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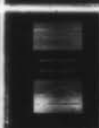
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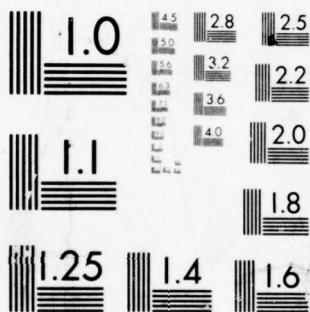
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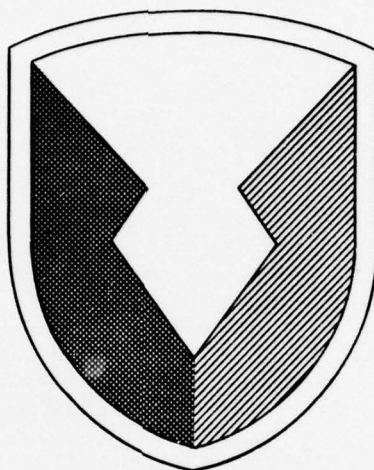
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RDT&E PROJECT NO. NONE
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Final Report of Test
"MILITARY POTENTIAL TEST (CATEGORY II)
OF JUNGLE CANOPY PLATFORM SYSTEM"

Bobbie A. Brassfield
Thomas P. Kehoe
James A. Gillaspie

August 1965

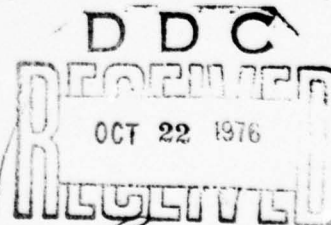
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FORT RUCKER, ALABAMA

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USATECOM PROJECT NO. 4-5-7496-01, -02, -03

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Thomas P. Kehoe
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DEPARTMENT OF THE ARMY
UNITED STATES ARMY AVIATION TEST BOARD
Fort Rucker, Alabama 36362

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ABSTRACT

A military potential test of the Jungle Canopy Platform System was conducted in the vicinity of Hilo, Hawaii, by USALWL during the period 19 April to 8 May 1965. The general approach was to demonstrate a concept and collect data necessary for design changes rather than to test a final system with the intention of standardization. Testing consisted of laying various combinations of nets and the platform with a UH-1B Helicopter in five types of trees. Personnel from Headquarters USATECOM, USAIB, USAYPG, and USAAVNTBD observed and participated in the testing to determine whether the test item and its ancillary equipment possess the potential which warrants its consideration for Army use, and whether the system meets the technical and operational performance characteristics which may justify its adoption as standard equipment. It was concluded that the Jungle Canopy Platform System concept possesses sufficient military potential to warrant its consideration for further development and Army use, but that much additional development and testing must be done to develop optimum hardware which will be suitable for use in an operational environment. It was recommended that the Jungle Canopy Platform System be considered for further development and testing, that the deficiencies and as many as possible of the shortcomings be corrected prior to service testing, and that military characteristics be provided against which to service test the system.

FOREWORD1. Authority.

Letter, AMSTE-BG, Headquarters, US Army Test and Evaluation Command, 7 April 1965, subject: "Test Directive for Military Potential Test (Category II) of Jungle Canopy Platform System, USATECOM Project No. 4-5-7496."

2. References.

a. AR 705-35, "Criteria for Air Portability and Air Drop of Materiel," Department of the Army, 15 June 1964.

b. Letter, AMSTE-BC, Headquarters, US Army Test and Evaluation Command, 26 August 1964, subject: "Safety Release."

c. Message, UNCLAS TT15444, AMSTE-BC, Commanding General, US Army Test and Evaluation Command, 15 September 1964, subject: "Additional Information for Safety Release of Lowering Device Utility 500 Pounds."

d. Message, UNCLAS TT16203, AMSTE-BC, Commanding General, US Army Test and Evaluation Command, 28 September 1964, subject: "Lowering Device, Utility, 500 Pounds."

e. Message, UNCLAS TT17917, AMSTE-BC, Commanding General, US Army Test and Evaluation Command, 27 October 1964, subject: "Attachment Method for Lowering Device, Utility, 500 Pounds, USATECOM Project No. 8-3-7630-02."

f. Plan of Test, "Conduct of a Feasibility Concept and Engineer Design Test of the Jungle Canopy Platform, LWL Task Number 11-S-63," US Army Limited War Laboratory, 19 February 1965.

g. Message, UNCLAS SMOSM-EEL-UH-1-2-1414, Commanding General, US Army Aviation Materiel Command, 20 February 1965, subject: "Canopy Exploitation Platform."

h. Letter, AMSTE-BG, Headquarters, US Army Test and Evaluation Command, 18 March 1965, subject: "Planning Directive for Monitoring Engineer Design Test of the Jungle Canopy Platform System, USATECOM Project No. 4-5-7496."

i. Letter, CRD-AM-5B, US Army Limited War Laboratory,
9 April 1965, subject: "Addendum to Plan of Test, Jungle Canopy
Platform, Task Number 11-S-63."

j. "Operator's Manual for Lowering Device, Utility, 500 Pounds,"
US Army Limited War Laboratory, undated.

DEPARTMENT OF THE ARMY
UNITED STATES ARMY AVIATION TEST BOARD
Fort Rucker, Alabama 36362

FINAL REPORT OF TEST

"MILITARY POTENTIAL TEST (CATEGORY II)
OF JUNGLE CANOPY PLATFORM SYSTEM"

USATECOM PROJECT NO. 4-5-7496-01, -02, -03

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SECTION 1 - GENERAL

1.1. OBJECTIVES.

1.1.1. Purpose.

To determine "if test item and its ancillary equipment possesses the potential which warrants its consideration for Army use; and, if the system meets the technical and operational performance characteristics which may justify its adoption as standard equipment. "

1.1.2. Test Objectives.

The objectives listed below are classified into three categories:

- a. General objectives applicable to all participating agencies.
- b. Specific objectives for a particular test agency.
- c. Combined objectives which apply to two test agencies.

1.1.2.1. General Objectives.

- a. To evaluate safety aspects of all equipment used during the test program.
- b. To determine whether test items have any nonessential features.
- c. To determine whether modifications are required for improvement of operational and safety factors.
- d. To determine degree of personnel training required to effectively employ system.
- e. To evaluate human engineering factors associated with functional and operational parameters.
- f. To determine effects of adverse climatic and environmental conditions on the system.
- g. To determine durability of test item.

h. To determine reliability of the system and its components.

1.1.2.2. Specific Objectives.

1.1.2.2.1. US Army Aviation Test Board (USAAVNTBD).

a. To determine physical characteristics of the system and related components, including commercial items that are used during the test which may be considered for adoption or employment with the system.

b. To determine suitability of reels, nets, and platform for air transport as sling loads.

c. To determine emergency jettisoning procedures.

d. To determine suitability of the employed platform as a helicopter refueling station.

1.1.2.2.2. US Army Infantry Board (USAIB).

To evaluate the suitability of the platform for use as a:

a. Patrol site.

b. Casualty evacuation station.

c. Communication site.

d. Mortar firing position.

1.1.2.2.3. US Army Yuma Proving Ground (USAYPG).

a. To determine whether the LWL Jungle Canopy System, including all ancillary equipment, meets the design criteria specified in existing drawings and technical specifications.

b. To determine whether the commercial equipment used during the test is considered as a potential part of the system and should be considered for further engineering tests.

1.1.2.3. Combined Objectives.

1.1.2.3.1. USAAVNTBD - USAIB.

a. To determine general characteristics of jungle vegetation required for employment of the system.

b. To determine tree or vegetation pruning requirements necessary to employ the nets and platform.

c. To determine ability to "sling load" the reels, nets, and platform.

d. To determine the most suitable method for employment and removal of the system.

e. To determine best procedure for deployment of troops to the platform and to the jungle floor.

f. To determine suitability of the employed platform as a resupply point.

1.1.2.3.2. USAAVNTBD - USAYPG.

To determine effect of dynamic loading the employed platform to approximately 10,000 pounds.

1.2. RESPONSIBILITIES.

1.2.1. The USAAVNTBD, as the coordinating test agency, was responsible for submission of the integrated test report and for evaluating and reporting on aviation service-type tests, including an analysis as to the suitability of the UH-1 helicopter to employ and pick up nets and platform.

1.2.2. The USAIB was responsible for evaluating and reporting on infantry application tests, including an evaluation as to the suitability of lowering devices, structure, or individual type equipment used during conduct of the test program.

1.2.3. USAYPG was responsible for evaluating and reporting on structural and engineering adequacy of the jungle canopy platform system and all ancillary equipment used during test, or under consideration as a potential component of the system.

1.3. DESCRIPTION OF MATERIEL.

The Jungle Canopy Platform System is intended to be used in areas where there are no helipads, or where the dense jungle growth and terrain normally prohibit the landing of helicopters. While several variations of basic hardware were experimented with during testing, the final configuration employed by test personnel of the US Army Limited War Laboratory (USALWL) consisted of two support net assemblies (one across another) emplaced by helicopter over the tops of trees, their dispenser rack, a platform positioned at the vertex of the nets, and necessary auxiliary equipment. A detailed description of materiel is contained in appendix I.

1.3.1. Support Net Assemblies.

Two support net assemblies are contained in the test system. Each assembly consists of a 20- x 196-foot net fabricated from 1/8-inch and 3/16-inch stainless steel cables, ten aluminum-tube spreader bars 2 1/4 inches in diameter, a cable-tightening yoke, and a grapnel assembly. The center 40 feet of the net is made up of a network of six-inch square mesh (for ease of movement), while each 78-foot end portion consists of a network of 30-inch square mesh (for engaging branches in the tree tops).

1.3.2. Dispenser Rack.

The dispenser rack consists of an improvised "bed frame" constructed to fit under the skids of a UH-1B Helicopter, support-net-assembly locking arms, a control board from which a series of cords is attached to the individual locking arms, and the necessary cables with which to attach the rack to the helicopter.

1.3.3. Platform.

The platform consists of a hexagonal space frame 18 feet in diameter, constructed of five-inch aluminum tubing and covered by one-inch-square nylon mesh. The frame is supported by struts which attach it to a triangular platform base. Platform jacking legs extend from the platform base. Mounted on this platform are a commercially-designed two-kilowatt generator, a power hoist, an A-frame with guide brackets, two fire extinguishers, and a rack for storage of gas or water cans.

1.3.4. Auxiliary Equipment.

In addition to the items mounted on the platform, miscellaneous pruning equipment, cable tighteners, snap links, grounding wires, chains, etc., are used in association with major components of the test system.

1.3.5. Individual Type Equipment.

The Lowering Device, Utility, 500 Pounds, was used to lower test soldiers from the nets, or platform, to the jungle floor during the conduct of infantry application testing.

1.4. BACKGROUND.

1.4.1. Requirement.

1.4.1.1. The armed action associated with counterinsurgency operations frequently takes place in tropical countries which are composed of large areas of jungle terrain. The jungle environment often negates the military advantages available to those nations utilizing modern technology and forces military operations to the relatively primitive level which is advantageous to the insurgents. It would benefit the technically-advanced nations if they could utilize the vegetation of the area to their advantage rather than be limited by it.

1.4.1.2. One of the major problems of jungle counterinsurgency warfare is the lack of mobility. Although modern aircraft have greatly-improved mobility in areas where suitable drop zones and landing zones are available, only a small proportion of the total area has such zones within a practical distance of the military tactical objectives.

1.4.2. Concept.

In early 1964, USALWL began work on a concept which, they hoped, would overcome many of the limitations associated with mobility in counterinsurgency operations. The concept consisted of mounting a staging platform atop the jungle canopy to serve as a helicopter landing and off-loading area. The canopy platform, intended for use in areas where there are no helipads and where the dense jungle growth and terrain normally prohibit the landing of helicopters, would be used for on/off-loading of troops and supplies, medical evacuation station, etc.

