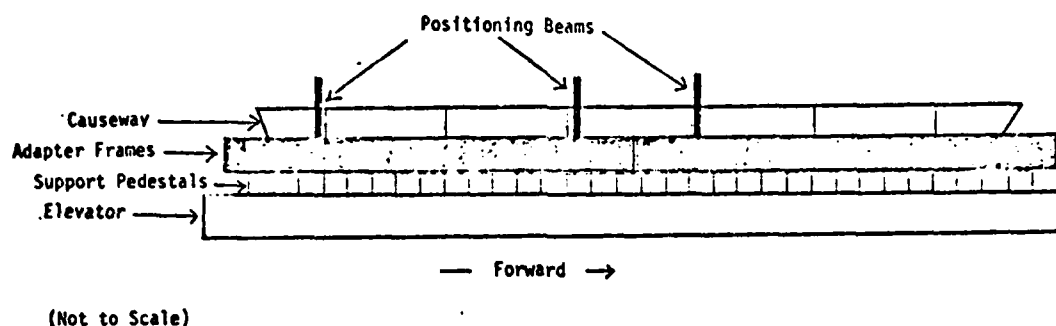


FIGURE A.6. CAUSEWAY ON THE ELEVATOR

Note should be taken that these adapter frames were on the starboard side and were repositioned after the TCDF lift. The forward frame has its forward end 24 in. aft of the elevator's front edge. The aft adapter was placed against the forward one.

The adapter frames were secured to the elevator in the same manner as for the TCDF. When the elevator was submerged, no relative movement among the frames was noted. The elevator stopped when about 2½ ft of water was over the adapter frames. Again the powered tag lines were used for proper alignment.

While the elevator was lifting the causeway to the main deck, stevedores unlashed the adapter frames from the elevator platform. A delay which required the elevator to stop was encountered while the stern gates were being lowered from the main deck to the lower deck. The average time for these gates to move between decks is about 3.3 minutes. These gates could have been lowered earlier, since their movement is independent of the elevating system.

Once at the main deck, the elevator stopped and the transporter's power supply was connected. The transporter had moved with the causeway approximately 8 ft forward when it started to jump out of its guide track. An investigation showed that the front jacks, which were not under the adapter frames, needed some weight to hold onto the track. Accordingly, the transporter was respotted further aft so that the front jacks bore some of the

weight. (Note, the causeway is about 7 ft shorter than the transporter.) With the transporter so positioned, the causeway was moved off the elevator without further incident to its designated storage position on the main deck. This terminated operations on the first day of the test.

Weather conditions on the second day of the test were similar to the first day and did not significantly affect the test. Navy crews used heaving lines on this day for passing the positioning winch rings (power tag lines) as compared to the army crews using boathooks on the first day.

As planned, additional modifications were installed on the frames designated for the 1646 class LCU subsequent to the TCDF lift. The forward adapter on the port side of the elevator was fitted with six 3-ft cradling blocks (8-in. I beams faced with 6 in. by 12 in. timber) and one vertical positioning beam (similar to those in Figure A.6). The aft adapter was fitted with twice that number. The installation of these additional modifications was completed during the causeway lift and are as noted in Figure A.7.

