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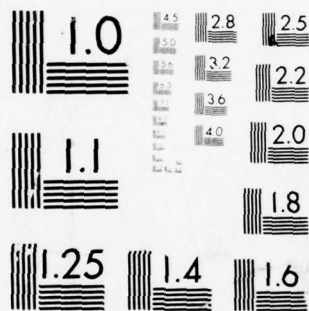
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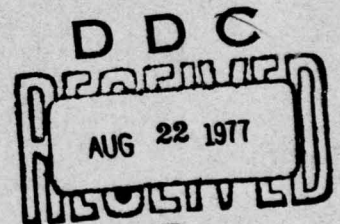
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MTMC REPORT TR 75-9

TECHNICAL REPORT

**STACKING VEHICLES
IN LASH AND SEABEE BARGES**

DECEMBER 1976



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TRANSPORTATION ENGINEERING AGENCY
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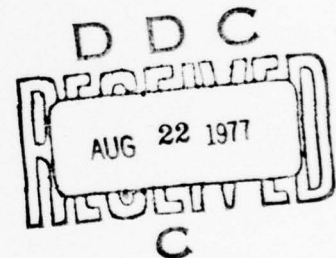
TECHNICAL REPORT

STACKING VEHICLES IN LASH
AND SEABEE BARGES

DECEMBER 1976

By

V. C. Taylor



MILITARY TRAFFIC MANAGEMENT COMMAND
TRANSPORTATION ENGINEERING AGENCY
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I. EXECUTIVE SUMMARY

1. OBJECTIVE. To study the methods employed by US Army depots for tiering vehicles for warehouse storage, and to determine the feasibility of utilizing the same methods to transport military vehicles in LASH and SEABEE barges.
2. SCOPE. Check and compare multilayer stowage methods to determine the most efficient and economical procedures for transporting military vehicles aboard LASH lighters and SEABEE barges.
3. APPROACH. At the time of publication, shipping costs for barge-ship movement of military cargo are based on commodity rates or freight all kinds (FAK) rates. The rate structure is such that only one rate may be offered on particular routes whereas there may be a choice of rates on other routes. In the latter cases, the Military Sealift Command determines the most advantageous tariff arrangement. During contingencies it is possible that unit barge rates may be negotiated to supplant the existing measurement ton rates. In that case maximum cube utilization would provide for maximum utilization of shipping resources and would in all probability be most cost effective. In light of this potential for cost savings, a study was made to determine the feasibility of multilayer stacking vehicles for shipment in LASH lighters and SEABEE barges. The "bundling/nesting" method of vehicle stowage, a possible alternative to multilayer stacking for certain types of vehicles, was not considered in this study.

The original idea was to study the storage system employed in Army depots for tiering vehicles, and apply it to multilayering vehicles in LASH lighters and SEABEE barges. However, when a review of drawings and photographs of cantilever storage racks from Red River and Tobyhanna Army Depots indicated this method to be unsatisfactory for shipping vehicles in sea barges, other feasible methods were explored. Three possible ways to false deck barges for shipment of vehicles were identified: (a) False decking kits commercially available from the respective barge manufacturers may be used. A modification for SEABEE barges has been developed by the Lykes Brothers Steamship Company. A kit for the LASH lighter is available that utilizes cross beams with prefabricated metal covers placed over the top of the cross beams; (b) Wood can be used to construct a false deck that fits the vehicular cargo; (c) A false deck can be assembled using adjustable commercial storage racks.

4. CONCLUSIONS. The following conclusions were determined from the analysis of the study:

a. Multilayering military vehicles in sea barges is economically feasible under certain charter conditions and must be determined on a case-by-case basis.

b. Barges, when converted or modified by the owner to accommodate false decking, are the most advantageous for the Government.

c. False decking barges with wood rather than with metal is more desirable from an economical standpoint, especially for occasional shipments.

d. Smaller and lighter vehicles have the greatest potential for cost savings per unit.

5. RECOMMENDATIONS. The following recommendations should be considered for shipping military vehicles.

a. Barges modified or converted by the owners to accommodate false decking be chartered by the Government to ship vehicles, whenever economically justified.

b. Wood be utilized to false-deck barges for occasional or one-time shipments.

c. If a plan can be established for the shipment of a large volume of vehicles, an adjustable metal rack system be utilized.

II. INTRODUCTION

1. BACKGROUND. With the present trend of American shipping companies converting from break-bulk to container ships, it is anticipated that the role of barge-carrying vessels in military logistics will increase. Break-bulk cargo and most military equipment can be accommodated in the barges and lighters inherent to barge-carrying ship systems. The large hatch openings in the LASH lighters and SEABEE barges allow easy access to the decks, and permit vehicles to be loaded and positioned with optimum efficiency. One major problem encountered in using LASH and SEABEE barges is the poor cube-utilization factor experienced due to the lack of vehicle cargo build-up in the vertical direction.

2. RATES FOR LASH LIGHTERS AND SEABEE BARGES. Shipping company services are usually booked by the local Military Sealift Command (MSC) office and are selected by the low-cost carrier method. Military cargo rates are established by measurement ton (MTON) (40 cubic feet) or freight all kinds (FAK) barge capacity multiplied by a rate for the route.

When FAK rates are applicable or if it becomes necessary to lease barges for exclusive use by the Government, the situation may become economically advantageous for the military to maximize space utilization.

III. BARGE-SHIP SYSTEMS

1. BARGE SHIPS. There are two barge-carrying ship systems - LASH and SEABEE. Each system has two primary components: a mother ship and a family of lighters or barges, both commonly called barges. Both ships can load or discharge their barges by using lifting devices at the stern in either an offshore anchorage or an established port. SEABEE barges and LASH lighters are compatible with worldwide inland waterway systems.

2. LASH SYSTEM. LASH is an acronym for "lighter aboard ship." Although there are minor variations in the ships and lighters of the different carriers, all are basically similar. Five different shipping companies under the US Flag use the LASH lighter system. The companies are as follows:

| <u>Name of Shipping Company</u> | <u>Number of Mother Ships</u> | <u>Maximum Number of Lighters Carried by Mother Ship</u> | <u>Ship Classification</u> |
|-------------------------------------|-----------------------------------|--|--------------------------------|
| Waterman | 3 | 89 | C9 |
| Central Gulf | 3 | 89 | C9 |
| Delta | 3 | 89 | C9 |
| Pacific Far East | 6 | 62 | C8 |
| Prudential | 5 | 62 | C8 |

The C8 LASH mother ship is 820 feet long and 100 feet wide. The C9 LASH mother ship is 893 feet long and 100 feet wide. The LASH carries 62 to 89 lighters plus some containers equating to 25,000 to 40,000 measurement tons of cargo volume, depending upon the utilization factors of cargo stowage and hull size. All LASH ships are equipped with a 500-long ton (LTON) gantry crane to lift the lighters. The crane travels on rails the entire length of the ship. It picks up a lighter at the stern, travels towards the bow of the ship, and stows the lighter transversely in a vertical stack in the holds. When the stack of lighters reaches the weather deck level, the hatch covers are positioned by the crane, and one or two more lighters or containers may be stowed on the hatch cover. One of the outstanding features of the LASH system is that all lighters have the interchangeability of being loaded/unloaded and transported by any available mother ship.

3. SEABEE SYSTEM. SEABEE is a short title for sea barge. The SEABEE mother ship is the larger of the barge-carrying ships. There is only one shipping company that operates the SEABEE system.

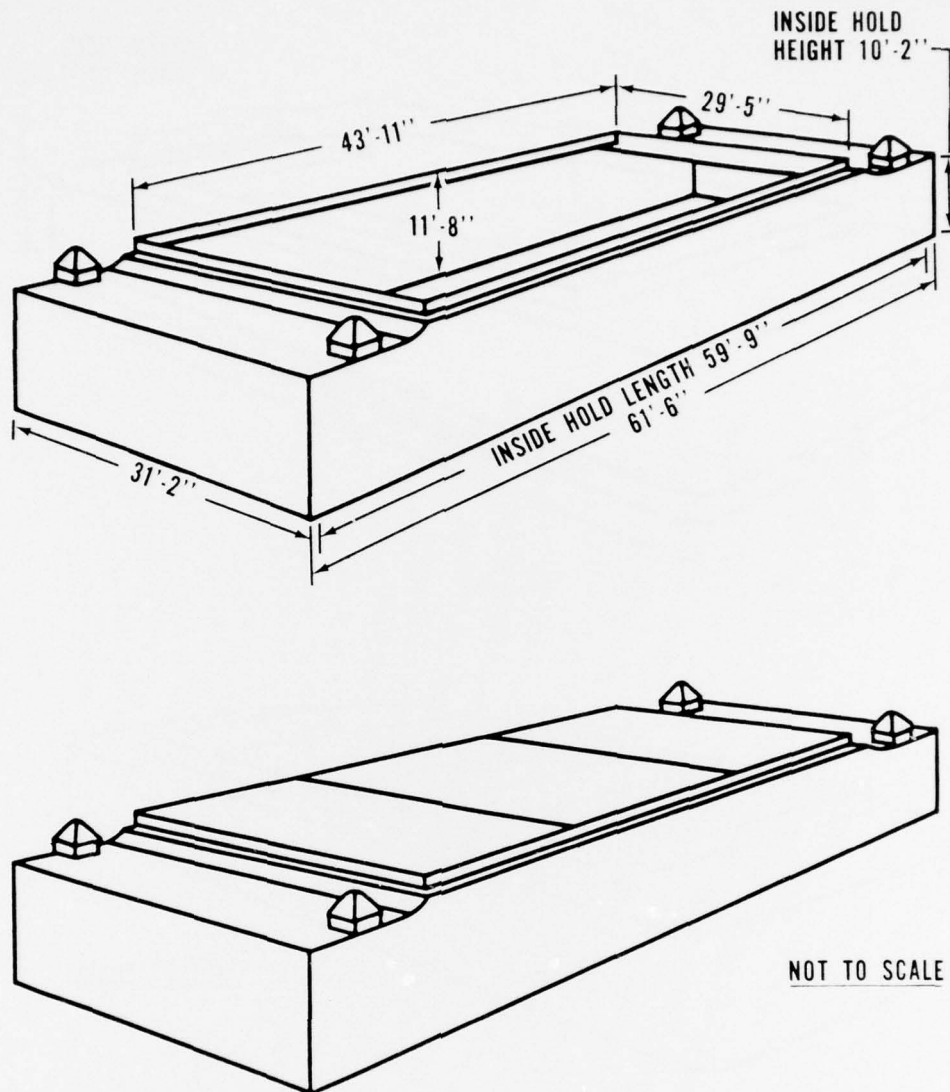
| <u>Name of Shipping Company</u> | <u>Number of Mother Ships</u> | <u>Number of Barges Carried by Mother Ship</u> | <u>Ship Classification</u> |
|---------------------------------|-------------------------------|--|----------------------------|
| Lykes Brothers | 3 | 38 | C8 |