1.4.3. Previous Test.

Operating without any stated requirement for such a system, USALWL evaluated this concept at the Aberdeen Proving Ground Churchville Test Area. Techniques were developed for laying and recovering the nets and platform. Results from this limited evaluation were such that in December 1964, USALWL requested that the US Army Test and Evaluation Command (USATECOM) evaluate the test system. In April of 1965, Headquarters, USATECOM directed the USAAVNTBD, USAIB, and USAYPG to observe testing by USALWL personnel, which was about to begin near Hilo, Hawaii. Accordingly, project officers witnessed and participated in the testing during the period 28 April - 8 May 1965.

1.5. FINDINGS.

1.5.1. Physical Characteristics.

(Data have not been received to date from USALWL.)

1.5.2. Vegetation Characteristics.

The type of vegetation required to employ the system depended on the mission. Generally, the canopy must be very dense and rigid. Rain forests found near Hilo, Hawaii, were generally unsatisfactory for other than troop deployment from the support nets.

1.5.3. Pruning Requirements.

Pruning was required during a majority of the operations.

1.5.4. Sling Loading.

Reels, nets, platform, and dispenser rack were easily sling loaded. However, the dispenser rack presented peculiar problems because the helicopter had to be landed on the rack for hook-up and a tensioning tool used to take up slack in the hook-up cables to position the rack securely against the skids of the helicopter.

1.5.5. Air Transport.

Reels, nets, dispenser rack, and platform were suitable for air transport as sling loads.

1.5.6. Jettisoning Procedures.

Provisions for jettison of sling loads (except for the dispenser rack) were adequate. In the case of the dispenser rack, jettison characteristics had not been established and no safety-of-flight release was available.

1.5.7. Employment and Removal Methods.

All methods of employment and recovery used were suitable with the exception of laying the nets using the reels. The best method cannot be determined until further development and testing are conducted.

1.5.8. Personnel Training.

An informal training course will be required for personnel expected to employ the test system operationally.

1.5.9. Dynamic Loading.

Because of the lack of necessary equipment and a shortage of fuel for the UH-1B Helicopter, no attempt was made to dynamic load the platform to 10,000 pounds. The platform was static loaded to approximately 4500 pounds before it toppled because of unequal load distribution and high vertical center of gravity.

1.5.10. Troop Deployment.

The most suitable method for deploying troops to the jungle floor was to have them jump onto the nets from a hovering helicopter and then descend to the jungle floor by using a lowering device anchored to cables of the nets.

1.5.11. Resupply Point.

The test system was found to be suitable for use as a resupply point.

1.5.12. Helicopter Refueling.

The platform installed on the nets provided a satisfactory refueling site for the UH-1B on one occasion.

1.5.13. Patrol Base.

The test system was not entirely suitable for use as a patrol site because of the excessive noise emitted by the generator of the powered hoist.

1.5.14. Medical Evacuation.

The test system was not suitable for use as a medical evacuation station because of inadequacies in the platform configuration.

1.5.15. Communication Site.

The test system was suitable for use as a communication site.

1.5.16. Mortar Firing Position.

The test system was not suitable for use as a mortar firing position.

1.5.17. Safety.

1.5.17.1. No flight-safety release was provided for the dispenser rack.

1.5.17.2. Six potential safety hazards were noted during the test. These were:

1.5.17.2.1. A loose power hoist cable engaged a support net during climbout while the platform was being recovered.

1.5.17.2.2. One person standing on a support net while it was being tightened and repositioned with the helicopter was injured.

1.5.17.2.3. One person got off the aircraft onto the support nets with loose equipment which hung up on the UH-1B skid.

1.5.17.2.4. Grappling hooks were structurally incapable of supporting heavy loads during recovery operations.

1.5.17.2.5. No method was provided for discharging static electricity build-ups on the UH-1B cargo hook.

1.5.17.2.6. Persons on the nets and platform were vulnerable in the event of power failure of the helicopter while hovering over or sitting on the nets and platform.

1.5.18. Nonessential Features.

No nonessential features were noted on the final configuration of the test system.

1.5.19. Modification Requirements.

Five major components were found to be deficient in design and to require modification. These were:

- a. All net configurations
- b. The platform
- c. The dispenser rack net-laying device
- d. Both types of reel net-laying devices
- e. Both hoist systems

1.5.20. Climatic and Environmental Effects.

Climatic and environmental conditions encountered during testing had no adverse effects on the test system or its employment.

1.5.21. Durability.

Durability of the components of the system was unsatisfactory.

1.5.22. Reliability.

Reliability of the system was unsatisfactory for all missions except troop deployment from support nets alone.

1.5.23. Human Engineering.

Because of the experimental nature of this test and lack of a final configuration to evaluate, human engineering characteristics were not determined.

1.5.24. Design Criteria.

The test system was constructed in accordance with the drawings and specifications that were available for review. The load-bearing capability of the system was limited by the density and rigidity of the jungle canopy rather than the test system itself.

1.5.25. Commercial Equipment.

The commercial hoist equipment did not perform to its rated capacity and was too slow.

1.6. CONCLUSIONS.

1.6.1. The Jungle Canopy Platform System concept possesses sufficient military potential to warrant its consideration for further development and Army use.

1.6.2. Much additional development and testing must be done to develop optimum hardware which will be suitable for use in an operational environment.

1.7. RECOMMENDATIONS.

It is recommended that:

1.7.1. The Jungle Canopy Platform System be considered for further development and testing.

1.7.2. The deficiencies and as many as possible of the shortcomings listed in appendix II be corrected prior to service test.

1.7.3. Military characteristics be provided against which to service test the system.

SECTION 2 - DETAILS AND RESULTS OF SUBTESTS

2.0. INTRODUCTION.

2.0.1. Testing of the Jungle Canopy Platform System was conducted in the vicinity of Hilo, Hawaii, by US Army Limited War Laboratory (LWL) during the period 19 April to 8 May 1965. The general approach used by LWL was to demonstrate a concept and collect data necessary for design changes rather than to test a final system with the intention of standardization.

2.0.2. Personnel from Headquarters, US Army Test and Evaluation Command (USATECOM), the US Army Infantry Board (USAIB), US Army Yuma Proving Ground (USAYPG), and the US Army Aviation Test Board (USAAVNTBD) observed and participated in the testing.

2.0.3. Testing consisted of laying various combinations of nets and the platform with a UH-1B Helicopter in five types of trees: Eucalyptus Robusta, Mango, Guava, Koa, and Ohia. The performance of each component of the system was noted. During the course of testing, some items were considered undesirable by LWL test personnel and subsequently deleted. Other components were designed and constructed on an expedited basis during the course of testing. In this report, prime emphasis is placed on those items the LWL test personnel considered best for their purposes at the conclusion of testing.

2.0.4. An approved stated requirement was not available for evaluation of the system; therefore, the conclusions based on the results of test are mostly subjective in nature.

2.1. PHYSICAL CHARACTERISTICS.

2.1.1. Objective.

To determine physical characteristics of the system and related components, including commercial items that are used during the test which may be considered for adoption or employment with the system.

2.1.2. Method.

The test system was weighed, measured, and inspected visually by LWL test personnel prior to the test. Complete data were recorded by LWL personnel.

2.1.3. Results.

(Data have not been received to date.)

2.1.4. Analysis.

Not applicable.

2.2. VEGETATION CHARACTERISTICS.

2.2.1. Objective.

To determine the general characteristics of jungle vegetation required for employment of the system.

2.2.2. Method.

The system was employed in several sites on vegetation of various strengths and densities. Sites were reconnoitered to gather information regarding the general characteristics of the vegetation, such as canopy height, branch density, and uniformity of height of the trees. The helicopter was hovered low over the sites to determine the rigidity and density of the canopy structure.

2.2.3. Results.

2.2.3.1. Without knowing the structural properties of a particular type of tree under consideration, the best method for selecting a site was careful reconnaissance for selection of high-density canopy which did not separate too much under rotor downwash. Amount of separation under rotor downwash was an indication of rigidity of the trees and the amount of sagging which would occur in the installation. Large separations resulted in placement of the nets below the primary canopy when nets were laid from a low hovering height.

2.2.3.2. The most satisfactory site was on a canopy consisting primarily of Guava trees and some Rose Apple trees approximately 60 feet high.

2.2.3.3. The least satisfactory sites were found in Ohia and Eucalyptus trees more than 100 feet high. Both types of canopy were sparse and lacked rigidity.

2.2.4. Analysis.

2.2.4.1. Height of a canopy did not appear to be a factor in canopy selection in a direct sense. For example, a canopy consisting of short Ohia or Eucalyptus trees would probably be no more satisfactory than one consisting of taller trees of the same type.

2.2.4.2. Canopy which was not sufficiently rigid for employment of the complete system as a refueling station or other more permanent operation could still be used for deploying troops to the ground from nets with the lowering device. A very rigid system was required for actual landing of the test helicopter on the platform or for supporting heavy weights without large vertical displacements of the system.

2.3. VEGETATION PRUNING REQUIREMENTS.

2.3.1. Objective.

To determine the tree or vegetation pruning requirements necessary to employ the nets and platform.

2.3.2. Method.

Vegetation was pruned as necessary to provide helicopter tail rotor clearance, to provide clearance for hoist operation, and to level the deployed platform. Pruning was accomplished by personnel emplaced on the nets or platform. Three different types of pruning equipment (axe, saw, and 12-foot pruning knife) were used and evaluated for adequacy. Records were not kept on all pruning performed but an assessment was made to determine whether pruning would be required in general for employment of the nets and platform.

2.3.3. Results.

2.3.3.1. Pruning to provide tail rotor clearance was required during a majority of the operations performed during the test. Amount of pruning depended on the types of vegetation and the amount of weight placed on the nets and platform. Pruning was normally not required prior to platform emplacement. Pruning provided adequate clearance in the instances where it was required.

2.3.3.2. Pruning was required for one of the hoist operations.

2.3.3.3. The platform could not be leveled satisfactorily by pruning.

2.3.3.4. All pruning was accomplished satisfactorily using the axe and saw. The 12-foot pruning knife would not cut large limbs and therefore was unsatisfactory.

2.3.4. Analysis.

The amount of pruning required varied with every situation. Primary factors involved were:

- a. Type of tree and vegetation.
- b. The amount of weight placed on the platform and nets.
- c. The method of employment of the net (i. e., placement on crest of tree or in depression between trees).

2.4. SLING LOADING.

2.4.1. Objective.

To determine the ability to sling load the reels, nets, and platform.

2.4.2. Method.

All equipment was sling loaded by standard methods except for the dispenser rack. The rack was fitted to the bottom of the skids and secured by cables pulled together at the center and attached to the cargo hook. The rack became a part of the aircraft rather than a sling load and was designed to be jettisoned by use of the cargo-hook release. Where the standard hookup with swivel could not be retrieved after release, other means of attachment to the cargo hook were used.

2.4.3. Results.

2.4.3.1. No special problems were encountered in hookup of any equipment with the exception of the dispenser rack. The helicopter had to be placed on top of the rack for hookup; hookup required approximately four minutes.

2.4.3.2. The grappling hook did not always have the strength required for the stresses incurred in retrieving equipment from the jungle.

2.4.4. Analysis.

2.4.4.1. Prior to adoption of the test system as standard equipment, structural integrity of all sling components and compliance with AR 705-35 (Criteria for Air Portability and Air Drop of Materiel) should be determined using all the methods for carrying sling loads.

2.4.4.2. The weakest component in the special sling equipment used in the test was the grappling hook.

2.4.4.3. A safety-of-flight release should be obtained for the final version of the dispenser rack if it is adopted.

2.5. AIR TRANSPORT.

2.5.1. Objective.

To determine suitability of reels, nets, and platform for air transport as a sling load.

2.5.2. Method.

Reels, nets, platform, and the dispenser rack with nets were air transported by sling load and flight characteristics were noted for each type load.