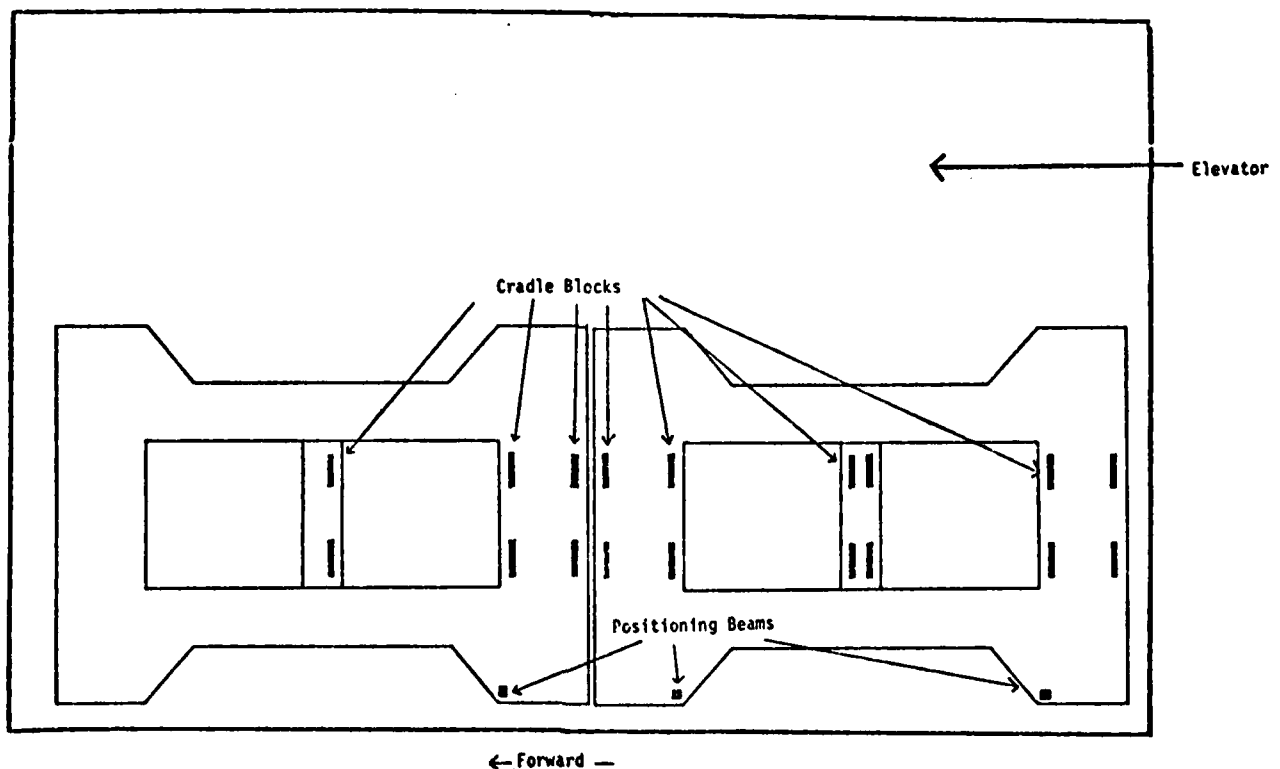


FIGURE A.7. TOP VIEW OF THE LCU (1646-CLASS)  
MODIFIED ADAPTER FRAMES

#### 1646-CLASS LCU

When the elevator had been lowered to maximum submergence, the LCU entered the well under its own power, backing in stern first on the starboard side. The craft had a draft of 5 ft at the stern. It was maneuvered to the port side where the powered tag lines were secured. The positioning rings were too large to fit through the line ports and therefore had to be shackled to wire ropes which were secured to the LCU mooring bitts. As the craft was positioned over the elevator, it was warped against the three vertical positioning beams that were cantilevered vertically from the adapter frames. Each of these beams failed when contacted by the side of the craft. However, this failure did not prevent the craft from being appropriately positioned. Subsequent examinations revealed that two or three of the four 5/8-in. retaining bolts broke off at the weld on each beam.

The elevator was raised to a point where the craft was settled on the support pedestals while the elevator platform was still under water. Two divers inspected the underside of the craft and determined that the keel blocks of the LCU were just barely in contact with the docking cradles on the adapter frames. After attaching the starboard positioning winch rings, the craft was refloated by lowering the elevator slightly. Both positioning winches were used to realign the craft. After 15 minutes of alignment, the elevator was lifted to the main deck. Visual checks determined that the craft was resting properly on the adapter frames. It appeared that there would be less chance for alignment problems if the cradling blocks were longer than the present 36 in.