The SEABEE mother ship is 874 feet long and 106 feet wide. The SEABEE carries up to 38 barges equating to 38,000 measurement tons of cargo stowage volume. The barges are stowed longitudinally on three decks; 12 each on the main and lower decks and 14 on the upper deck. A unique feature of the SEABEE ship is the 2,000-LTON-capacity submersible stern elevator that is capable of lifting or lowering two fully loaded barges simultaneously.

IV. LIGHTERS AND BARGES

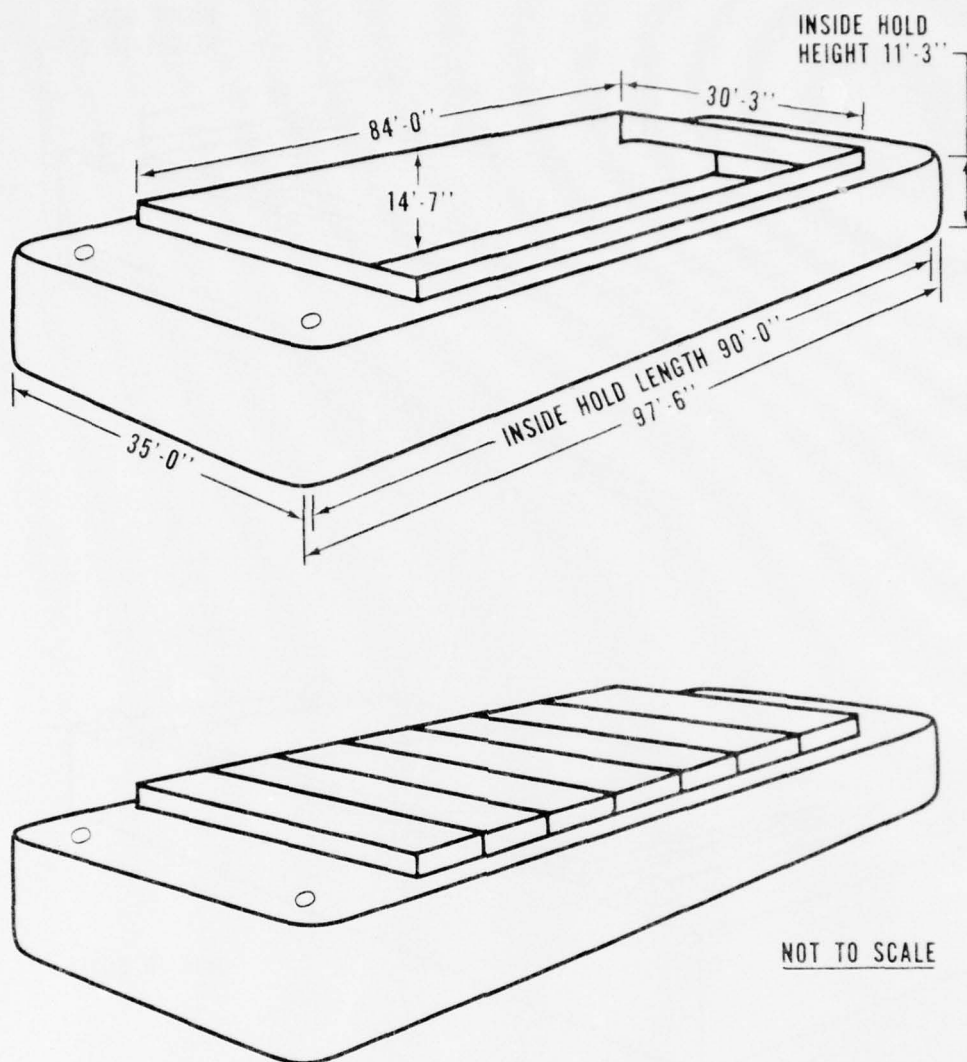
1. LASH LIGHTER CHARACTERISTICS. LASH lighters are essentially floating ship holds. They are rectangular in shape, approximately 61.5 feet long by 31 feet wide, normally with double-skinned metal hulls, and removable hatch covers (Figure 1). Most are of steel construction, but some are of fiberglass and some are of steel with only the hatches fiberglass. The steel inner hull is not watertight, and a hole in the outer hull could result in a flooded cargo compartment. The lighter can carry up to 369 LTON of cargo at a maximum draft of 8 feet 7 inches, but most cargo loads of average density draw only 5 or 6 feet.

2. SEABEE BARGE CHARACTERISTICS. The SEABEE barges are rectangular in shape, approximately 97.5 feet long by 35 feet wide, and are constructed with a double hull. Each barge has seven watertight metal hatch cover panels that weigh approximately 5,800 pounds each and require a crane for emplacement and removal (Figure 2). The SEABEE barge is the same width and one-half the length of the standard US commercial river barge. It has approximately twice the cargo-carrying capacity of the LASH lighter.



HATCH PANELS: 3 EA, APPROX 6000 LB PER PANEL
CARGO CAPACITY: 369 LTON/19500 CU FT/490 MTON
EMPTY DRAFT: 2'-1/2"
FULLY LOADED DRAFT: 8'-7"
LIGHTER EMPTY WEIGHT: 80 LTON

Figure 1. LASH Lighter Characteristics (Prudential).



HATCH PANELS: 7 EA, APPROX 5800 LB PER PANEL
CARGO CAPACITY: 834 LTON/39140 CU FT/978.5 MTON
EMPTY DRAFT: 1'-9"
FULLY LOADED DRAFT: 10'-7"
LIGHTWEIGHT BARGE: 150 LTON

Figure 2. SEABEE Barge Characteristics.

V. VEHICLE STACKING METHODS

1. VEHICLE ASSESSMENT. After an assessment of dimensional characteristics of the LASH lighters and SEABEE barges, a review of TB 55-46-1 was made to determine which military vehicles had dimensional characteristics suitable for multilayer stacking. A list was compiled by table of equipment (TOE) number with the major factor of consideration being the minimum reduced height of the vehicle (Table 1). From this list, loading plans were developed for both barges.

TABLE 1
VEHICLES CONSIDERED FOR STACKING

| TOE Index No. | Vehicle Description ^{a/} | Model | Length | Width | Height | Weight (lbs) |
|------------------|-----------------------------------|-----------|--------|-------|--------------------|-----------------|
| W95400 | Trailer, Cargo, 1/4-Ton | M416 | 108.5 | 61.5 | 44.0 | 580 |
| W95537 | Trailer, Cargo, 3/4-Ton | M101A1 | 147.0 | 73.5 | 50.0 | 1,350 |
| W95811 | Trailer, Cargo, 1-1/2-Ton | M105A2 | 166.0 | 83.0 | 55.0 | 2,670 |
| W98619 | Trailer, Cargo, 3/4-Ton | M709 | 114.0 | 52.0 | 42.0 | 750 |
| W98825 | Trailer, Tank, Water | M107A2 | 162.0 | 82.0 | 76.3 ^{b/} | 2,040 |
| X38365 | Truck, Ambulance | 4L | 156.5 | 78.1 | 83.8 | 3,700 |
| X38369 | Truck, Ambulance, 1/4-Ton | M718 | 143.4 | 65.0 | 52.3 | 2,615 |
| X38369 | Truck, Ambulance, 1/4-Ton | M170 | 155.0 | 60.5 | 56.3 | 2,963 |
| X38961 | Truck, Ambulance, 1-1/4-Ton | M792 | 226.0 | 84.0 | 65.0 | 7,620 |
| X39598 | Truck, Cargo, 1/4- - 3/4-Ton | 4800GVW | 190.0 | 78.9 | 71.5 ^{b/} | 3,590 |
| X39735 | Truck, Cargo, 3/4-Ton | M37B1 | 185.5 | 75.3 | 64.5 | 5,660 |
| X39872 | Truck, Cargo, 3/4-Ton | M37B1WWN | 190.3 | 75.3 | 64.5 | 5,800 |
| X39877 | Truck, Cargo, 1-Ton | 7000GVW | 206.1 | 79.9 | 70.8 ^{b/} | 4,140 |
| X39883 | Truck, Cargo, 1-1/4-Ton | M715 | 210.3 | 85.3 | 59.3 | 5,460 |
| X39906 | Truck, Cargo, 1-1/4-Ton | M715WWN | 220.5 | 85.3 | 59.3 | 5,880 |
| X39940 | Truck, Cargo, 1-1/4-Ton | M561WWN | 231.1 | 85.3 | 67.5 | 7,480 |
| X40009 | Truck, Cargo, 2-1/2-Ton | M35A2 | 264.8 | 96.5 | 81.3 ^{b/} | 13,060 |
| X40077 | Truck, Cargo, 2-1/2-Ton | M35A2C | 264.8 | 96.5 | 81.3 ^{b/} | 13,070 |
| X40146 | Truck, Cargo, 2-1/2-Ton | M35A2WWN | 278.5 | 96.5 | 81.3 ^{b/} | 13,700 |
| X40214 | Truck, Cargo, 2-1/2-Ton | M35A2CWWN | 278.5 | 96.5 | 81.3 ^{b/} | 13,700 |
| X40283 | Truck, Cargo, 2-1/2-Ton | M36A2 | 329.0 | 95.0 | 80.5 ^{b/} | 14,760 |
| X40420 | Truck, Cargo, 2-1/2-Ton | 36A2WWN | 342.5 | 95.0 | 80.5 ^{b/} | 15,110 |
| X42064 | Truck, Carryall, 1/2-Ton | 4500GVW | 167.8 | 77.3 | 76.4 ^{b/} | 3,235 |
| X60833 | Truck, Utility, 1/4-Ton | M151A2 | 131.0 | 64.3 | 52.5 | 2,400 |
| X60833 | Truck, Utility, 1/4-Ton | M38 | 134.9 | 62.3 | 55.3 | 2,750 |
| X60970 | Truck, Utility, 1/4-Ton | M38WWN | 133.0 | 62.0 | 55.0 | 2,835 |
| X61244 | Truck, Utility, 1/4-Ton | M151A1C | 131.3 | 63.3 | 52.4 | 2,460 |
| X61381 | Truck, Utility, 1/4-Ton | M38A1D | 134.8 | 64.0 | 56.5 | 2,940 |