2.5.3. Results.

2.5.3.1. Flying qualities of the helicopter were similar to those encountered when carrying any normal sling load.

2.5.3.2. Maximum comfortable flying speed with the 20- x 196-foot net hanging free was 60 knots indicated airspeed (IAS) with a nose-down attitude of approximately 13 degrees.

2.5.3.3. Maximum comfortable flying speeds with the 10- x 200-foot and 10- x 250-foot nets were 70 knots IAS and 60 knots IAS, respectively. The helicopter was slightly more unstable with the longer net than with the shorter net.

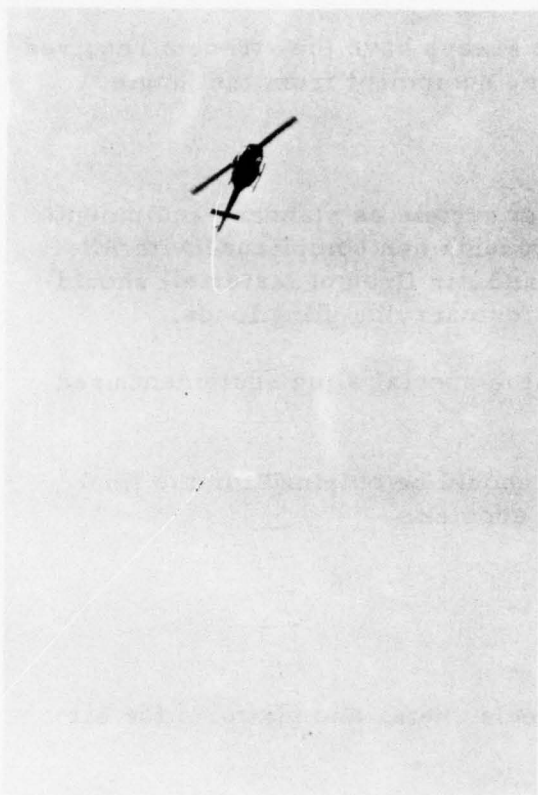


Figure 1.
UH-1B in flight with
free-hanging net.

2.5.3.4. Maximum comfortable flying speed with the platform was 60 knots IAS with a nose-down attitude of approximately 15 degrees. Flight characteristics were similar to those with the 10- x 250-foot net.

2.5.3.5. Flight qualities with the dispenser rack were good up to a maximum 70 knots IAS. No severe pendulum action occurred during maneuvers with banks up to 30 degrees. Pitch attitude was approximately 10 degrees nose down.

2.5.3.6. Testing with reels was completed prior to arrival of USAT-ECOM test personnel so flight with reel and net was not observed.

2.5.4. Analysis.

There appears to be no particular problem associated with any of the sling-load configurations tested with the possible exception of the free-hanging nets. These nets hang 230 to 280 feet below the aircraft and present a high drag load, reducing forward airspeed considerably, and a problem of ground clearance in other than flat and familiar terrain. The nets also present a problem during an attempt to employ the system in marginal weather.

2.6. EMERGENCY JETTISONING PROCEDURES.

2.6.1. Objective.

To determine emergency jettisoning procedures.

2.6.2. Method.

Emergency jettisoning procedures were determined by inspection of the equipment and by a review of applicable publications. Actual jettison of loads was not performed although the cargo hook was checked for proper functioning prior to hookup to loads where practical.

2.6.3. Results.

2.6.3.1. All loads were carried by means of the cargo hook and could be jettisoned electrically by actuating the cargo-hook release on the pilot's or copilot's cyclic control. Manual jettisoning could be accomplished by actuating the manual cargo release located between the pilot's antitorque rotor pedals.

2.6.3.2. In cases where guide lines or bungee devices were used for stabilizing loads or positioning loads prior to setdown, quick-release devices were used to insure breakaway in the event of emergency jettison.

2.6.4. Analysis.

A flight-safety release for jettison of the dispenser rack must be obtained.

2.7. EMPLOYMENT AND REMOVAL METHODS.

2.7.1. Objective.

To determine the most suitable method for employment and removal of the system.

2.7.2. Method.

2.7.2.1. Three methods of net employment and three methods of net removal were investigated.

2.7.2.2. The platform was placed and removed by the same method throughout the test with only minor variations in procedure.

2.7.2.3. Particular attention was given to ease of installation and removal and the amount of time required for each method. Other factors considered were safety, training requirements, meteorological conditions, and reliability of the various components.

2.7.3. Results.

2.7.3.1. Laying the nets by the reel method was abandoned because of problems with the reels and brake systems. Binding in the reel system occurred several times, and the brakes were not reliable. In some instances cables became entangled on the reels to the extent the problem could not be remedied without landing.

2.7.3.2. Laying the nets by the free-hanging method was accomplished easily and in a short time by experienced personnel. However, precise net placement was difficult and required good aircraft control and expert direction from the crew chief. Average time to lay a net by this method was approximately three minutes with longer periods necessary if the nature of the canopy required that the net be laid precisely. Wind velocity was a factor in this method because the net tended to turn over or twist in a crosswind above 10 knots. Control of the helicopter was also difficult when working in crosswind conditions. A high hover was required using this method, which would be dangerous in the event of a power failure.

2.7.3.3. Laying the nets with the dispenser rack was minimally satisfactory but did eliminate the requirement for high hovering. Two nets

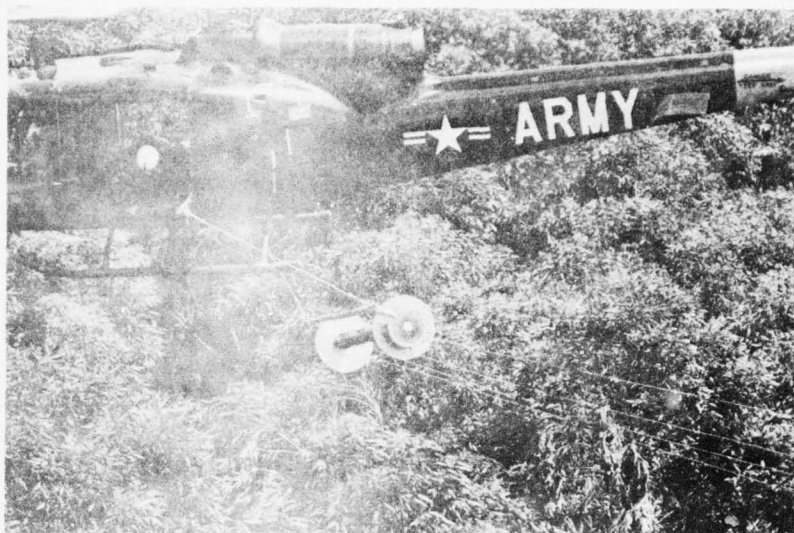


Figure 2. Laying nets with reel.

were carried simultaneously with this installation. Precise placement of the nets was obtained, but required an average of eight minutes per net. The crude hardware (designed and built during the test) was unsatisfactory and was the primary reason for the excessive time required to lay a net by this method. Improper functioning of the trigger arms on the device caused sections of the net to hang up during the operation. In one instance a net became entangled on the rack, and in most cases spreader bars were broken or bent because of asymmetric loading on the nets as they were spread by section.

2.7.3.4. Deployment of the platform was difficult on the 10-foot wide nets because of the small available area and the difficulty of getting all three legs on the nets at the same time. When a person on the net gave directions and a boat hook was used from inside the aircraft to stabilize and position the platform for setdown, the operation required from three to five minutes depending on how precisely the platform had to be placed to get the hoist in the desired position and the platform reasonably level. By placing two markers on the nets for the legs of the platform, one

Figure 3.
Preparing to lay the nets
with the dispenser rack.



control man on the nets, and two persons in the helicopter with guide ropes to stabilize and position the platform, the operation required approximately two minutes and gave a more reliable result. Employing the platform on the 20-foot wide nets was easier because the margin for error was greater.

Figure 4.
Placing the platform.
(Note cloth markers
used for positioning
the platform legs.)



2.7.3.5. In all cases where foliage and proper placement of the nets gave a satisfactory employment of the nets, the platform was leveled satisfactorily using the methods described in paragraph 2.7.4.5.

2.7.3.6. All three methods of net removal were satisfactory.

2.7.3.6.1. Stripping the nets from the canopy individually was least desirable because it required two or three operations depending on the number of nets used. In this method, the net was transported at full length which was undesirable. This method required three to five minutes to retrieve one net assuming there was no great difficulty in freeing the anchor end.

2.7.3.6.2. Removing all nets simultaneously by engaging the grapnel at the vertex of the nets and climbing vertically was most satisfactory at low altitudes using 10-foot wide nets. In one case, two 10- x 200-foot nets and one 10- x 250-foot net were retrieved simultaneously. The operation required 12 minutes from initial hover for anchor inspection to complete removal. Six and one-half minutes of this time were used to free one anchor end and 3 1/2 minutes were consumed in inspection of the three anchor points.

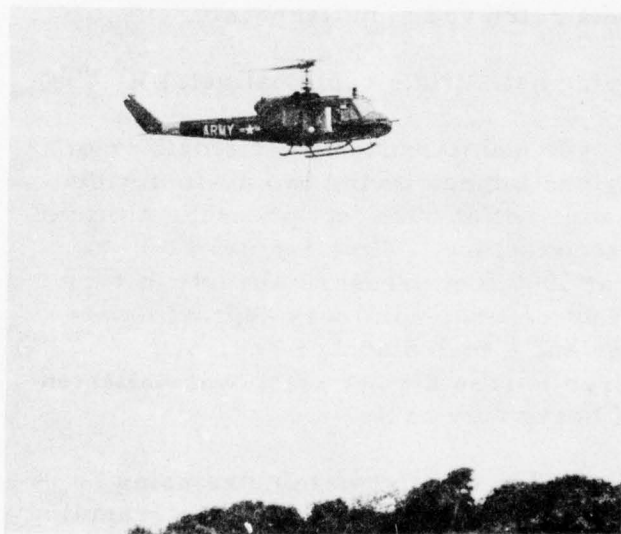


Figure 5.
UH-1B with grappling
hook, preparing to
retrieve nets.

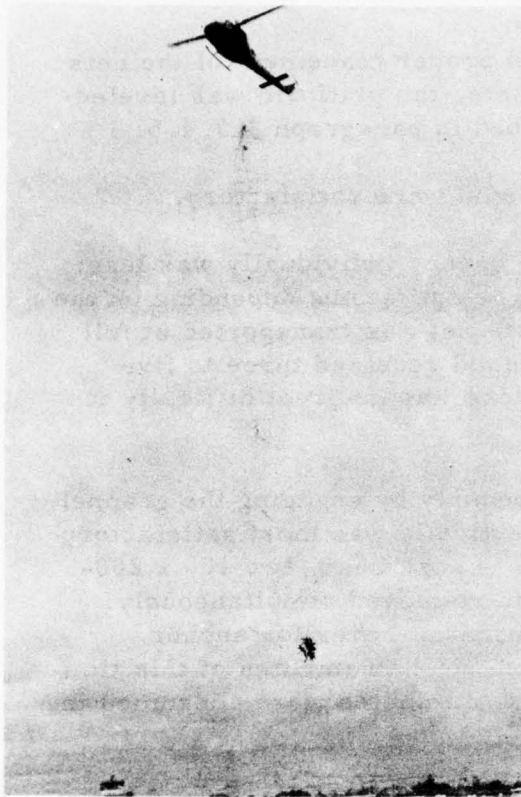


Figure 6 (left). Three nets retrieved simultaneously.