Once at the main deck level, the adapters were quickly unshackled and both transporters were moved onto the elevator. After the elevator had then been lifted to the upper deck, the starboard transporter moved forward and was secured. The port transporter lifted and slowly moved the LCU to its designated storage point. (See Figure A.8.) During its movement with the LCU, the port transporter made loud snapping noises as it transversed track joints, however, no apparent damage was evident.

#### 1466-CLASS LCU

No adapter frames were used for this lift, because the 1466-class LCU (See Table 1) has a flat bottom and is only 1 ft narrower than the barges normally hoisted by the elevator. The LCU entered the well under its own power, stern first. The crew experienced some difficulty in securing the positioning winch ring. They initially tried to jury rig the rings to shackles and nylon line to the craft's mooring bitts. They eventually put the rings directly onto the bitts, after one of the nylon lines began to split. Final positioning appeared to be slow. Coordination between the two powered tag line (positioning winch) operators was lacking. As soon as the elevator was lifted to a position where the craft was barely resting on the support pedestals, two divers were dispatched to check alignment.

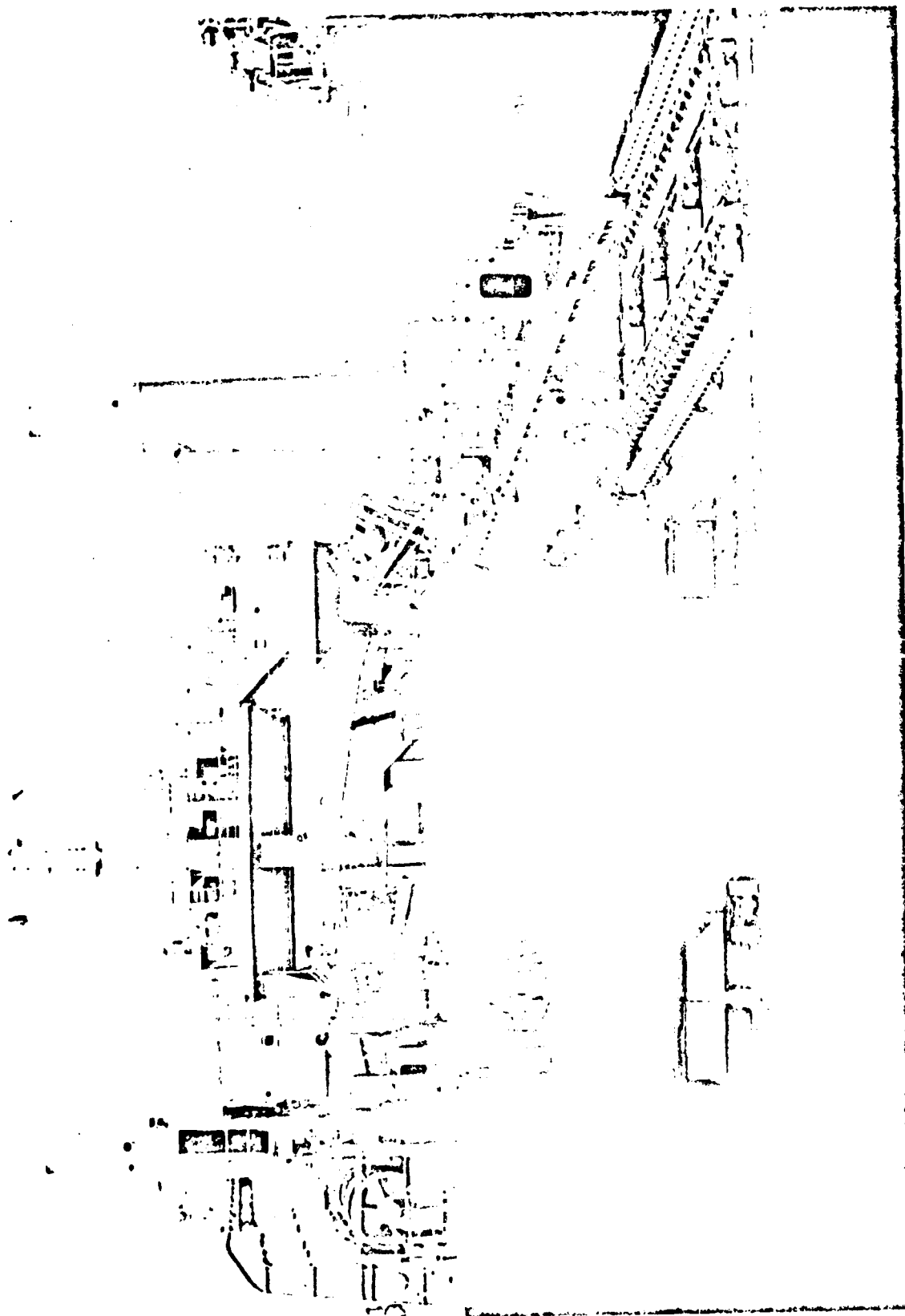


FIGURE A.8. 1646-CLASS LCU ON TRANSPORTER

After the alignment inspection, the elevator was raised to the upper deck, where the transporter was moved under the craft. It was immediately evident that the transporter jacks would have less contact with the bearing surface of the craft than had been originally estimated. This was due to the curved shape of the stern underside. After several tries with different alignments, the transporter was positioned so that jack no. 8 (there are 23 jacks, no. 1 is the most forward) had a partial contact with the aft most accessible part of the hull. When the LCU was lifted with this alignment, jack no. 8 tilted and caused unknown but possibly high stresses on the hull. Accordingly, the hydraulic lines to jack no. 8 were disconnected and the LCU was lifted and moved without incident to its designated stowage point. If jack no. 8 had been moved forward or rearward, another jack would have been located at a crucial non-bearing plate beneath the bow ramp with the same unsatisfactory result.