^{a/} All vehicles are reduced to minimum dimensions in accordance with AR 220-10.
^{b/} SEABEE only.

2. METHODS CONSIDERED. Based on the list of vehicles and barge loading plans, four vehicle stacking methods were considered:

- a. Shipbuilder's false decking in the LASH lighter and SEABEE barge.
- b. Storage racks used for tiering vehicles in warehouses at Army depots.

- c. False decking with standard commercial storage racks.
- d. Building wooden false decking in the barges.

3. SHIPBUILDER'S FALSE DECKING OF SEABEE BARGES AND LASH LIGHTERS. The Lykes Brothers SEABEE barge provides the capability of installing and removing a semifalse deck. This is accomplished by installing a series of removable steel beams thwartship of the barge at approximately 8-foot intervals and at a height of 5 feet 7 inches above the bottom cargo deck. The beams are suspended in place by locking them into a series of sockets built into the wall of the barge. The use of this tween deck arrangement permits cargo of moderate height to be loaded on two levels and the mixing of cargo for better cube utilization. This system was developed primarily as a container platform for shipping vehicles on the barge bottom cargo deck and containerized cargo above. Wheeled equipment may be transported on two levels by utilizing the removable tween deck for vehicle stowage. However, the tween deck will require additional false decking across the beams to accommodate an all-vehicular load. Vehicles reducible to 67 inches or less may be stowed on the barge deck beneath the converted container platform or tween deck. Included in this group are most 1/4-ton trucks and certain 3/4- and 1-1/4-ton trucks. Vehicles reducible to 96 inches or less may be stowed on the converted container platform or tween deck. Use of the bilevel stowage arrangement substantially increases the capacity of the SEABEE barge for certain vehicular cargo.

Assuming that the barge charter or rental cost will be the same with or without the tween deck conversion, this is probably the most economically advantageous method for the Government to ship military vehicles because the maintenance and storage of the tween deck conversion kit would be the responsibility of the shipping company. Unfortunately there are only three barges modified for the tween deck conversion. The Lykes Brothers management was queried regarding the likelihood of future modifications to existing barges. Their reply was that they have no plans in this respect for the foreseeable future since the modification cost of \$28,000 per barge is not an economically feasible investment for the shipping company.

MacGregor-Comarain, Inc., has designed a prototype conversion kit that can be utilized for false decking LASH lighters. The kit consists of six upright posts and three cross beams along with ten hatch cover sections. Two upright posts (6-feet high) and a cross beam (28-feet long) are placed at each end of the lighter. The third cross beam and two upright posts are installed in the center of the lighter. This arrangement provides the substructure to support the hatch cover sections. The ten hatch cover sections (15 feet long by 5.7 feet wide) are placed lengthwise inside the lighter to form the false deck. This method of false decking LASH lighters

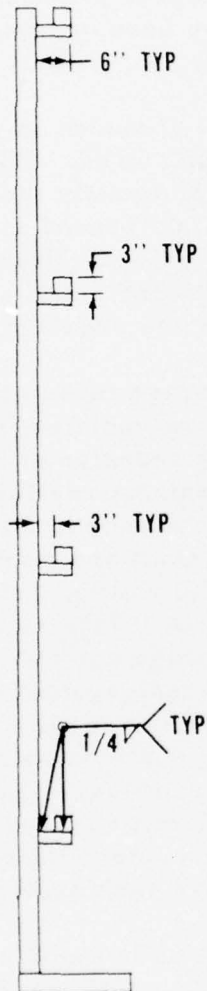
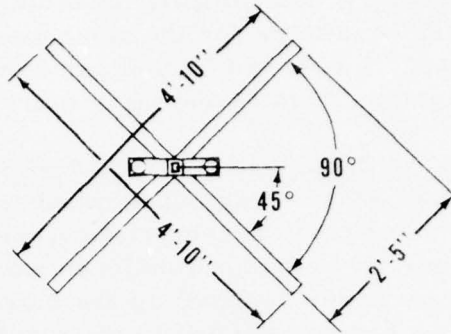
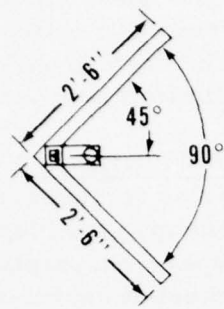
is probably the most economically advantageous to the Government under certain charter conditions for the same reasons previously stated for the SEABEE barge. A cost of \$33,000 per conversion kit may prohibit the shipping companies from investing in more than a limited number.

4. VEHICLE STORAGE IN WAREHOUSES AND ARMY DEPOTS. Present Army policy demands storage of most wheeled vehicles in covered facilities. Because of dimensional characteristics, vehicles occupy considerable floor area, and single tier storage results in excessive space onsumption. In order to achieve space economy in the storage of wheeled vehicles, steps have been taken to tier vehicles to the maximum degree practicable. In support of this policy, equipment and methods have been designed for stacking many types of vehicular equipment.

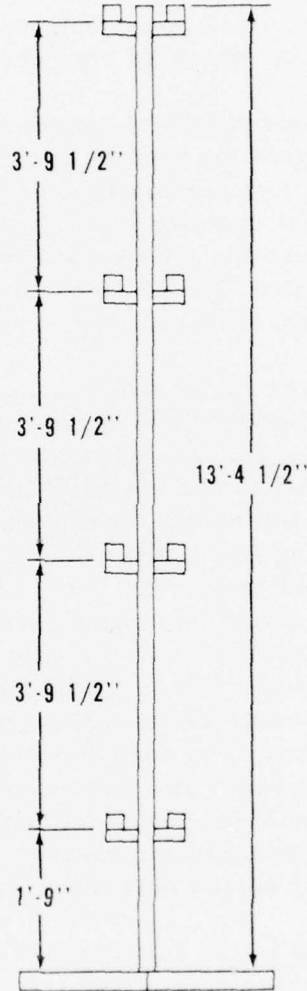
a. Metal tiering equipment consists of racks of stands in varying designs, depending upon the type of equipment to be stored. For tiering two-wheeled trailers and certain types of trucks, an upright member constructed of heavy steel channel or an angle adequately braced at the base is placed at each end of the storage space for the vehicle. Brackets are spaced at proper vertical intervals to support the tiered units. For heavier truck vehicles, different types of supports are required.

b. The cantilever racks that are used for storage in Army depots were analyzed with respect to suitability for stacking vehicles in the LASH lighter or SEABEE barge. Major modifications or redesign of the storage rack would be required to secure adequately the vehicles resting on the cantilever portion of the rack. There must be an awareness that the forces acting on a barge or lighter during ocean transit are more extreme than those encountered in normal river traffic. The rolling motion of the barges in rough seas could be as much as 30 degrees. This rolling motion and tilting effect prohibits use of the cantilever storage rack without modification or redesign. Since the depot storage rack system was not suitable for stacking vehicles in barges, no attempt was made to make a cost analysis for comparison with the other tiering systems being considered for use. Figures 3 and 4 are drawings of cantilever storage racks used for multilayering M416 military trailers, and Figure 5 depicts the vehicles as they are mounted for storage in Army depots. Figure 6 depicts 1/4-ton trucks (jeeps) stored on a cantilever storage rack system.