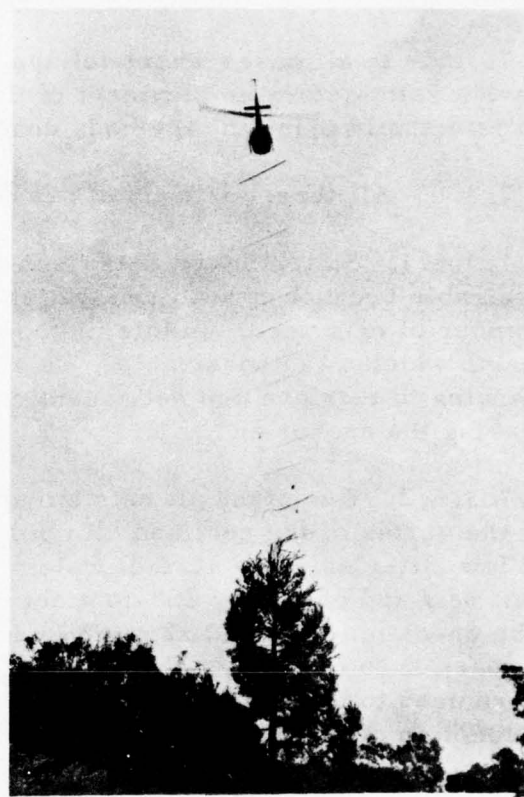


Figure 7 (right). Retrieving net. (Note cable ballast.)

2.7.3.6.3. Folding the nets end over end to reduce their length prior to removal was used on two occasions for retrieving two 20-foot wide nets at sea level and one 20-foot wide net at 6000 feet pressure altitude. In both cases, the recovery was satisfactory. Time required for recovery of one 20-foot wide net at 6000 feet pressure altitude in very marginal weather (estimate 400-foot ceiling, rain) was approximately 30 minutes because of bad weather and a fouled anchor end. All available engine power was required to free the net which was ballasted with approximately 500 pounds of heavy duty cable.

2.7.3.7. The platform was recovered in one to two minutes using assistance from an individual on the nets. Retrieving with the grappling hook without assistance was more difficult and less desirable.

2.7.4. Analysis.

2.7.4.1. Laying the nets by the reel method was considered unsatisfactory because of the problems stated in paragraph 2.7.3.1.

2.7.4.2. Laying the nets by the free-hanging method was not considered desirable for the following reasons:

- a. Precise net placement was difficult and required good aircraft control and expert direction from the crew chief.
- b. Net control was difficult in crosswinds above 10 knots.
- c. The high hover is dangerous in the event of power failure.
- d. The high hover affords little security from observation.
- e. Employment using this method would be hampered severely by adverse weather conditions.

2.7.4.3. Laying the nets using a redesigned, well-manufactured dispenser rack would probably eliminate most problems encountered using that method. Time required for emplacement of the nets should be comparable to that using the free-hanging method, and placement should be more precise. In addition, the requirement for a high hover would be eliminated.

2.7.4.4. All methods used for net recovery were suitable. The choice of method would be dictated by the situation.

2.7.4.5. The leveling devices did not appear to be warranted on the present platform as the procedure for using them was too time consuming. If the platform did not remain level because of loading or settling of the trees, the nets could be tightened by stretching with the helicopter or some other means yet to be determined.

2.8. PERSONNEL TRAINING REQUIREMENTS.

2.8.1. Objective.

To determine the degree of personnel training required to employ the system effectively.

2.8.2. Method.

2.8.2.1. A qualitative assessment was made based on the experience of the USATECOM personnel after participation in various phases of the test. All phases of employment were observed with the exception of net deployment by the reels. The USAAVNTBD pilot retrieved nets from two different sites and either observed or participated in laying the nets by two methods in two different sites.

2.8.2.2. The 25th Infantry Division pilot and crew chief were consulted to obtain professional opinions. Both persons, completely unfamiliar with the system prior to initiation of the test, had participated throughout the test program to a great extent.

2.8.3. Results.

2.8.3.1. After receiving a briefing on the system, and seeing the various phases of employment performed, the USAAVNTBD pilot was able to deploy and recover the system, with supervision, in a satisfactory manner.

2.8.3.2. The crew chief, who conducted the deployment operation, performed his duties satisfactorily after receiving a briefing and participating in one complete operation.

2.8.3.3. Several different personnel were utilized as control personnel on the installed nets and platform and performed their duties to varying degrees of satisfaction depending on familiarity with the system and sling load operation.

2.8.3.4. Since there was no training literature available for the test system, all training was accomplished by means of practical exercises supervised by LWL personnel. This was completed so that test personnel easily mastered required skills in minimum time.

2.8.4. Analysis.

2.8.4.1. Personnel expected to employ the system should be trained in sling load operations. This would include the aircraft crew and the control individual who supervises operations on the net. The pilot should be proficient both in his aircraft and in sling load operations for the type aircraft.

2.8.4.2. Control personnel on the net should be familiar with the operation of auxiliary equipment. Personnel to be deployed from the nets by a lowering device should be trained in the use of the device.

2.8.4.3. As a minimum, the crew should be shown a training film outlining specific methods of conducting each phase of the operation. They should be completely familiar with all components and have the benefit of experience in deploying the system at least once prior to operational commitment. A special training team should be dispatched to present a one-time class to units authorized the Jungle Canopy Platform System. Unit training would suffice thereafter. It is assumed that technical manuals would be provided. The lack of a preliminary operator's and organizational maintenance manual is considered a deficiency. Such a manual should include a maximum of illustrations and photographs.

2.9. DYNAMIC LOADING EFFECTS.

2.9.1. Objective.

To determine the effect of dynamically loading the employed platform to approximately 10,000 pounds.

2.9.2. Method.

A simulated UH-1B skid section with 2- x 6-inch boards on top was placed on the deployed platform. The helicopter was then used to set 500-pound weights on the simulated skid section. The amount of settling of the platform was recorded.

2.9.3. Results.

When approximately 4500 pounds had been placed on the platform, the platform toppled because of unequal load distribution and high vertical center of gravity. This caused the majority of the weights to drop to the jungle floor. The platform settled approximately five feet when loaded to 4500 pounds.

2.9.4. Analysis.

2.9.4.1. It was planned to load the platform statically to 8500 pounds, then drop 1500 pounds from a height of five feet onto the platform. However, because of a shortage of fuel for the UH-1B, no further dynamic loading tests were attempted.

2.9.4.2. The platform and nets were designed for loading to 10,000 pounds. The amount of load the employed system will bear is dependent on the strength and rigidity of the jungle canopy rather than the test system.

2.10. TROOP DEPLOYMENT.

2.10.1. Objective.

To determine the best procedures for deployment of troops to the platform and to the jungle floor.

2.10.2. Method.

2.10.2.1. A UH-1B Helicopter carrying four combat-equipped soldiers (each equipped with a lowering device, utility, 500 pounds) flew over an area where the nets had been emplaced. While the helicopter hovered approximately three to four feet above the vertex of the nets (platform not yet emplaced), the soldiers jumped from the skids onto the nets, moved away from the vertex, and lowered themselves from the nets to the jungle floor by means of a device anchored to the cables of one of the nets.

2.10.2.2. Similar procedures were also followed with the soldiers stepping from the helicopter as it hovered over the platform of the test system. Once on the platform, the soldiers lowered themselves to the ground either with their lowering devices or with the powered hoist.

2.10.3. Results.

2.10.3.1. Using procedures outlined in paragraph 2.10.2.1, each soldier required an average of 30 seconds to exit the helicopter and move away from the vertex of the nets. Times consumed by these same soldiers in descending from the nets to the jungle floor using a lowering device varied with the height of the platform and the thickness of the canopy, but were not considered excessive.

2.10.3.2. Using procedures outlined in paragraph 2.10.2.2, soldiers took slightly more time to move off the platform of the test system due to the difficulty experienced in walking on the nylon mesh.



Figure 8 (top).
Troops deploying
onto nets.



Figure 9 (bottom).
Troops deploying
onto platform.

2.10.3.3. Use of the powered hoist to lower the soldiers to the ground consumed considerably more time than did the use of the lowering device. The maximum speed attained by either of the two hoists used was 32 feet per minute (0.53 foot per second).

2.10.4. Analysis.

The best procedure for deploying troops to the jungle floor was for the troops to jump onto the nets from a hovering helicopter and lower themselves to the jungle floor with a lowering device anchored to cables of the nets. This procedure, in addition to being faster, was more suitable than using a hoist in that it allowed the troops to deploy without waiting for positioning of the platform.

2.11. SUITABILITY AS A RESUPPLY POINT.

2.11.1. Objective.

To determine suitability of the employed platform as a resupply point.

2.11.2. Method.

Personnel secured four miscellaneous loads (simulating Class I and V supplies) to 30- x 36-inch wooden pallets at a supply point set up in close proximity to the emplaced test system. Then a UH-1B Helicopter sling loaded each of these loads separately onto the nets. Once positioned appropriately, each was lashed into place on the six-inch mesh. Weights were as follows:

- a. Pallet No. 1 - 225 pounds
- b. Pallet No. 2 - 350 pounds
- c. Pallet No. 3 - 445 pounds
- d. Pallet No. 4 - 700 pounds

2.11.3. Results.

No difficulties were encountered in the sling loading; however, the ease with which pallets could be lashed to the nets was complicated by the instability of the nets under weight and by the downwash of the

hovering helicopter. Despite this, all four pallets were positioned and lashed down by three personnel in approximately 15 minutes.

2.11.4. Analysis.

2.11.4.1. The employed platform was not as desirable as a location on which to store supplies.

2.11.4.2. The six-inch mesh of the test system's nets offers a suitable location onto which supplies can be built up to serve as a resupply point or supply cache. Should a greater quantity of supplies be sling loaded to the system than could be stored on the six-inch mesh, then a certain area of the 2 1/2-foot mesh could doubtlessly be used to supplement the more limited space on the smaller mesh.

2.11.4.3. No attempt was made to use the test platform as a resupply point because of the success attained in lashing supplies to the six-inch mesh and the fact that storing these supplies on the platform would impair the use of the platform as a landing site.

2.12. SUITABILITY AS A HELICOPTER REFUELING STATION.

2.12.1. Objective.

To determine the suitability of the employed platform as a helicopter refueling station.

2.12.2. Method.

A fuel cell containing 100 gallons of fuel and the LWL refueling pump were sling loaded and placed on the nets adjacent to the platform. The helicopter was landed on the platform and grounded with copper wire extending to the jungle floor, and a simulated refueling operation was conducted.

2.12.3. Results.

2.12.3.1. The simulated refueling operation was satisfactory. Actual refueling could not be accomplished because the refueling pump was contaminated with rust and existing regulations do not permit refueling an aircraft with the engine running.

2.12.3.2. The entire weight of the helicopter could not be placed on the platform because of the requirement to maintain cyclic pitch control.

2.12.3.3. There was difficulty in keeping the fuel cell in place on the nets since it had a tendency to roll around. It was too heavy to man-handle (approximately 900 pounds).

2.12.4. Analysis.

2.12.4.1. Refueling a helicopter on the platform cannot be done unless it is done with the engine operating and the rotor turning with the aircraft remaining light on the skids.

2.12.4.2. Refueling probably could not be performed on every installation because of instability of the platform in most cases and the likelihood



Figure 10.
Simulated refueling
operation, UH-1B
atop platform.

the platform would sag too deep with the concentrated load. Each installation would have to be checked individually to see whether the helicopter could be landed prior to setting up for refueling operations.

2.12.4.3. It is doubtful that any installation will support the high-density load of a 500-gallon fuel container on the net; therefore, a means would be required to distribute the load or a different fuel cell would have to be designed.

2.13. SUITABILITY AS A PATROL SITE.

2.13.1. Objective.

To determine the suitability of the platform for use as a patrol site.

2.13.2. Method.

2.13.2.1. Five soldiers, having lowered themselves from the nets to the jungle floor, conducted a short reconnaissance patrol using the test system as their patrol base. Upon returning, one of the patrol members was raised to the platform of the test system by the powered hoist.

2.13.2.2. Three other test personnel bivouaced on the nets overnight.

2.13.2.3. An attempt was made to control a radio net from atop the test system.

2.13.3. Results.

2.13.3.1. Testing as described above was accomplished without incident except that the sound emitted by the generator for the powered hoist was readily heard approximately 1/2 mile away.