#### LARC-LX

The LARC-LX was taken aboard using neither an adaptor frame nor a transporter. After the elevator was submerged to a depth of about 9 ft, the LARC-LX (see Table 1) under its own power moved over the elevator, bow first. As the elevator was slowly lifted, the LARC-LX was maneuvered in a partially floating condition, using its wheels to position itself. The wheels were aligned at a point immediately inboard of the outboard support pedestals and without the aid of tag lines. About 5 minutes were needed to properly align the vehicle before the elevator cleared the water and was lifted to the lower deck.

Approximately 6 ft forward of the elevator platform on the lower deck is the edge of a raised dome-like cover approximately 6 ft in diameter. The cover is on the centerline of the ship and extends onto both sides of the deck. The outer edge of the cover is about 6 in. high rising to about 18 in. at the center of the cover. Dunnage of 6 in. by 6 in. timbers was placed between the inboard pedestals and the cover before the LARC-LX was driven over it. No problems were encountered with this arrangement. Fortunately, the added 6 in. that the LARC-LX had to climb was on the side opposite to its wheel house. Therefore, it did not significantly increase its overall height, otherwise, there might have been a vertical clearance problem.

#### LCM-8

Prior to submerging the elevator for the LCM-8 lift, an adapter frame modified as shown in Figure A.9 was secured to the starboard side of the elevator platform. The method of securing this particular frame differed from that used for previous lifts in that wire ropes and turnbuckles were secured to each side of the fore and aft ends of the frame, rather than to D rings on the sides.

The LCM-8 entered the elevator well under its own power, bow first. Additional alignment was required during the initial stages of the elevator lift. The powered tag lines and vertical positioning beams attached to the frame functioned well. Subsequent inspection of these fenders, which had been welded to the frame, revealed no apparent damage. This was in contrast to the similar beams which, as already described, failed during the lift of the 1646-class LCU.