5. FALSE DECKING LASH LIGHTER WITH WOOD. In the first quarter of Fiscal Yar 1975, there was a requirement to ship 1,055 jeeps to the Middle East. The only available American-flag service to the Red Sea area was Waterman Steamship Company's LASH lighter service. At that time it was determined by Military Traffic Management Command Eastern Area that if a false deck were constructed above the first level of vehicles,



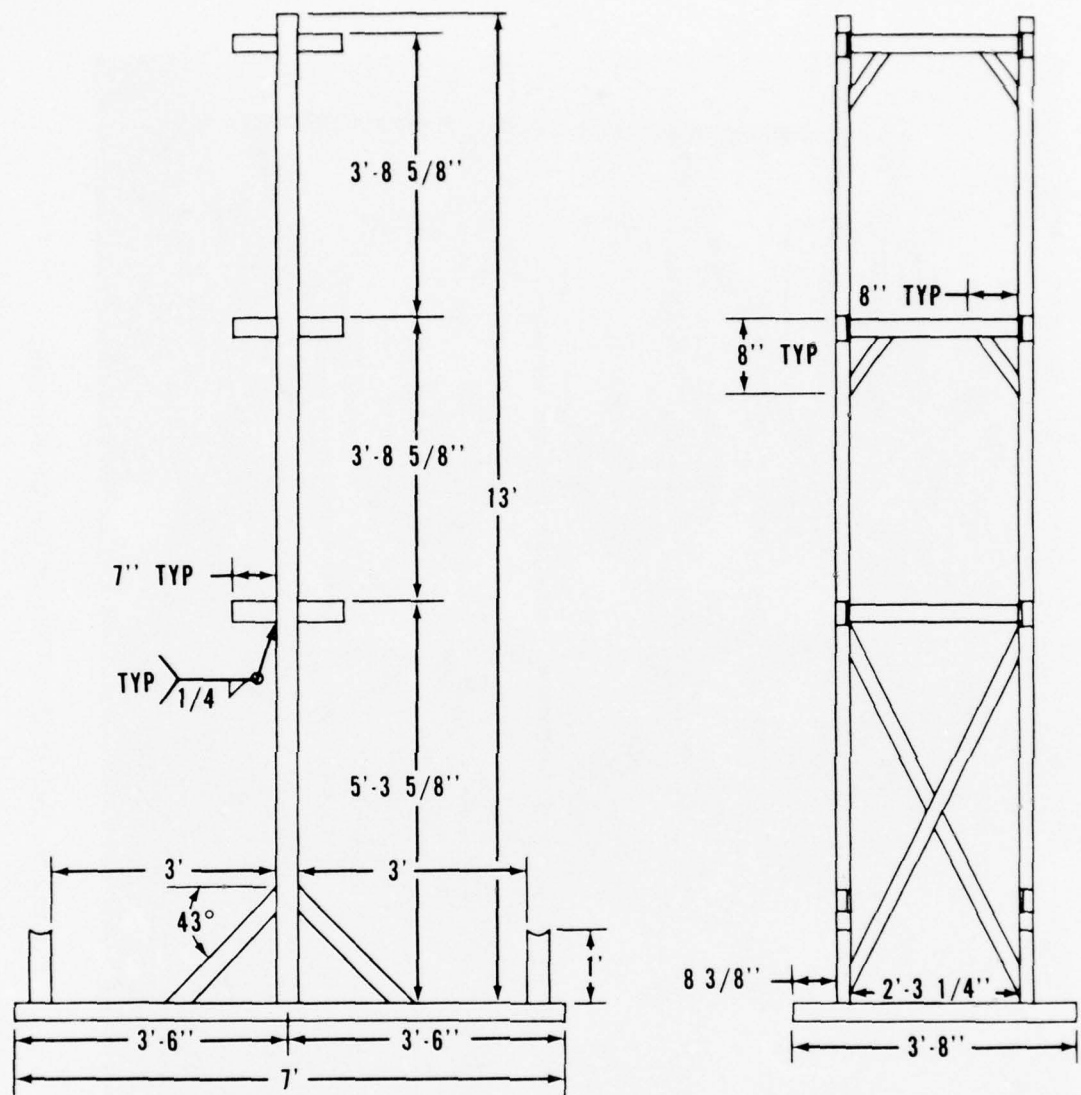
END-FRONT RACK



INTERMEDIATE-FRONT RACK

NOT TO SCALE

Figure 3. Depot Storage Racks for M416 Trailer.



REAR RACK

NOT TO SCALE

Figure 4. Depot Storage Rack for M416 Trailer.

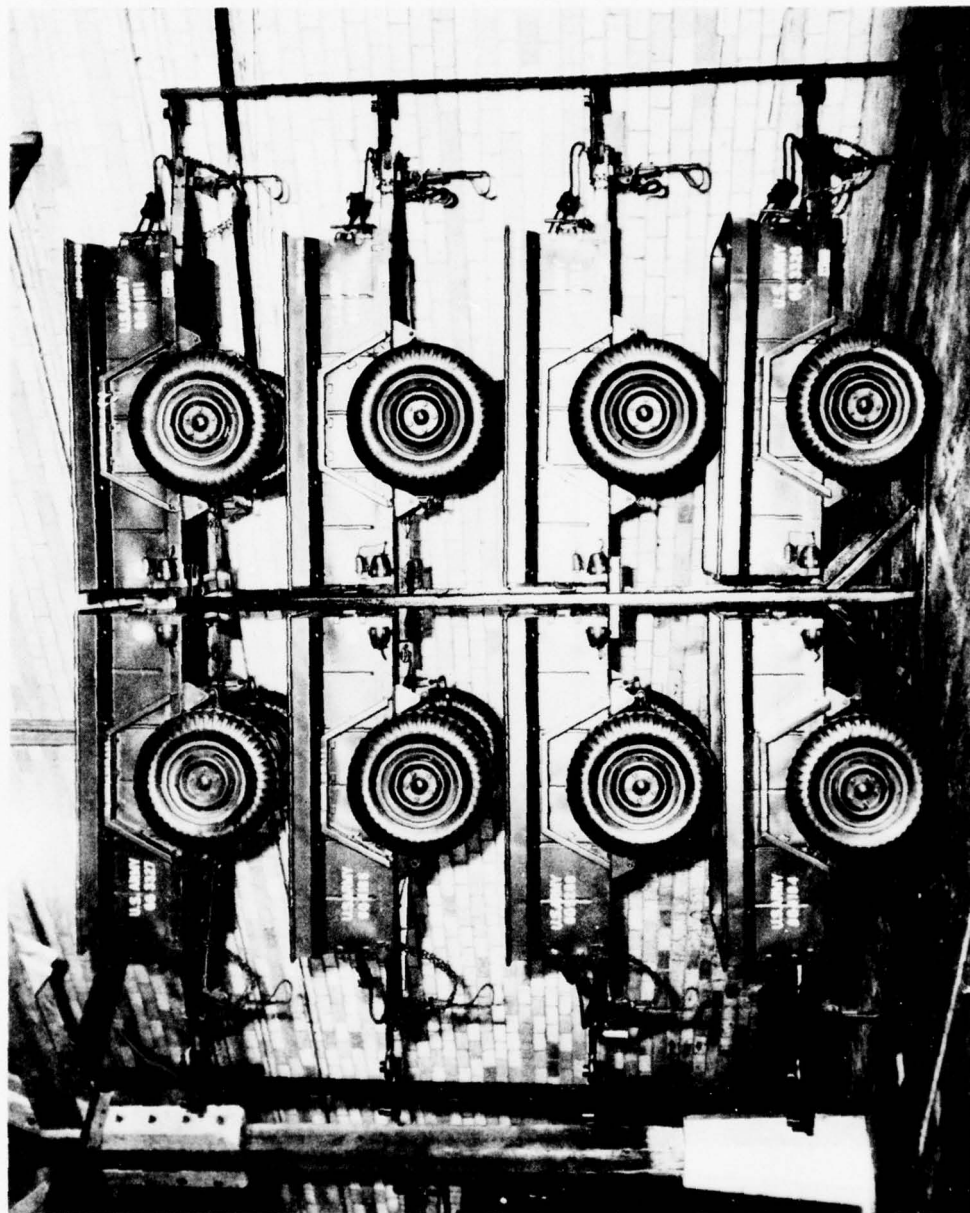


Figure 5. M416 Trailers in Depot Storage.

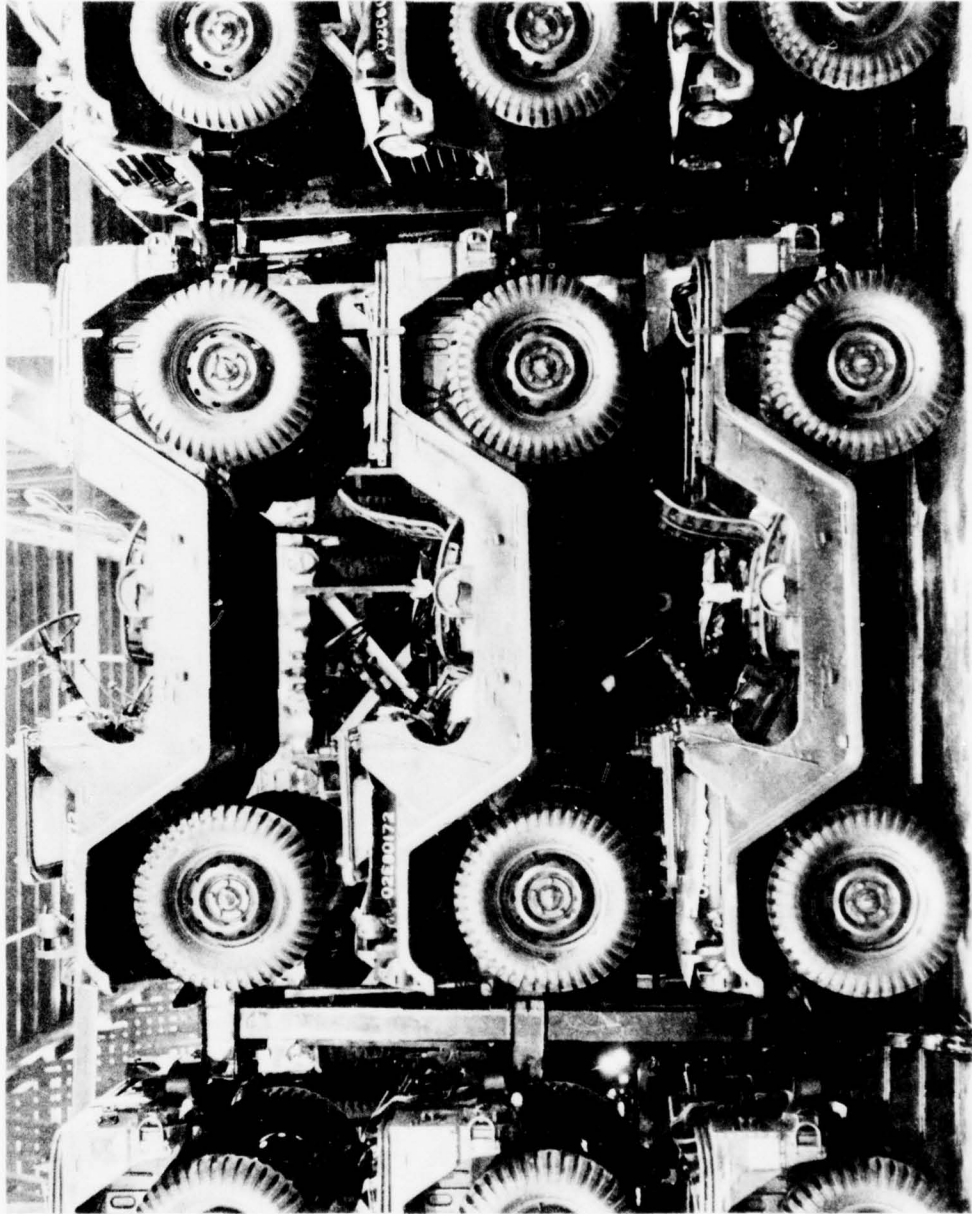


Figure 6. M151 Jeeps in Depot Storage.