2.13.3.2. No apparent effect on radio transmission was introduced when transmitting from the top of the test system. See paragraph 2.15.3 for further details.

2.13.4. Analysis.

2.13.4.1. In its present configuration the platform is not entirely suitable for use as a patrol site because of the excessive noise emitted

by the generator of its powered hoist. Although the test system's emplacement by helicopter was quite noisy, it is felt that, once in place, further noise should be kept to a minimum. Accordingly, a quieter generator for the hoist system should be installed on the platform, and the hoist system should also be made adaptable for manual operation in the event of generator failure, or when complete silence of operation is required.

2.13.4.2. Radio transmissions from the top of the system were not affected during this limited test; however, this determination should be confirmed by the use of different radios during any future testing.

2.14. SUITABILITY AS CASUALTY EVACUATION STATION.

2.14.1. Objective.

To determine the suitability of the platform for use as a casualty evacuation station.

2.14.2. Method.

2.14.2.1. Test personnel prepared the platform for use as a casualty evacuation station by raising the A-frame into position on the platform and engaging the cable of the powered hoist to its guide pulleys. *Simulated casualties were then evacuated in a Stokes litter from the jungle floor to the platform.* The litter was rigged to carry the simulated casualties in both the upright (one time) and supine (three times) positions.

2.14.2.2. Twice, while the casualties were being raised in the litter, a UH-1B Helicopter was called in for further aerial evacuation from the platform.

2.14.3. Results.

2.14.3.1. The A-frame was easily erected and the cable engaged. Total elapsed times for this operation did not exceed one minute. However, the rate of descent of the cable to the jungle floor and the subsequent ascent of simulated casualties onto the test system was slow (hoist rated at 16 f.p.m.).



Figure 11 (top). Test personnel attempting to pull simulated casualty over side of net.

Figure 12 (bottom). Loading simulated casualty onto evacuation helicopter.

2.14.3.2. As these casualties reached their limit of ascent, the platform tended to tilt. As a result the legs of the platform had to be anchored to the nets by use of chains.

2.14.3.3. Test personnel were required to steady the litter while the hoist mechanism was reversed to let out sufficient cable to pull the simulated casualty over the net. They then disengaged the litter.

2.14.3.4. Once the litter was disengaged, a minimum of four test soldiers was needed to raise the casualty onto the platform and subsequently emplace him inside the evacuation helicopter.

2.14.3.5. While assisting in the air evacuation, the crew chief of the UH-1B Helicopter twice received electrical shocks when he touched the metal of the litter.

2.14.4. Analysis.

In its present configuration, the platform is not suitable for use as a casualty evacuation station due to the following inadequacies in the design of the A-frame:

2.14.4.1. The A-frame will not rotate; therefore, a casualty cannot be placed directly onto the platform. Less "manhandling" of the casualty would result if provisions for rotating the A-frame were incorporated into its design.

2.14.4.2. The A-frame can be fixed to the platform in only one place. It cannot be positioned to take advantage of a more desirable location. Therefore, any selectivity of evacuation routes through the canopy is eliminated.

2.15. SUITABILITY AS COMMUNICATION SITE.

2.15.1. Objective.

To determine the suitability of the platform for use as a communication site.

2.15.2. Method.

2.15.2.1. A radio net, composed of three stations employing AN/PRC-9 radios, was opened. A fourth station (in an OH-23 Helicopter) also

entered the net using the helicopter's FM radio. One AN/PRC-9 station was located on the platform, one on the jungle floor directly below the platform, and one on the ground in a cleared area approximately one-half mile away. The location of the helicopter varied with respect to the platform. During some testing it hovered virtually atop the platform while during other phases it ranged out to five miles away from the platform.

2.15.2.2. Once the net was opened, radio contact was established and an attempt made to discover any problem areas associated with using the test system as a communication site.

2.15.2.3. The radio net was operated during the day and also at night.

2.15.2.4. An OH-23 was brought to a landing on the platform at night using one AN/PRC-9 radio and the helicopter's FM homer.

2.15.3. Results.

2.15.3.1. The radio net described above operated satisfactorily both during the day and at night. No apparent effect on the clarity of signals was introduced by positioning a radio atop the test system. Transmissions at ranges up to five miles (maximum attempted) were completed.

2.15.3.2. The helicopter was landed on the platform of the test system without incident.

2.15.4. Analysis.

The platform appears to be suitable for use as a communication site with the AN/PRC-9 radio. However, if this test system is continued in development, testing with other types of radios under more varied atmospheric and climatic conditions should be conducted.

2.16. SUITABILITY AS MORTAR FIRING POSITION.

2.16.1. Objective.

To determine the suitability of the platform for use as a mortar firing position.

2.16.2. Method.

With the platform of the test system set up on the ground, an 81mm M-29 mortar was emplaced in various positions on the platform netting. Since the plan of test had been amended to delete the evaluation of the platform as a mortar firing position, note was made as to the feasibility of such an emplacement, but testing of this concept was not attempted.

2.16.3. Results.

2.16.3.1. Even when the baseplate and bipod legs of the mortar were positioned over, or in close proximity to, the support cables of the platform, the mortar sank up to 18 inches into the nylon mesh.

2.16.3.2. Had any attempt to fire the mortar been made, test personnel would have had to:

- a. Pack its baseplate and bipod legs with sand bags.
- b. Determine some means of emplacing the aiming stakes in the jungle canopy.
- c. Tighten the nylon mesh of the platform cover.
- d. Install some type of rigid planking atop the test platform to reduce its "trampoline-like" effect.

2.16.4. Analysis.

In its present configuration, the platform lacked the stability essential for its effective use as a mortar firing position. This capability, being of secondary importance to its primary use as a landing expedient, should be given a very low priority and attempts to develop it should not be allowed to delay perfection of the test system to accomplish its primary role.

2.17. SAFETY.

2.17.1. Objective.

To determine the safety aspects of all equipment used during the test program.

2.17.2. Method.

During the conduct of all operational tests, safety was emphasized. The crew chief was required to supervise actively, or assist in, attaching all sling loads carried by the helicopter, and all personnel on the nets were required to tie (or hook) themselves to the nets. At the end of testing, these and other safety features were carefully analyzed and evaluated for adequacy.

2.17.3. Results.

2.17.3.1. On one occasion during test operations a serious accident was narrowly avoided when the cable of the power hoist disengaged from the platform during recovery.

2.17.3.2. On another occasion a soldier standing on the nets was injured while supervising their tightening.

2.17.3.3. On one occasion a soldier got off the aircraft with loose coils of a safety rope hanging from his waist. A coil of the safety rope hung up on the UH-1B skid during helicopter lift-off and the soldier was carried to a height of over 100 feet before he was discovered hanging beneath the helicopter.

2.17.3.4. Several times during the test grappling hooks were found slightly deformed, and in some cases straightened, because of excessive applied loads.

2.17.3.5. No method was provided for grounding the helicopter cargo hook to discharge static electricity buildup during hook-up operations on the installed Jungle Canopy Platform System.

2.17.3.6. A safety-of-flight release was not provided for the dispenser rack, and the capability to jettison the rack under emergency conditions was not determined.

2.17.3.7. Persons on the nets and platform were in constant danger when the aircraft was hovering over or sitting on the platform because of the possibility of helicopter engine failure or momentary loss of control if the platform were to tilt or lurch unexpectedly.



Figure 13.
Coil of safety rope
hung up on UH-1B
skid.

2.17.4. Analysis.

2.17.4.1. The test system will not be safe for infantry use until a satisfactory method is found to secure all loose equipment prior to recovery, and until a preliminary operator's and organizational maintenance manual is prepared and followed by trained personnel. The lack of an adequate means to secure the hoist cable constitutes a grave safety hazard and is considered a deficiency. The lack of a preliminary operator's and organizational maintenance manual was listed as a deficiency in paragraph 2.8.

2.17.4.2. All items of equipment must be structurally sound and capable of withstanding some dynamic load for recovery purposes. Failure

of grappling hooks during recovery could be dangerous to the ground-handling crew. Some of the equipment used in the test was not safe from a structural standpoint and this was considered to be a deficiency.

2.18. NONESSENTIAL FEATURES.

2.18.1. Objective.

To determine whether the test items have any nonessential features.

2.18.2. Method.

During the course of all subtests an analysis was made to determine whether the test system incorporated any features which could be eliminated without compromising its performance, reliability, durability, or safety.

2.18.3. Results.

No nonessential features were noted on the final configuration of the test system.

2.18.4. Analysis.

Not applicable.

2.19. MODIFICATION REQUIREMENTS.

2.19.1. Objective.

To determine whether modifications are required for improvement of operational and safety factors.

2.19.2. Method.

Suitability of each major component was evaluated from an operational and safety standpoint. Particular emphasis was placed on design deficiencies.

2.19.3. Results.

The following items were found to be deficient in design or construction and required modification for operational suitability and safety:

- a. All net configurations.
- b. The platform.
- c. The dispenser rack net-laying device.
- d. Both types of reel net-laying devices.
- e. Both hoist systems.
- f. The method of attachment of the dispenser rack to the helicopter.

2.19.4. Analysis.

2.19.4.1. Modification of the nets should include as a minimum:

- a. Redesign of the spreader bars to increase their load-bearing capability; to increase their durability during ground handling and net deployment; and to provide increased rigidity of the nets on the jungle canopy.
- b. Additional attaching points for the net cables where they cross the spreader bars to distribute the load more evenly on the nets and increase the rigidity of the nets.

2.19.4.2. In the test configuration, the platform was generally impractical for use on jungle canopy of the type encountered during the test. The three legs of the platform, which form an equilateral triangle with a side dimension of eight feet, produce a high load concentration causing the nets to sag locally from the weight of the platform alone.

2.19.4.2.1. The platform was structurally designed to be capable of supporting 10,000 pounds when supported adequately itself. The limiting factor was not the platform but the strength of the jungle canopy.

2.19.4.2.2. The platform should be modified to provide simpler methods of leveling, a lower vertical center of gravity, rigidity in the top surface for stable footing, and the capability to raise or lower personnel between the platform and the jungle floor at velocities up to 100 feet per minute.

2.19.4.3. The dispenser rack should be modified to provide:

a. A simple method of rigging the net to the rack without the use of special equipment (crane, wrecker).

b. An approved method of air transport.

c. A positive release of spreader bars and a positive lock on the release mechanisms to prevent inadvertent disengaging of the release.

d. Simple and economical method of releasing each spreader bar.

e. Lightweight construction commensurate with stress requirements.

f. Compatibility with the helicopter electrical system and a quick-disconnect type cannon plug if applicable (in the event an electrical release mechanism is used).

2.20. CLIMATIC AND ENVIRONMENTAL EFFECTS.

2.20.1. Objective.

To determine the effects of adverse climatic and environmental conditions on the system.

2.20.2. Method.

Concurrently with other applicable subtest, the effects of climatic and environmental conditions encountered on the test system and its employment were noted and recorded. Specific attention was given to the effects on helicopter performance when deploying the system.

2.20.3. Results.

2.20.3.1. No adverse effects were noted on the test system as a result of climatic and environmental conditions. Fahrenheit temperatures during the test period ranged from the low 70's to the low 80's, with high humidity and frequent rainfall. Density altitude varied from +500 feet to +7000 feet at various test sites. Low ceilings and reduced visibility were quite common.

2.20.3.2. On one occasion, maximum power on the UH-1B Helicopter was required to retrieve a 20-foot net at a density altitude of 7000 feet and at a gross weight of approximately 6200 pounds. In this case, the net was ballasted with construction cable and weighed approximately 1000 pounds.

2.20.4. Analysis.

2.20.4.1. This subtest was limited by the short period of time allotted for testing.

2.20.4.2. The UH-1B Helicopter probably would be capable of installing the system in most regions where it would conceivably be required. Proper planning to keep helicopter weight to a minimum should eliminate problems in most high-density-altitude situations.