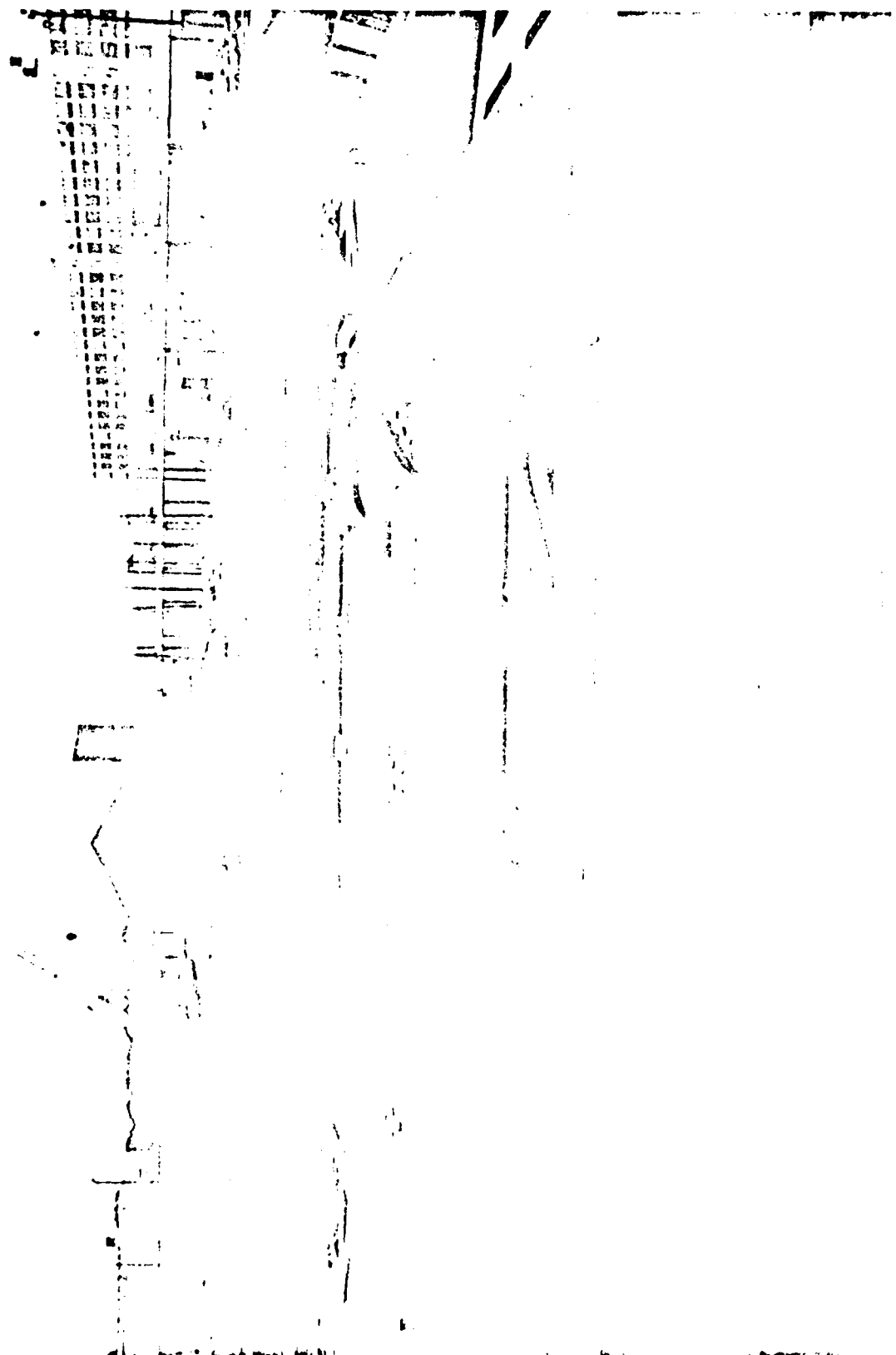


FIGURE A.9. LCM-8 MODIFIED CONTAINER ADAPTER FRAME

Once the elevator had been raised enough for the LCM-8 to rest on the support pedestals, two divers checked the alignment. After they had reported a good alignment, the elevator was lifted to the lower deck level.