the number of vehicles carried in each lighter could be doubled. Assuming the lighter charter cost would remain constant, then twice as many vehicles could be shipped for the original charter cost plus the cost of labor and materials used in the construction of the false deck. The two loading ports involved were Baltimore Outport and Mobile Detachment. Even though all LASH lighters are interchangeable with the mother ships, the designs of the barge interwalls vary between shipping companies, which means false deck erection may be different depending upon barge construction. Materials used to construct the wooden false decks were 4- by 4-inch studs, 2- by 4-inch studs, 2-inch planking, and appropriate size nails. Plywood of sufficient strength was utilized in lieu of planking when the price was favorable. Sills of 4- by 4-inch were placed against the inside edge of a double bulkhead barge (Prudential). Single bulkhead barges (Waterman) do not need sills. Upright 4- by 4-inch studs were toenailed into the baseplate or sill at intervals to form supporting members for the false deck. A 2- by 4-inch top plate was used to secure the supporting studs into position, then 4- by 4-inch beams were installed on top of each of the 4- by 4-inch studs to transversely support the false deck. The beams were extended across the barge to the opposite side with 4- by 4-inch supporting studs at opportune points determined by vehicle size. The 4-inch by 4-inch beams were decked over with 2-inch planking laid in a fore and aft direction. Various types of braces, such as corner, 1-inch, and K-braces, were used to provide strength as required. Figures 7 and 8 show construction of the false deck in progress. Figure 9 depicts a loaded barge ready for covers to be secured for shipment. Wheeled cargo that should be considered in this type of program on false decking to increase cube utilization is light vehicles of a short height dimension, such as jeeps, sedans, 2-wheeled trailers, and so forth.

6. FEATURES OF WOOD DECKING. There is usually an ample supply of lumber readily available in desired sizes at major seaports within CONUS. Southern pine or Douglas-fir is plentiful and makes an excellent building material with a compressive strength range parallel to grain of 1,150 psi to 1,750 psi. Wood can be cut, slotted, and shaped to accommodate vehicular cargo in both LASH lighters and SEABEE barges. Wood used for false decking barges can be manifested to the receiving installation and reused or disposed of as appropriate.

7. METAL STORAGE RACKS - OFF-THE-SHELF ITEMS. Most racks that can be purchased as off-the-shelf items are basically the adjustable type with various height ranges. Safety pins and locking devices, which secure the interlocking members, are offered as optional equipment (Figure 10). There are several different commercially manufactured metal storage racks that have the potential for being used for false decking in LASH lighters and SEABEE barges. Components required to build a false deck consist of upright frames, step stringers, decking, and cross support bars (Figure 11).



Figure 7. Beginning False-Deck Construction in LASH Lighter.

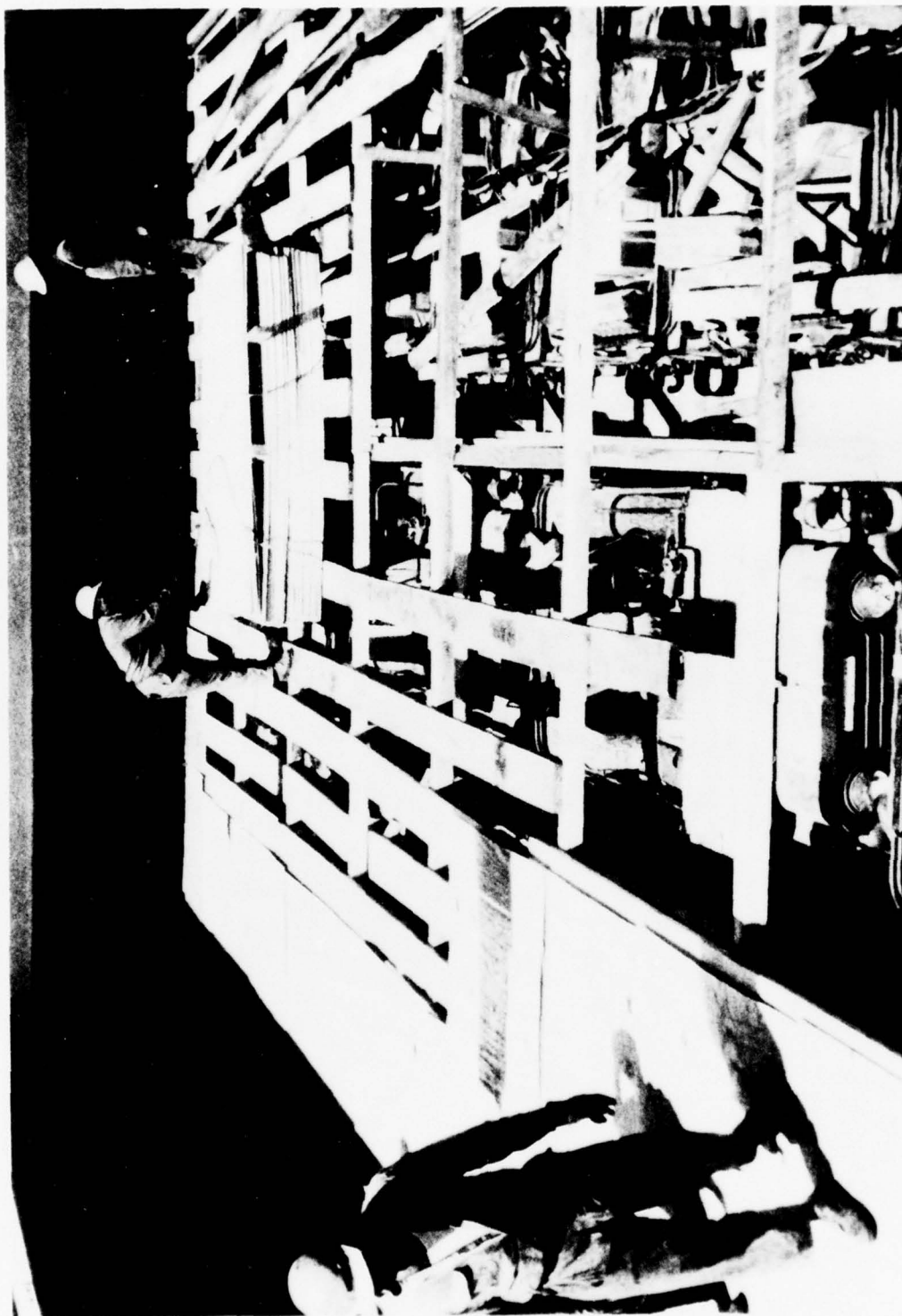


Figure 8. False-Deck Construction in Progress.



Figure 9. M151 Jeeps Loaded on False Deck.