2.20.4.3. The ceiling required to install the system safely would be dependent on the method chosen to emplace the nets (see paragraph 2.7).

2.21. DURABILITY.

2.21.1. Objective.

To determine the durability of the test item.

2.21.2. Method.

Throughout the conduct of applicable subtests, data reflecting on the durability of the equipment were recorded. Specific attention was paid to major components only. Hardware which was tested and subsequently discarded as unsatisfactory by USALWL was not evaluated.

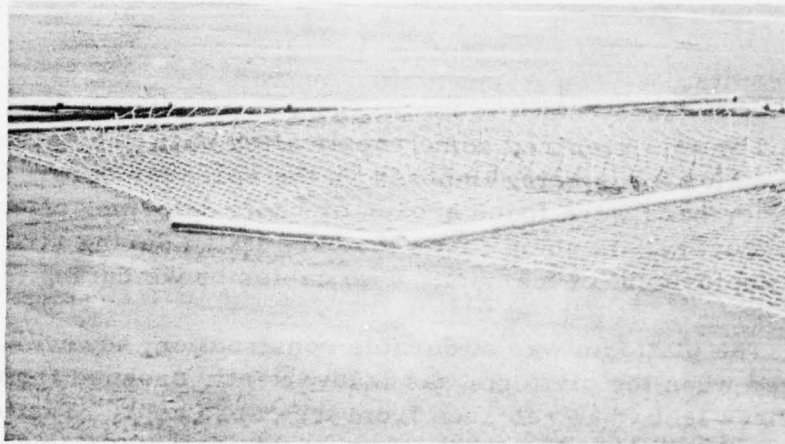
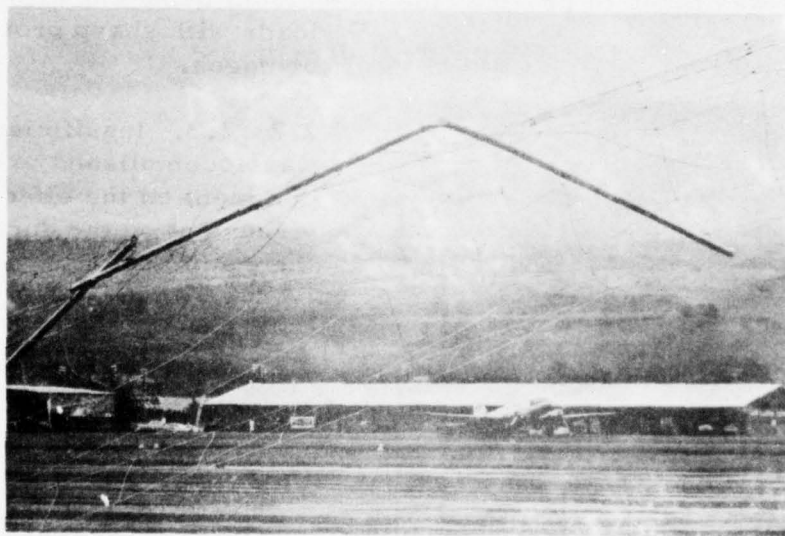


Figure 14 (above). Bent spreader bar.

Figure 15 (below). Bent spreader bar.



2.21.3. Results.

2.21.3.1. The nets required some repair after each use because of the high compression loads being imposed on the spreader bars. One or more spreader bars were found broken or badly deformed after almost every net recovery. In some cases the bars failed during air transport and during deployment of the nets. Two cables broke during the test.

2.21.3.2. The platform was of durable construction; however, one leg was damaged when the platform was inadvertently dropped from a height of two or three feet when released from the cargo hook. The fabric netting which forms the working surface of the platform was damaged when a grappling hook was inadvertently ensnared in the mesh.

2.21.4. Analysis.

2.21.4.1. The present configuration and construction of the nets are unsatisfactory from the durability standpoint because of the excessive repair requirements. The spreader bars must be redesigned and be attached to the nets in a different manner to allow better distribution of the load on the entire net.

2.21.4.2. The platform must be handled carefully when being picked up or set down to prevent damage to the legs. It is doubtful that the fabric mesh on the platform would survive under field conditions unless great care was taken to prevent the mesh from being cut with heavy loads with sharp protrusions or edges.



2.21.4.3. Insufficient testing was accomplished to permit comment on the effects of environment on the durability of the equipment.

Figure 16.
Broken spreader bar.

2.22. RELIABILITY.

2.22.1. Objective.

To determine the reliability of the system and its components.

2.22.2. Method.

Throughout the conduct of the test, data reflecting on the reliability of the test system were recorded. Major components only were considered. Items tested and subsequently discarded by USALWL were not evaluated with the exception of the reels.

2.22.3. Results.

2.22.3.1. The nets were reliable when in the proper state of repair prior to installation. Satisfactory employment was achieved even when spreader bars were broken during emplacement.

2.22.3.2. The reels were completely unreliable as a means of net deployment because of fouling of the nets during deployment and unreliability of the brake system. The reels were discarded prior to the end of testing.

2.22.3.3. The dispenser rack was unreliable when laying the aft net while moving forward because of the crude hardware.

2.22.3.4. The USALWL refueling pump was unreliable because of improper maintenance and use prior to testing.

2.22.4. Analysis.

2.22.4.1. The system is reliable for deployment of troops. Troops can be deployed satisfactorily on every installation if the site is chosen properly.

2.22.4.2. Expanding the site to permit medical evacuation with the platform and hoist or to permit helicopter refueling will not always be possible because of variations in the canopy structure unless time is available to permit improvement on the net and platform installation after the initial employment. It is impossible to achieve a stable platform installation every time even when utilizing trained personnel.

2.23. HUMAN-ENGINEERING CHARACTERISTICS.

2.23.1. Objective.

To determine human-engineering factors associated with functional and operational parameters.

2.23.2. Method.

Because of the experimental nature of this test and the lack of a final configuration to evaluate, human-engineering characteristics were not determined.

2.23.3. Results.

Not applicable.

2.23.4. Analysis.

Not applicable.

2.24. DESIGN CRITERIA.

2.24.1. Objective.

To determine whether the LWL Jungle Canopy Platform System, including all auxiliary equipment, meets the design criteria specified in existing drawings and technical specifications.

2.24.2. Method.

A review of all drawings provided in the USATECOM Planning Directive and the Structural Design Analysis of the Helicopter Landing Platform prepared by Geometrics, Inc., was made prior to initiation of test. During conduct of LWL's tests, particular attention was directed toward determining design deficiencies occurring as a result of test.

2.24.3. Results.

2.24.3.1. The drawings available for review were:

a. USALWL Drawing No. 6-1006-4, Sling, Anti-Sway and Breakaway Cable Assembly for Carrying Net Reel with UH-1B.

b. Geometrics, Inc., Drawings No. 135M-310, Jungle Canopy Net Reel Modification 20 Foot Reel Assembly; No. 135M-10, Jungle Canopy Net Reel Modification, 20-Foot Details; No. 135M-12, Jungle Canopy Net Reel Modification Brake Control Handle; No. 135M-13, Support Net Assemblies for Jungle Canopy Platform; No. 135-1 and -2, Platform Assembly Jungle Canopy Platform.

c. Western Gear Corporation Drawing, "Sky Climber Hoist Assembly."

The drawings listed above did not contain design criteria but instead showed only a final configuration by which the items were constructed. Technical specifications were not available for all items.

2.24.3.2. The Structural Design Analysis of the platform contained both design criteria and a method of arriving at a calculated solution. Ultimate performance of the Jungle Canopy Platform System to support 10,000 pounds including all auxiliary equipment was not approached during conduct of this test. The limiting factor in utilizing this system lies in the jungle canopy and not the system in its present configuration. If the jungle canopy can support the system and the ultimate payload, the system should meet the design criteria. Therefore, design requirements appear to have been excessive. See paragraph 2.19 for modification recommendations and discussion.

2.24.4. Analysis.

Not applicable.

2.25. COMMERCIAL EQUIPMENT.

2.25.1. Objective.

To determine whether the commercial equipment used during the test is considered as a potential part of the system and should be considered for further engineering tests.

2.25.2. Method.

The single hoist assembly was used at various times during the course of testing. Tests were conducted using the three-foot square cage, modified litter baskets, and personnel wearing harnesses. The double hoist assembly was mounted on the platform and used only one

time. This test was conducted while the platform was deployed on the 20-foot nets. The gasoline-engine driven generator was used to provide power to both hoist assemblies.

2.25.3. Results.

2.25.3.1. The first attempt to use the single hoist assembly resulted in generator-engine stoppage after lowering the cage approximately 80 feet. New brushes were installed and the cage was raised up to the platform. One man weighing approximately 170 pounds was lowered to the jungle floor and then raised back up to the platform. Two men whose combined weight was approximately 320 pounds were lowered to the jungle floor. An attempt was made to raise these two men back up to the platform; however, the hoist system was incapable of raising their weight. The 170-pound man was again raised to the platform. Raising the man approximately 105 feet required six minutes. USALWL test personnel then deleted the cage from the system. Subsequently, the hoist was utilized to raise and lower personnel singly while wearing harnesses. Several lifts were made with personnel in a modified litter basket.

2.25.3.2. The double hoist system, which weighs approximately 400 pounds, was installed on the platform and utilized one time. One man weighing approximately 150 pounds and wearing a harness was raised from the jungle floor to the platform.

2.25.3.3. The generator did not provide sufficient power to the hoist systems to enable them to perform at rated capacity. In addition, the generator was excessively noisy (see paragraph 2.13).

2.25.4. Analysis.

2.25.4.1. It was apparent that neither the single nor the double hoist systems would perform at rated weight capacity (600 pounds) because the gas-engine-driven generator does not provide sufficient power to the hoist systems.

2.25.4.2. The slow speeds of the two systems, 16 and 32 f.p.m., were considered inadequate. It is felt that the most desirable system should be capable of lifting 400 pounds' weight at velocities up to 150 f.p.m.

SECTION 3
APPENDICES

APPENDIX I

DETAILED DESCRIPTION OF MATERIEL

The basic Jungle Canopy Platform System consists of two support-net assemblies, a means of transporting and laying the nets, a platform for emplacement on the nets, and various items of auxiliary equipment. This appendix contains a detailed description of the major items used during the test.

1. Support-Net Assemblies. Three different sizes of nets--10 x 200 feet, 10 x 250 feet, and 20 x 250 feet--were used. In addition, one 20- x 250-foot net was modified during the test by cutting 27 feet off each end, leaving a total length of 196 feet. The nets consist of stainless steel cables woven into a square mesh and aluminum spreader bars spaced at



Figure 17. Support net assemblies in place atop jungle canopy.