A detailed inspection revealed that the craft was firmly aground on both its skids, keel and that portion of the hull in contact with the starboard docking block. The hull had no contact with the port docking block. By design, the only contact should have been with the docking blocks. It was evident that the 5-in. I beam used for the docking blocks should have been at least 3 in. larger. It was determined that neither the adapter frame nor the LCM-8 were over-stressed and the lift process was continued.

The adapter frame, with the LCM-8 on it, was unlashed from the elevator platform and the transporter moved it to its designated stowage point without incident. The top half of the wheel house had been removed and the overhead clearance was about 6 in. during movement on the transporter.

#### LACV-30

The LACV-30, operating under its own power, taxied into the elevator well, bow first. See Figure A.10. Mooring lines from both sides of the well were secured to the craft. An additional line was secured to the center of the bow. Throughout the mooring and alignment procedures, these lines were manually operated. The ability of the craft to maintain a particular station was very good. No radical attitude changes were noted. Sea conditions were calm.

The time from the initial elevator lifting to when the LACV-30 cleared the water was approximately 44 minutes. During this time, two divers conducted five alignment checks. Each check usually following a cycle in which the platform had been elevated another 6-12 in. Above surface alignment was facilitated with markings on the elevator bulkhead which corresponded to the craft's landing pads.

A subsequent inspection revealed that the landing pads were about 1½ in. aft of the most forward possible resting position. This gap would have prevented the reinstallation of the removable sides to the pad platforms which had been taken off prior to the lift. The alignment procedures and diver involvement might have been significantly reduced if the platforms had been made larger. This would permit a greater latitude for alignment. Such a procedure appears to be feasible considering the physical characteristics of the craft and adapter frame.

Once the proper alignment had been confirmed, the LACV-30 was lifted to the upper deck. Transporter movement from the elevator platform to its designated stowage point was accomplished without incident. Lines were attached to the LACV's skirts and they were lifted to allow the transporter to exit from beneath them without causing damage.