STANDARD RACKS

SERIES 3200

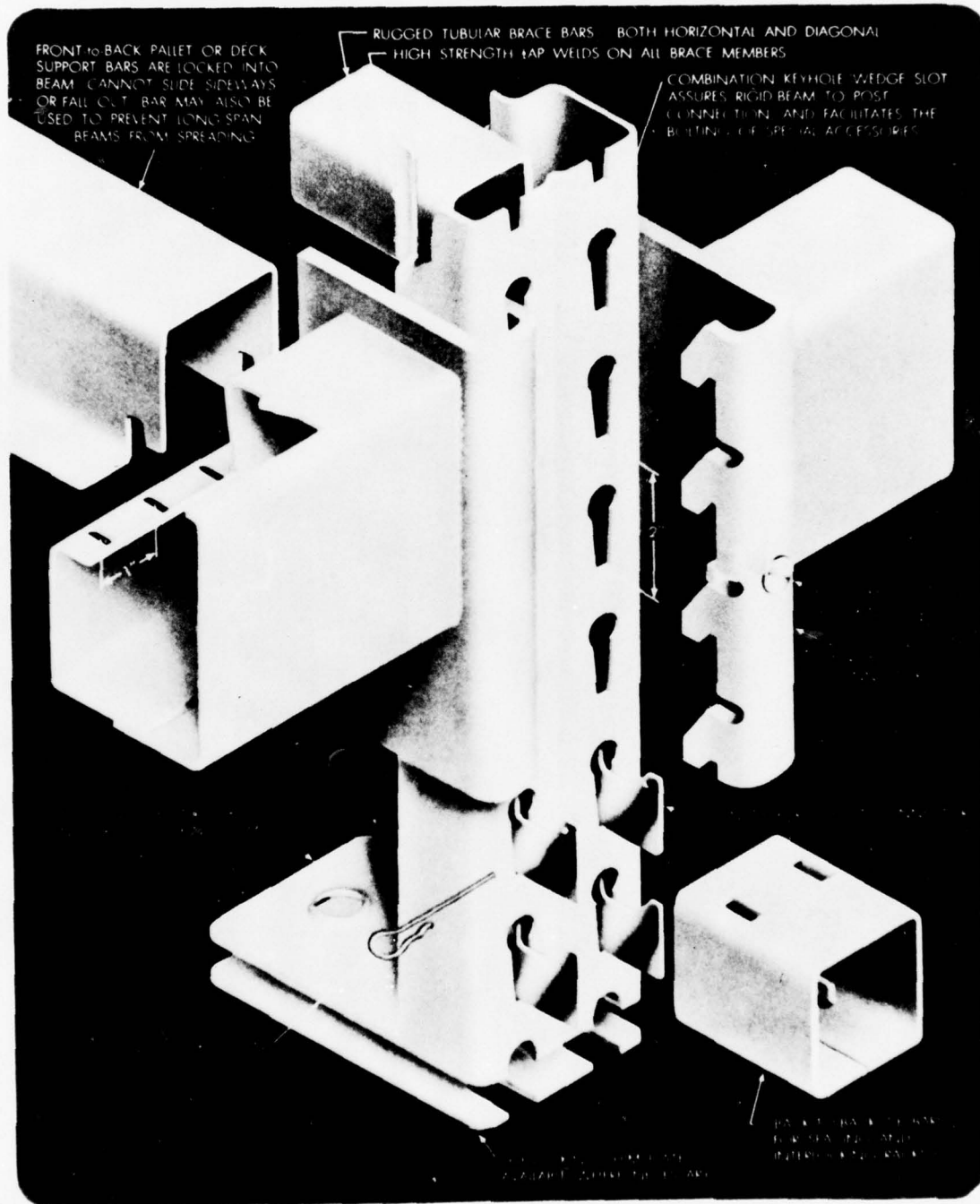
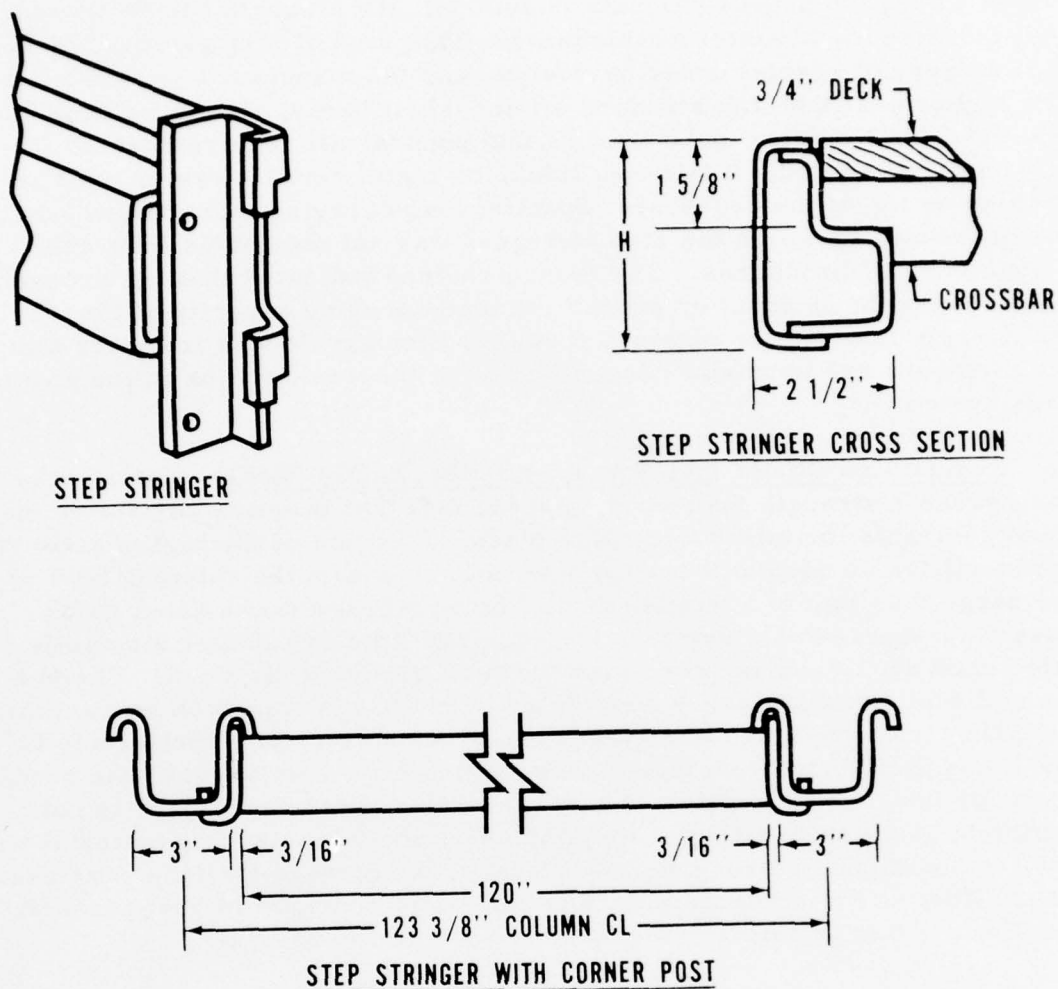


Figure 10. Storage Rack Corner Post.



NOT TO SCALE

Figure 11. Step Stringer Characteristics.

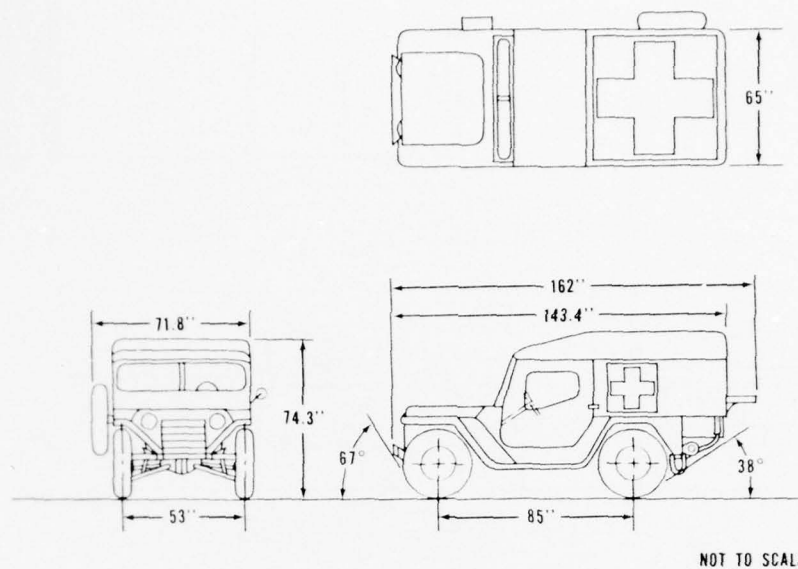
The upright frames serve as corner posts and are available in a height range of 5 to 24 feet in increments of 1 foot. Load-carrying capacity range for the upright frames is 16,000 to 45,000 pounds per pair, depending upon which type of frame is selected.

Step stringers come in 15 different step heights with a range of 3 to 6-1/2 inches and are available in increments of 1/4 inch. Stringers may be selected in 10 different lengths with a range of 4 to 12 feet. The load-carrying capacity is directly proportional to the step height with a load

range of 7,460 to 13,000 pounds per pair. If a load-carrying capacity in excess of 13,000 pounds per pair is desired, the strength can be increased with an increase in material thickness. This type of stringer would be in the category of special order or design, and the manufacturers offer them at a higher cost than the standard off-the-shelf items. It can be concluded that vehicles weighing more than 13,000 pounds will require special stringers. Plywood, 3/4-inches thick, or metal catwalk can be used as decking on top of the crossbar. Specific load-carrying information for the crossbars to match the step stringers was not obtainable from the manufacturers' brochures. The manufacturers indicated that the crossbars are designed to be equal or exceed the load-carrying capacity of the stringers. Information obtained from the rack developers indicates that the stringers are normally considered to be the weakest link in the storage rack system.

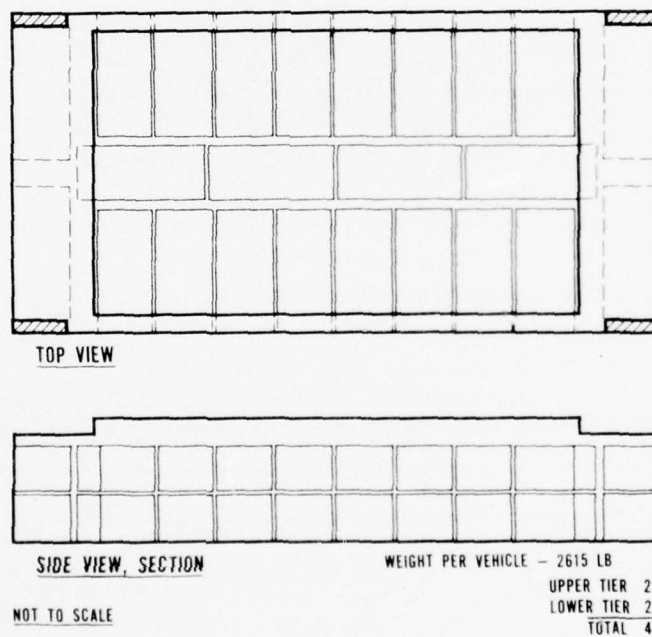
8. FEATURES OF METAL RACKS AS FALSE DECKING. Metal racks have greater strength than wood, and the fact that they are adjustable makes them desirable for mixed vehicular loads. Because of the higher strength, the metal frame deck will occupy less volume within the shipping hold of the barge than that of a wooden deck. Since storage racks are a quick assembly/disassembly system, the required time to build or dismantle a false deck should not be more than the time required for wood. There are some distinct disadvantages associated with the system, such as corrosion resulting from exposure to a salt laden atmosphere. The cost prohibits the racks from being considered as an expendable item, hence, the requirement for inventory records and storage space. If storage space is not available at the destination of the shipment, the false decking material will have to be shipped retrograde to a place where storage facilities are available. Routine maintenance and replacement of damaged or lost parts will also be a factor in determining the total cost of the system.