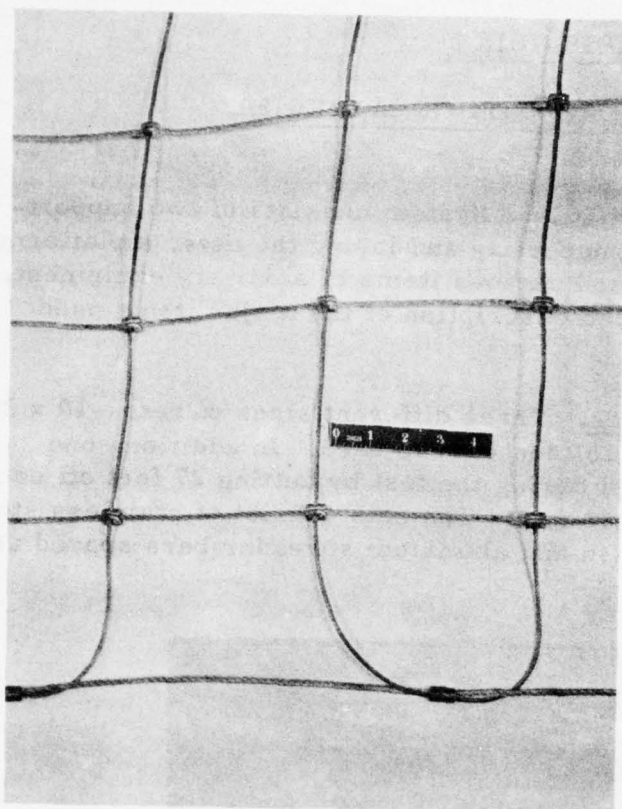


Figure 18.
Net center section, six-
inch square mesh.

intervals laterally across the net. The longitudinal cables are $\frac{3}{16}$ inch in diameter and lateral cables are $\frac{1}{8}$ inch in diameter with breaking strengths of 4000 and 2000 pounds, respectively. The cables are fastened together at each point where they cross. Each net has a yoke at one end for attachment to the helicopter cargo sling hook and a grapnel assembly at the other end for engaging tree branches when emplacing the net.

a. The 10- x 200-foot net has a 60-foot center section of six-inch square mesh and two 70-foot end sections of 30-inch square mesh. Eleven lateral spreader bars, aluminum tubes $1\frac{1}{2}$ inches in diameter, are spaced at 20-foot intervals on the net.

b. The 10- x 250-foot net has a 60-foot center section of six-inch square mesh and two 95-foot end sections of 30-inch square mesh. Twelve lateral spreader bars, aluminum tubes $1\frac{1}{2}$ inches in diameter, are

spaced at 20-foot intervals across the center section, 22.5-foot intervals across the next 45 feet, and 25-foot intervals across the end 50 feet.

c. The 20- x 250-foot net has a 40-foot center section of six-inch square mesh and two 105-foot end sections of 30-inch square mesh. Eleven lateral spreader bars, aluminum tubes 2 1/4 inches in diameter, are spaced 20 feet apart across the center section, 25 feet apart across the next 50 feet, and 27.5 feet apart across the end 55 feet.

d. One 20- x 250-foot net was modified by cutting 27 feet off each end, leaving a total length of 196 feet. Two spreader bars were attached at each end and banded together for extra strength. The bar in the center of the six-inch mesh section was removed and two bars added, one bar eight feet from each end of the section.

2. Dispenser Rack.

a. The dispenser rack is a framework of metal pipe with provisions for carrying and deploying two support nets. It is attached to the cargo hook by means of a shackle secured to a cable attached to two eyes on the left side of the frame and running freely through two corresponding eyes on the right side of the frame. Four uprights mounted on the forward and center cross members of the frame serve to stabilize the installation and keep the frame aligned with the helicopter skids at all times. Two "feet" on the center cross member provide ground clearance for the spreader bars to prevent damage to them when landing the helicopter on the rack when it is placed on the ground.

b. A central beam extending the length of the framework incorporates thirty bungee-loaded lever arms with hooks in the bottom ends to support and release the individual spreader bars. Each hook is made to release the spreader bar by pulling a riser cord which passes through an eye on the left longitudinal member of the frame.

3. Reel Assemblies.

a. The 10-foot reel assembly consists of an aluminum spool four inches in diameter and approximately 12 feet long, capped inboard of each end by 30-inch diameter aluminum discs to guide the net as it is deployed from the reel. A three-inch diameter tube for supporting the loaded spool is welded to two brackets attached to the ends of the spool and bushed to permit rotation of the spool and deployment of the net.

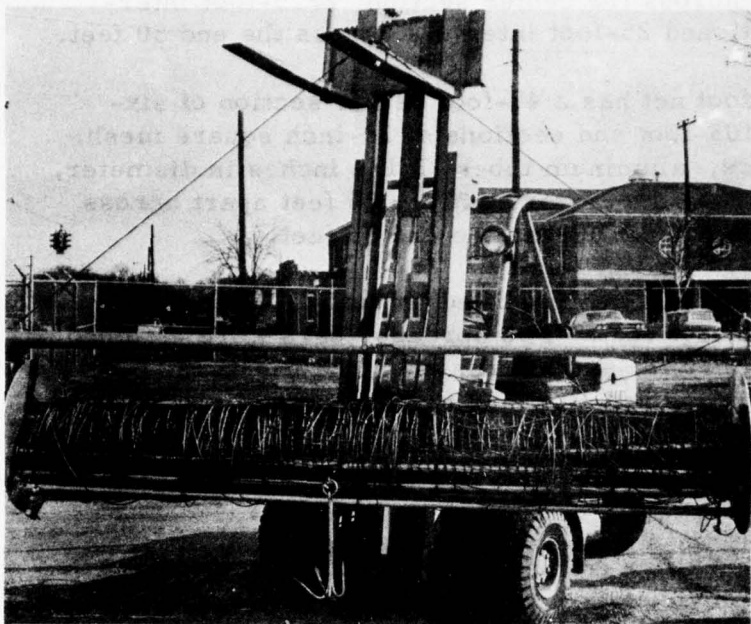


Figure 19.
Ten-foot reel assembly
with net wound for laying.



Figure 20.
Ten-foot reel assembly
with net mounted on
UH-1B.

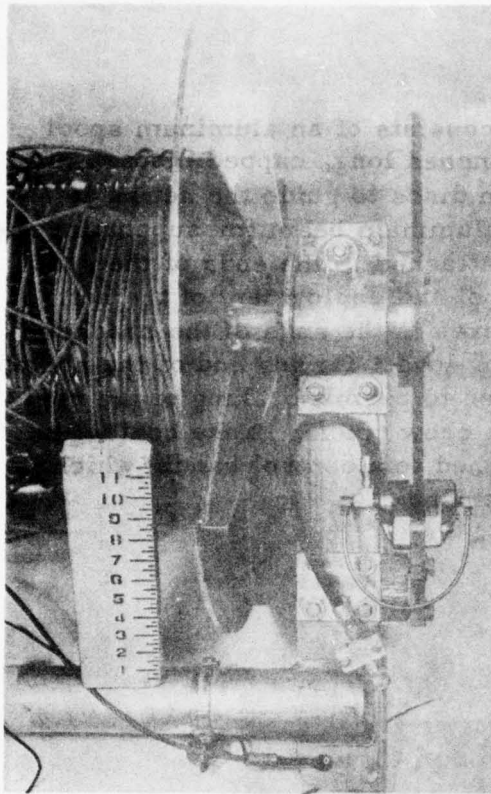


Figure 21. Brake assembly
10-foot reel.

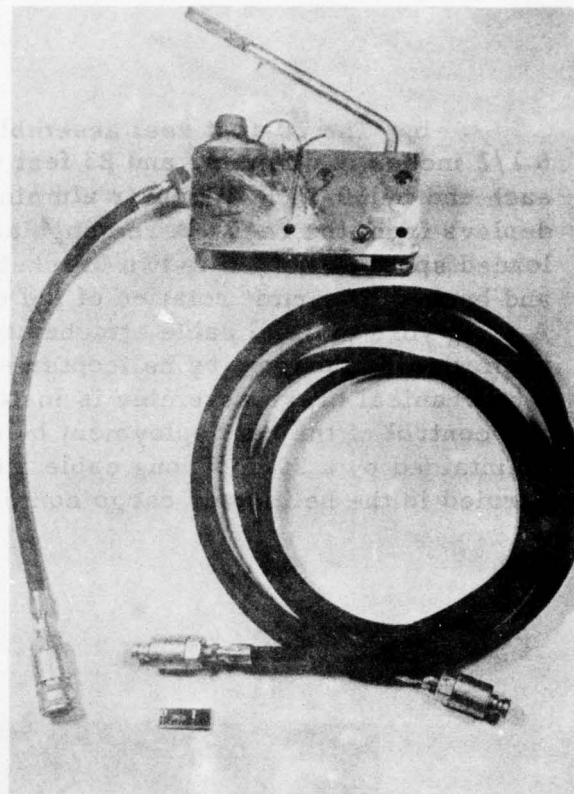


Figure 22. Brake control
lever and hydraulic line,
10-foot reel.

A sling yoke of steel cable attached to eyes in the ends of the brackets permits air transport by helicopter sling load. On one end of the spool outboard of the bracket, a steel disc 18 inches in diameter is installed with a hydraulic cylinder to permit hydraulic braking by the crew chief or other control personnel in the aircraft. Braking is controlled by a lever which actuates the hydraulic cylinder via a 15-foot long hydraulic line.

b. The 20-foot reel assembly consists of an aluminum spool 6 1/2 inches in diameter and 23 feet 4 inches long, capped inboard of each end by 30-inch-diameter aluminum discs to guide the net as it deploys from the reel. A rectangular aluminum beam for supporting the loaded spool is welded to two brackets attached to the ends of the spool and bushed to permit rotation of the spool and deployment of the net. A sling yoke of steel cable attached to eyes in the ends of the brackets permits air transport by helicopter sling load. On one end of the spool, a mechanical brake assembly is installed to permit braking of the reel and control of the net deployment by the crew chief. Brake control is maintained by a 20-foot long cable attached to a control handle which is carried in the helicopter cargo compartment.

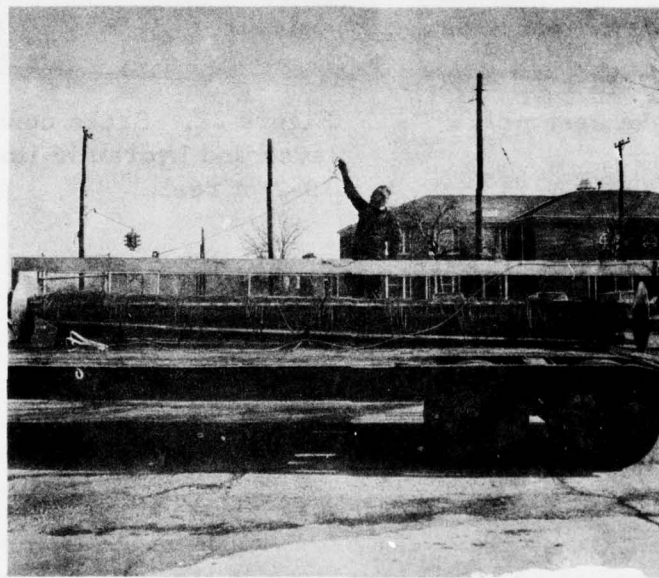


Figure 23. Twenty-foot reel assembly with net wound for laying.

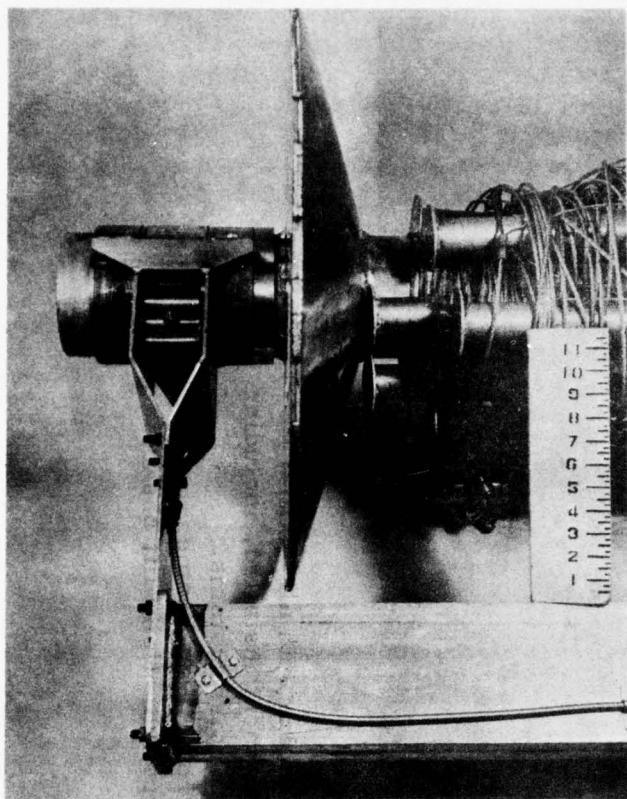


Figure 24.
Brake assembly, 20-foot
reel.