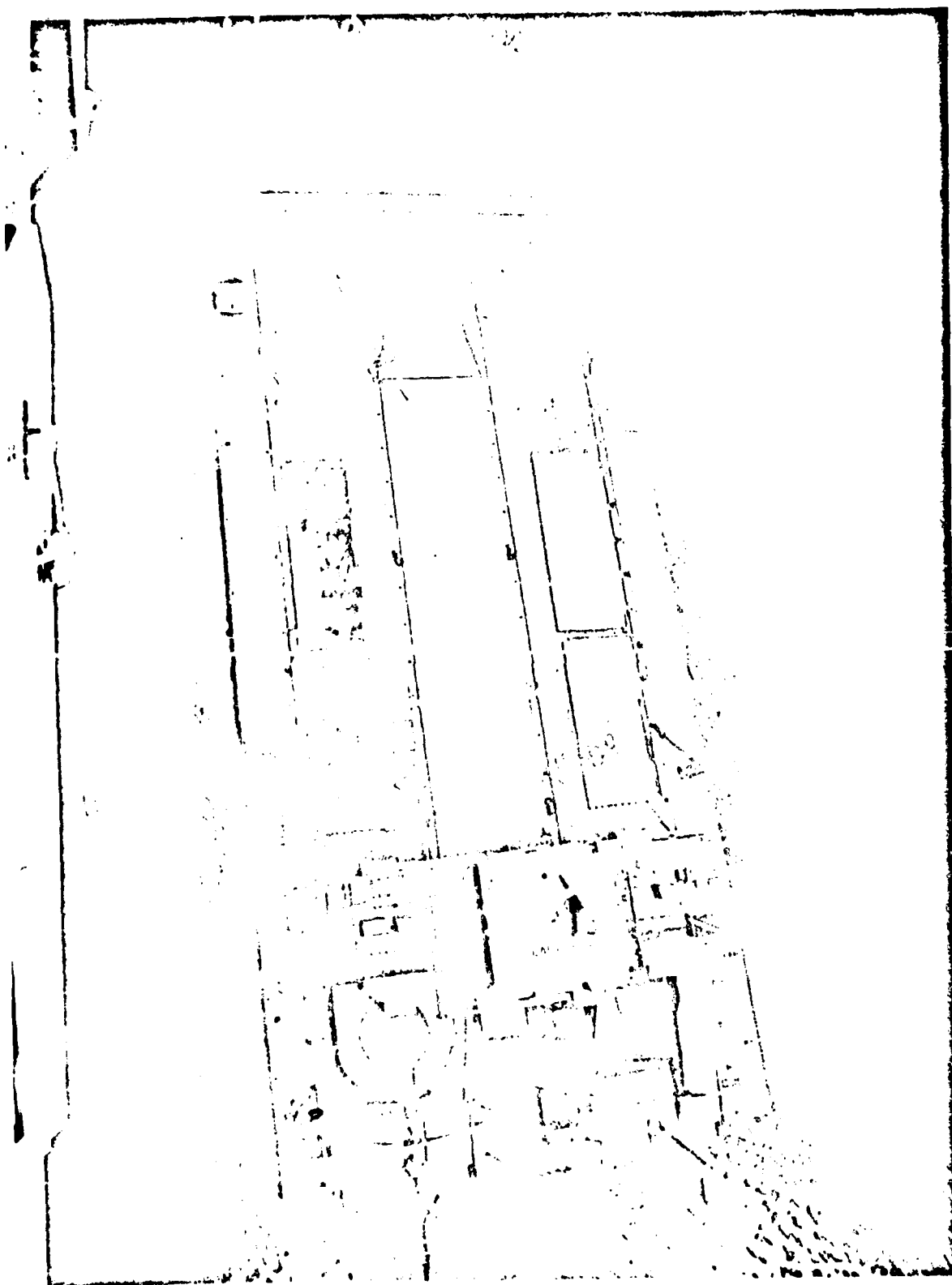


FIGURE A.10. LACV-30 IN SEABEE ELEVATOR WELL

## LASHING AND DUNNAGE

All equipment was secured as for an ocean voyage by contract stevedores. Lashing was standard with wire ropes, shackles, and turnbuckles. No problems were encountered using existing shipboard facilities. In some situations, it appeared that too many lashing points were used. In the case of the 1646-class LCU, both the craft and the adapter frames were independently lashed to the upper deck.

All of the container adapter frames remained in place when they were submerged during the loading cycles. Lashing procedures seemed adequate, but untested in view of the fact that sea affects were negligible in the harbor.

None of the equipment required extensive shoring. Some chocks and wedges were placed on the equipment to increase its stability.

For the later TCDF lift, a considerable number of 4 in. by 6 in. timbers was loaded aboard to further modify the LCU and causeway adapter frames as they became available during subsequent debarkation operations. These new modifications were required to permit another attempt to test lift the TCDF after the debarkation phase had been completed. These changes are discussed later in this report.

## APPENDIX B

### UNLOADING OPERATIONS

#### LACV-30 AND 1466-CLASS LCU

Both of these items were moved aft onto the elevator platform without incident. The LCU was on the starboard side, the LACV-30 on the port. The LACV-30 adapter frame was secured to the elevator platform in the same manner as during loading.

The elevator was submerged to the 8-ft level when the LACV-30 floated off the platform. Under its own power, it taxied out of the well and proceeded away from the ship.

Meanwhile the LCU was also afloat but secured to the powered tag lines. The craft had several rope fenders, but none of them were in place over the side. A strong current (about 2 knots) was moving under the ship and out of the well. While the craft was secured, it struck various portions of the elevator bulkheads. Of particular concern was the stern anchor of the craft striking the forward bulkhead of the well. After about 10 minutes in this situation an Army tug secured a line to the bow of the LCU and towed it out without further incident.

#### CAUSEWAY

Lashing equipment was removed from the causeway adapter frames and the causeway was transported without incident onto the elevator platform on the starboard side.