9. LASH AND SEABEE VEHICLE LOADING PLANS. During the review to determine which military vehicles in the Army inventory had dimensional characteristics suitable for multilayer stacking for shipment in LASH lighters and SEABEE barges (reference Table 1), the overall length, width, and height dimensions, along with the weight of 28 different vehicles, were analyzed. Each vehicular load considered, even when combined with the weight of the false decking, filled the maximum cube capacity of the LASH lighters and SEABEE barges before weight capacity was achieved. The analysis was based on vehicles being in the reduced configuration for shipping. A multilayer loading plan was established for each of the vehicles. Figure 12 shows the overall dimensions of the M718 ambulance, and Figure 13 is the loading plan for this vehicle in the LASH lighter. Figure 14 depicts the dimensions for the M715 cargo truck, and Figure 15 is the loading plan for the M715 in the SEABEE barge. These are representative examples of loading plans that were developed for all 28 vehicles.



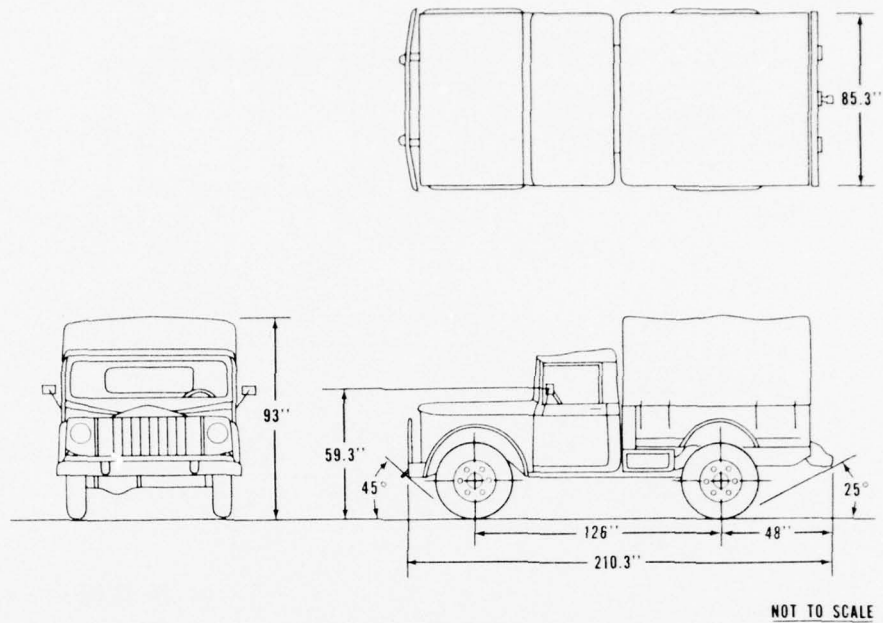
TRUCK, 1/4-TON, AMBULANCE, M718

Figure 12. Envelop Dimensions for M718 Truck.



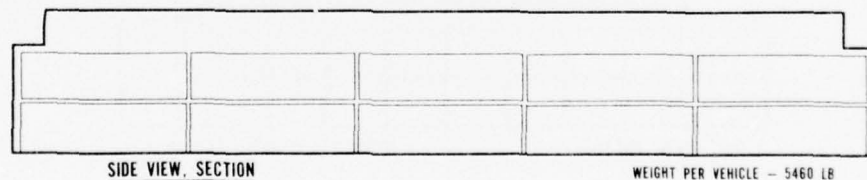
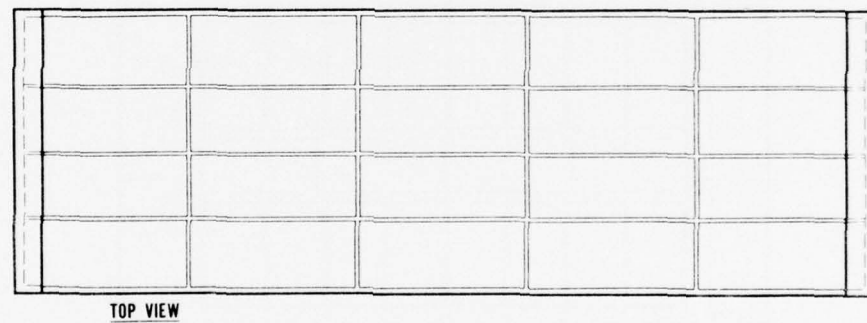
LASH LOADING PLAN, TRUCK, AMBULANCE, 1/4-TON, M718

Figure 13. Sample Loading Plan for LASH Lighter.



TRUCK, 1-1/4-TON, CARGO, M715

Figure 14. Envelop Dimensions for M715 Truck.



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WEIGHT PER VEHICLE - 5460 LB
 UPPER TIER 20
 LOWER TIER 20
 TOTAL 40

SEABEE LOADING PLAN, TRUCK, 1-1/4-TON, M715

Figure 15. Sample Loading Plan for SEABEE Barge.

VI. COST ANALYSIS

1. COST ANALYSIS FOR FALSE DECKING LASH LIGHTER WITH WOOD.

Experience gained from shipping the 1,055 jeeps to the Middle East in 1974 proved that false decking LASH barges is feasible from a safety point of view, and at that time under a chartered barge condition, it was economically feasible when maximum cube utilization was achieved. The 1974 estimated cost analysis was performed as follows:

| | |
|---|--------------|
| Total Shipping Charter Cost - Single Deck. | \$985,370.00 |
| Single Deck - Cost per Vehicle. | 934.00 |
| Double Deck - Cost per Vehicle | 467.00 |
| Prorated Construction Cost for False Deck per Vehicle - | |
| Baltimore | 30.25 |
| Prorated Construction Cost for False Deck per Vehicle - | |
| Mobile. | 28.21 |
| Total False-Deck Construction Cost | 30,702.00 |
| Total Shipping Cost - Double Deck | 492,685.00 |
| Total Cost - Double Deck | 523,387.00 |
| Cost Savings | 461,983.00 |

Although in 1974 the cost savings gained from double decking barges were substantial, subsequent changes in the rate structure and methods of affreightment dictate that a case-by-case (applicable rate) analysis must be conducted to determine the lowest shipment cost.

2. COST ANALYSIS FOR FALSE DECKING BARGES WITH METAL

RACKS. Several attempts were made to obtain cost information from manufacturers for the storage rack systems. The companies were reluctant to divulge cost data without design and procurement information, such as size, type, capacity, and quantity desired. If this type of system is chosen as a method for false decking, selection becomes a very difficult problem. In order to eliminate the need for a metal rack system for each vehicle within the military inventory, a system for false decking would probably be purchased with the capacity to carry the heaviest vehicles. The maximum load capacity system would accommodate a full range of vehicles, but would also be the most expensive. It is estimated that a system with a load-carrying capacity of 13,000 pounds would have a cost 8 to 10 times that of wood. Longevity derived from a reusable false deck could compensate the initial cost if the use is frequent and repetitive.

3. CURRENT METHODS FOR DETERMINING COST FEASIBILITY FOR FALSE DECKING.

Under the present rate structure for barges, maximum cube utilization may not be the most economical method. Current cost calculations are computed by using either "commodity rates" or "freight

all kinds (FAK) rates," whichever results in the lowest cost to the Government. Rates for barge ship movements are published by the Military Sealift Command (MSC) in the Shipping Agreement and Rate Guide (presently RG-11). The commodity rate is the amount charged by the shipping companies for break-bulk service by measurement ton. Freight all kinds rates are determined by multiplying the barge capacity (Table 2) in measurement tons by the published FAK rates (Table 3). Costs must be computed on a case-by-case basis to ascertain the most efficient method of affreightment.

TABLE 2

TABLE OF BARGE CAPACITIES

The following barge capacities are stated in measurement tons of 40 cubic feet.

| BARGE TYPE | CENT | LYKE | PFEL | PRUU | WATR |
|----------------|-------|-------|-------|-------|-------|
| LASH | 497.5 | | 487.5 | 487.5 | 490.0 |
| SEABEE TYPE A1 | | 900.0 | | | |
| SEABEE TYPE A2 | | 946.5 | | | |

The following examples illustrate methods for determining the economical feasibility of false decking barges.

Example 1

The requirement is to ship a LASH lighter loaded with M718 trucks from the East Coast to the Middle East. From the dimensions listed in Table 1, the reduced configuration of the M718 truck yields 7 MTON. Figure 13 shows a maximum capacity of 48 vehicles per LASH lighter using false decking or 24 vehicles with no false decking. There are two shipping companies that service the area, Central Gulf Lines, Inc. and Waterman Steamship Corporation, with both commodity and FAK rates applicable. For this example, the 1974 Baltimore cost per vehicle for false decking was used.

Commodity Rates with False Decking

| | | |
|--|------|--------|
| Central Gulf Lines, Inc., per MTON | = \$ | 111.30 |
| Waterman Steamship Corp., per MTON | = | 121.54 |
| Cost for False Deck per Vehicle | = | 30.25 |

TABLE 3

BARGE-SHIP SERVICE

TABLE OF FREIGHT ALL KINDS (FAK) BARGE RATES*

The following barge FAK rates apply when cargo is shipped in a barge loaded exclusively with military cargo booked under this agreement and loaded at a Government facility. Rates are stated in dollars and cents per measurement ton of 40 cubic feet (M/T) and are subject to a minimum charge per barge computed by applying the applicable rate to one hundred percent (100%) of the inside cubic capacity of the barge as listed in the Table of Barge Capacities.

| ROUTE INDEX | CENT | | C LYKE | | C PFEL | | PRUU | | WATR | |
|----------------|-------|-------|-----------|-------|-----------|-------|-------|-------|-------|-------|
| | OUT | IN | OUT | IN | OUT | IN | OUT | IN | OUT | IN |
| 01A1 | | | | | | | | | | |
| 01A2 | | | | | 28.35 | 28.35 | | | | |
| 01A3 | | | | | | | | | | |
| 01A4 | | | | | 34.20 | 34.20 | | | | |
| 01A5 | | | | | 34.20 | 34.20 | | | | |
| 01C | | | | | | | | | | |
| 01D | | | | | | | | | | |
| 01E | | | | | 26.00 | 25.00 | | | | |
| 06A | | | | | | | 30.00 | 30.00 | | |
| 06B | | | | | | | 40.00 | 40.00 | | |
| 07A | 85.43 | 85.43 | | | | | | | 92.96 | 92.96 |
| 07B | 85.43 | 85.43 | | | | | | | 92.96 | 92.96 |
| 10A | | | 22.00 | 22.00 | | | | | | |
| 11A | | | 19.00 | 19.00 | | | | | | |
| 13A | 85.43 | 85.43 | | | | | | | 92.96 | 92.96 |
| 13B | 85.43 | 85.43 | | | | | | | 92.96 | 92.96 |
| 14A1 | 85.43 | 85.43 | | | | | | | | |
| 14A2 | 85.43 | 85.43 | | | | | | | | |
| 14A3 | 85.43 | 85.43 | | | | | | | | |
| 14A4 | 85.43 | 85.43 | | | | | | | | |
| 14A5 | 85.43 | 85.43 | | | | | | | | |
| 14C | 85.43 | 85.43 | | | | | | | | |
| 14D | 85.43 | 85.43 | | | | | | | | |
| 14E | 85.43 | 85.43 | | | | | | | | |
| 47A | | | | | 94.90 | 94.90 | | | | |

* Rates in effect December 1976. Should not be used after that date without verification.

TABLE 4

SHIPPING CONTAINER AGREEMENT SCHEDULE OF RATES - Index of Routes
MSC FORM 4280/68 (REV. 2-78)

| INDEX NO. | DESCRIPTION OF ROUTE | INDEX NO. | DESCRIPTION OF ROUTE |
|-----------|---|-----------|---|
| #01 | U.S. WEST COAST-FAR EAST AREA | 25 | U.S. WEST COAST-MEDITERRANEAN AREA |
| 02 | | 26 | U.S. NORTHWEST PACIFIC-ALASKA |
| 03 | U.S. WEST COAST-HAWAII | 27 | HAWAII-CONTINENTAL EUROPE & UNITED KINGDOM & EIRE |
| #04 | U.S. EAST COAST-UNITED KINGDOM & EIRE | # 28 | U.S. WEST COAST-CANAL ZONE |
| #05 | U.S. EAST COAST-CONTINENTAL EUROPE | 29 | ALASKA INTERPORT |
| #06 | U.S. EAST COAST-MEDITERRANEAN AREA | 30 | U.S. EAST COAST-NEWFOUNDLAND/LABRADOR |
| #07 | U.S. EAST COAST-SOUTH ASIA & MIDDLE EAST AREA | 31 | U.S. EAST COAST-ICELAND |
| #08 | U.S. EAST COAST-FAR EAST AREA | 32 | U.S. EAST COAST-SCANDINAVIA |
| 09 | U.S. EAST COAST-HAWAII | # 33 | U.S. EAST COAST-AZORES |
| #10 | U.S. GULF COAST-UNITED KINGDOM & EIRE | 34 | U.S. PORTS NORTH OF CAPE HATTERAS-KENTRA, MOROCCO |
| #11 | U.S. GULF COAST-CONTINENTAL EUROPE | 35 | U.S. EAST COAST-BERMUDA |
| #12 | U.S. GULF COAST-MEDITERRANEAN AREA | 36 | U.S. EAST COAST-PUERTO RICO |
| #13 | U.S. GULF COAST-SOUTH ASIA & MIDDLE EAST AREA | # 37 | U.S. EAST COAST-DOMINICAN REPUBLIC |
| #14 | U.S. GULF COAST-FAR EAST AREA | 38 | U.S. EAST COAST-GUANTANAMO BAY & TRINIDAD |
| 15 | U.S. GULF COAST-HAWAII | # 39 | U.S. EAST COAST-CANAL ZONE |
| #16 | HAWAII-FAR EAST AREA | 40 | U.S. GULF COAST-GUANTANAMO BAY & TRINIDAD |
| 17 | U.S. GREAT LAKES-CONTINENTAL EUROPE & UNITED KINGDOM & EIRE | 41 | U.S. GULF COAST-PUERTO RICO |
| #18 | CARIBBEAN INTERPORT | # 42 | U.S. GULF COAST-DOMINICAN REPUBLIC |
| #19 | FAR EAST INTERPORT | # 43 | U.S. GULF COAST-CANAL ZONE |
| #20 | MEDITERRANEAN INTERPORT | 44 | U.S. GREAT LAKES-SOUTH ASIA & MIDDLE EAST AREA |
| 21 | U.S. WEST COAST-PUERTO RICO | 45 | U.S. GREAT LAKES-FAR EAST AREA |
| 22 | CALIFORNIA-ALASKA | # 46 | U.S. GREAT LAKES-MEDITERRANEAN AREA |
| 23 | U.S. WEST COAST-CONTINENTAL EUROPE | # 47 | U.S. WEST COAST-SOUTH ASIA & MIDDLE EAST AREA |
| 24 | U.S. WEST COAST-UNITED KINGDOM & EIRE | 48 | |

Indicates MSC Trade Route covered by this Rate Guide

| | |
|---|-------------|
| Cost per Vehicle . . . Central (7) (111.30) + 30.25 | = \$ 809.35 |
| Waterman (7) (121.54 + 30.25 | = 881.03 |
| Total Break-Bulk Cost for 48 Vehicles | |
| Central (48) (809.35) | = 38,848.80 |
| Waterman (48) (881.03) | = 42,289.44 |

Commodity Rates without False Decking

| | |
|---|-------------|
| Cost per Vehicle . . . Central (7) (111.30) | = \$ 779.10 |
| Waterman (7) (121.54) | = 850.78 |
| Total Break-Bulk Cost for 24 Vehicles | |
| Central (24) (779.10) | = 18,698.40 |
| Waterman (24) (850.78) | = 20,418.72 |

Freight All Kinds Rates

| | |
|---|--------------|
| Barge Capacity from Table 2 | |
| Central | = 497.5 MTON |
| Waterman | = 490.0 MTON |
| Rates from Table 3 | |
| Central per MTON | = \$ 85.43 |
| Waterman per MTON | = 92.96 |
| Cost for LASH Lighter | |
| Central (497.5) (85.43) | = 42,501.42 |
| Waterman (490) (92.96) | = 45,550.40 |
| Cost for False Deck per Vehicle | = 30.25 |
| Cost per Vehicle with False Deck | |
| Central 42,501.42 + (48) + 30.25 | = 915.70 |
| Waterman 45,550.40 + (48) + 30.25 | = 979.22 |
| Cost per Vehicle without False Deck | |
| Central 42,501.42 ÷ (24) | = 1,770.89 |
| Waterman 45,550.40 ÷ (24) | = 1,897.94 |

It is obvious from this example that the cheapest rate per vehicle is the commodity rate for both shipping companies without false decking.

Example 2

The requirement is to ship a SEABEE barge loaded with M715 trucks from the Gulf Coast to Europe. From the dimensions listed in Table 1, the reduced configuration of M715 truck yields 15.4 MTON. Figure 15 shows a maximum capacity of 40 vehicles per SEABEE barge with false decking. For this example, the 1974 Baltimore cost per vehicle for false decking was used.

Commodity Rates with False Decking

| | | |
|--|------|-----------|
| Lykes Brothers Steamship Co. per MTON. | = \$ | 50.00 |
| Cost for False Decking per Vehicle. | = | 30.25 |
| Cost per Vehicle (15.4) (50) + 30.25 | = | 800.25 |
| Total Break-Bulk for 40 Vehicles 40 (800.25) | = | 32,010.00 |

Commodity Rates without False Decking

| | | |
|---|------|-----------|
| Cost per Vehicle | = \$ | 770.00 |
| Total Break-Bulk for 20 Vehicles. | = | 15,400.00 |

Freight All Kinds Rates with False Decking

| | | |
|---|------|-----------|
| Barge Capacity from Table 2 | | |
| Lykes SEABEE Barge. | = | 900 MTON |
| Rates from Table 3 per MTON | = \$ | 19.00 |
| Total Cost for SEABEE Barge (900) (19.00) | = | 17,100.00 |
| Cost of False Deck per Vehicle | = | 30.25 |
| Cost per Vehicle with False Decking | | |
| \$17,100 ÷ 40 + 30.25. | = | 457.75 |
| Cost per Vehicle without False Decking | | |
| \$17,100 ÷ 20 | = | 855.00 |

It is obvious from this example that it is cheaper to ship by the "freight all kinds" rate with false decking. Before a decision is made to false deck any type of barge, complete cost calculations must be made, and each case should be considered on its own merits to determine which rate results in the lowest cost to the Government.

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Tier-Rack Corporation
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EQUIPTO
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Kalamazoo, MI 49007

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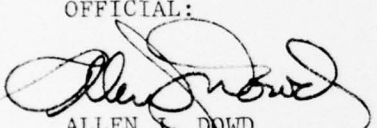
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