Once on the elevator, Navy personnel lashed the frames to the platforms. Instead of the wire rope and turnbuckle arrangement that was used during embarkation, they secured the frames with Peck & Hale lashings, a quick release device. The same D rings (two per side per adapter) were used as before.

It took the elevator approximately 10 minutes to lower the causeway from the main deck to a floating status. The elevator continued to lower to its maximum depth. At this point, one LCM-6 tender boat entered the well and secured two lines to the causeway. As this was accomplished the aft adapter frame came loose on the starboard side. It floated up and made contact with the underside of the causeway. A second LCM-6 tender boat attached a line to the causeway and together with the other boat quickly pulled the causeway from the well. At this point the starboard side of the adapter was afloat while the port side was still secured. During this time sea swells were entering into the well causing considerable motion to the floating half of the frame.

As the elevator was lifted, the entire adapter floated free. The prevailing current began to push the adapter out of the well. However, it grounded out on the lifting elevator. As the adapter cleared the water, it was misaligned on the support pedestals and overhanging the aft edge of the elevator by 6½ ft.

Powered taglines were then attached to the loose adapter and the elevator was again submerged. With the aid of the lines and a LCM-6 tender boat, the adapter was properly realigned. The elevator was lifted and the adapters transported to their designated stowage points on the upper deck without further incident.

A subsequent examination revealed considerable structural damage to the Peck & Hale tie-downs. Evidently one of the latching devices became untied and parted. The additional stresses this caused could not be withheld by the other lashings and they, in turn, parted.

#### 1646-CLASS LCU

The craft was transported from its stowage point on the upper deck to the elevator platform without incident. Navy personnel then spent 1 3/4 hr securing the adapter frames to the platform. Eight tie-downs were placed on each adapter. In addition to the two D rings on each side of each adapter, lashing points were established on each side of each end of the adapters. Wire straps were looped around the support pedestals. These were shackled to 4 ft heavy duty turnbuckles which, in turn, were shackled to the adapters. Also, powered tag lines were secured to both sides of the LCU.

Once the lashing was completed, the LCU was lowered into the water until it floated off the adapters. Under its own power, the LCU moved out of the well without incident. Both of the adapter frames remained tightly secured to the elevator when it was submerged.

## LCM-8 AND LARC-LX

Both of these items were moved from their lower deck stowage points to the elevator. The LCM-8 movement by transporter was routine. The LARC-LX again was able to drive itself over the raised deck cover and did so without incident.

Lashing operations for the LCM-8, which took 1.2 hr for the adapter, included installing wire rope and turnbuckles at six points. Two were on each end and one on each side. Neither the LCM-8 nor the LARC-LX had any mooring lines attached. The LARC-LX did not require any lashing.

As the elevator submerged, both the LCM-8 and the LARC-LX began to float at approximately the same time. Less than one minute after they became buoyant, both backed out of the well at the same time.

As the elevator was lifted the LCM-8 adapter broke loose at one lashing point and became misaligned with the support pedestals. Several attempts were made to correct the alignment by refloating the adapter and lifting the elevator when the adapter appeared to line up. These attempts failed. During this period, a heavy thunder storm was in progress. After both positioning winch lines had been attached, the adapter was realigned. Approximately 45 minutes were spent in correcting this situation. Once aligned to the support pedestals, the adapter was lifted and transported to its designated stowage point without incident.

Subsequent investigations revealed that one of the wire loops around the support pedestal had become loose and parted. Other loops, although not parted, were also found loose. The method of fastening these loops was with wire rope clips. As a rule, two were used. Essentially these clips are U-bolts (through which the wire ends are overlapped) and caps. These bolts evidently had not been tightened enough. The Army crews were using adjustable wrenches to tighten the nuts, and evidently did not tighten them satisfactorily.

## SEABEE BARGES

These items were scheduled to be off-loaded and back-loaded if time permitted. However, due to the lateness of the day and the unfavorable weather conditions, debarkation operations were concluded.

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