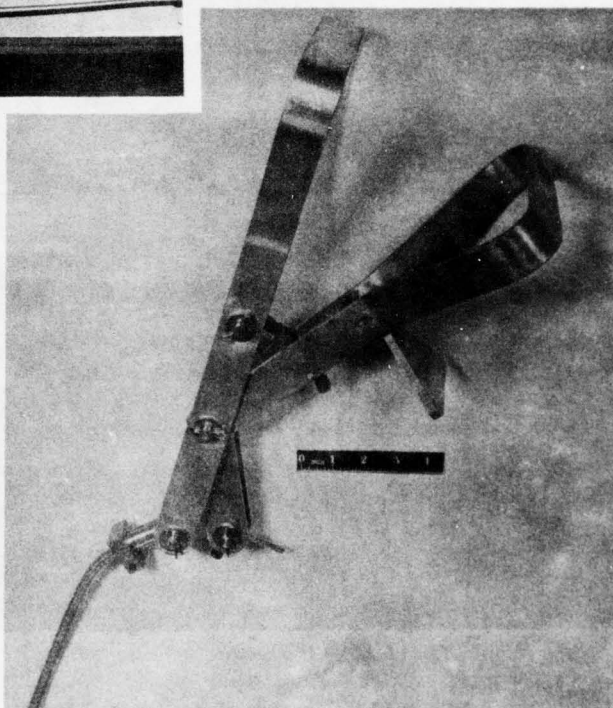


Figure 25.
Brake control handle,
20-foot reel.

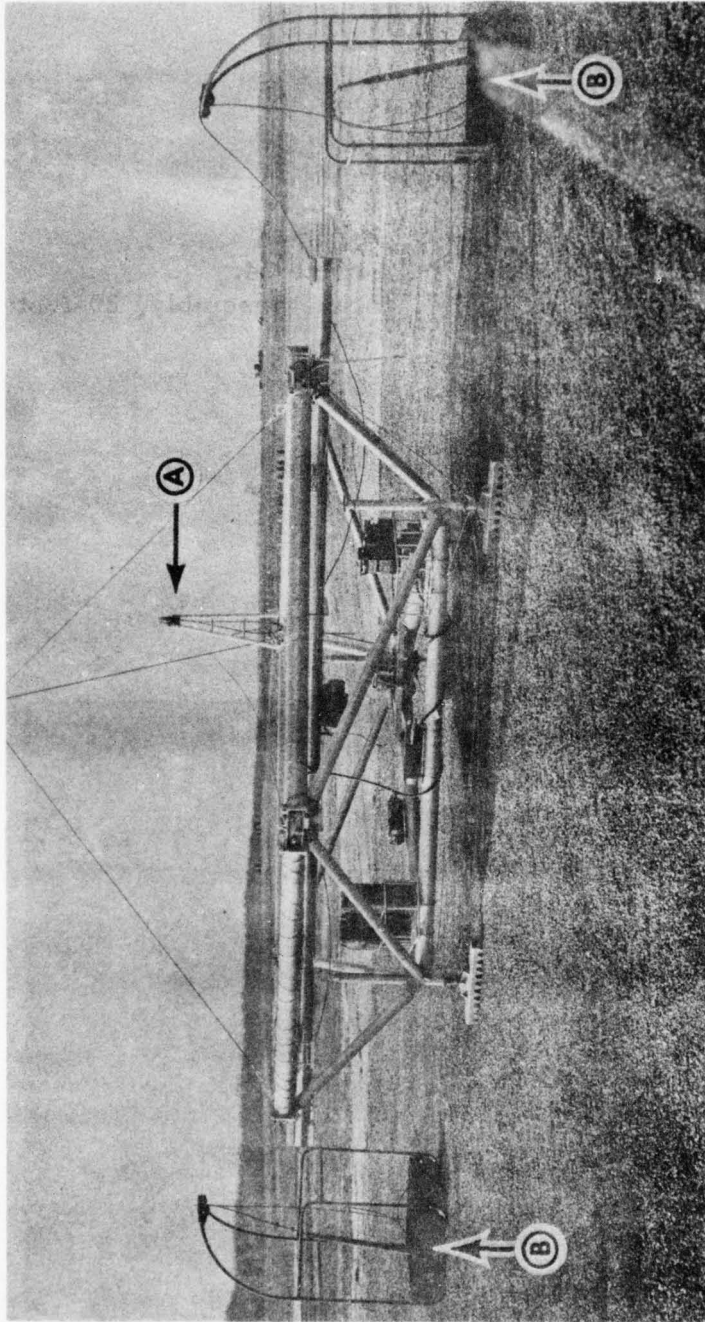


Figure 26. Platform with all auxiliary equipment installed, including both hoist systems.
Arrow A: A-Frame
Arrow B: Hoist lift baskets

4. Platform. The platform consists of an 18-foot diameter hexagonal space frame supported by struts attached to a triangular base. The space frame is constructed of 5-inch-diameter aluminum tubing, the struts of 3-inch-diameter aluminum tubing, and the base of 4 1/2-inch-diameter aluminum tubing.

a. The top of the platform is covered with one-inch square mesh nylon netting tied to the frame at approximately six-inch intervals and stretched taut. Stranded steel cables, 1/2 inch in diameter, are attached at each corner of the hexagon-shaped frame, stretched across the frame underneath the netting, and attached to opposing corners. These cables are tied together with U-bolts wherever they cross.

b. Jacking legs are attached at the corners of the base. The legs can be extended up to 18 inches and are used for leveling the platform. Each leg terminates in a serrated foot 30 inches long and six inches wide, with teeth extending downward to engage the mesh of the nets.

c. Baskets are mounted on the base at two corners of the triangle. One basket is used for mounting a two-kilowatt generator; the other is compartmented and holds four standard five-gallon gasoline or water cans. A plate installed across the third corner of the triangle is used for mounting a power hoist system. An A-frame with guide brackets, mounted on the platform frame immediately above the hoist, extends upward and outward approximately three feet from the platform frame when in use and folds back onto the platform top when not in use. Two dry-chemical, powder-type fire extinguishers, one beside each basket, are mounted on brackets on the platform base.

d. Without the auxiliary equipment installed, the platform weighs 520 pounds. Installation of the auxiliary equipment increases the weight to 700 pounds.

5. Generator. The two-kilowatt generator, mounted on the platform base, is a Model MK-2 MITE-E-LITE. It is driven by a four-horsepower, four-cycle, Briggs and Stratton gasoline engine, Model 100 902.

6. Hoist Systems. Two hoist systems were used. One was mounted on a plate on the platform base, and the other was mounted on an aluminum frame which attached to the underside of the platform frame. Both used a Sky Climber hoist, Model 6WL1000. The Sky Climber is driven by a 3/4-horsepower, 60-cycle, 108/216-volt, 12.2/6.1 ampere electric motor which obtains its power from the two-kilowatt generator.

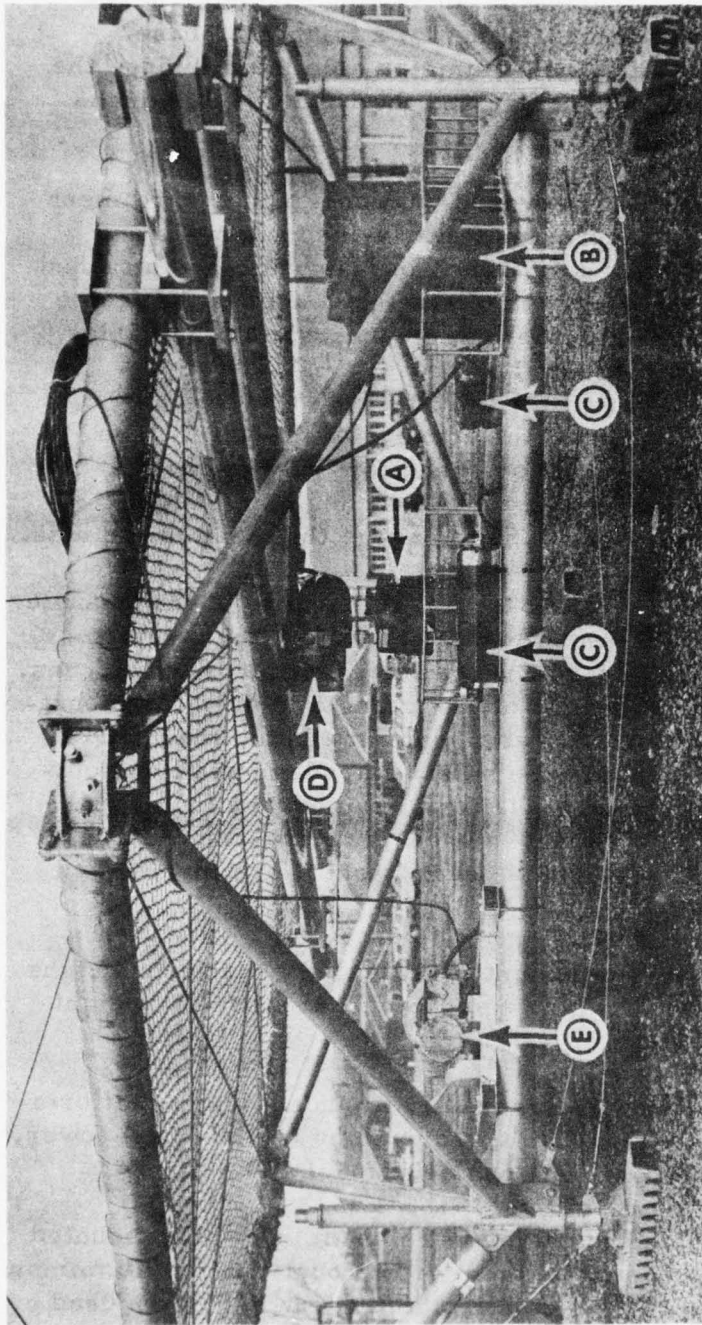


Figure 27. Underside of platform with all auxiliary equipment installed including both hoist systems.

Arrow A: Two-kilowatt generator

Arrow B: POL storage

Arrow C: Fire extinguishers

Arrow D: Hoist motor (double hoist system)

Arrow E: Hoist motor (single hoist system)

a. The hoist mounted on the base is an approved commercial type used by construction companies. The cable is routed across the pulley on the A-frame mounted on the platform frame. The hoist has a load capacity of 600 pounds and a rate of ascent of 16 f.p.m. The system lifts a three-foot square basket which can be converted for carrying a litter. System weight is 86 pounds.

b. The other hoist system consists of a Sky Climber, modified to obtain a rate of ascent of 32 f.p.m., mounted on a plate in the center of an aluminum frame. A pulley for the hoist cable is mounted on each end of the frame. The frame bolts to the underside of the platform frame and protrudes about two feet on either side of the platform. This system also has a load capacity of 600 pounds and handles two baskets or two litters, one ascending while the other is descending. System weight is 400 pounds.

APPENDIX II

DEFICIENCIES AND SHORTCOMINGS

1. Deficiencies. This section contains a list of deficiencies which must be corrected before the test system is suitable for use.

<u>Deficiency</u>	<u>Suggested Corrective Action</u>	<u>Remarks</u>
a. The two-kilowatt generator of the hoist system was too noisy.	Install a quieter generator. Also, make this system adaptable to manual operation in the event of generator failure or when complete silence of operation is required.	
b. The powered hoist was excessively slow and would not perform at rated capacity.	Provide a silent hoist system capable of raising or lowering 600 pounds at speeds adjustable up to 100 f. p. m.	
c. The A-frame, as presently installed is inadequate.	Provide an A-frame (1) which is movable from one corner of the platform to another, (2) which can be swiveled once the load being raised reaches its apex, and (3) which is adaptable for use with a vertical hauling line in the event of generator or powered hoist failure.	

<u>Deficiency</u>	<u>Suggested Corrective Action</u>	<u>Remarks</u>
d. There was no Preliminary Operator's and Organizational Maintenance Manual furnished with the Jungle Canopy Platform System.	Prepare a suitable manual prior to further testing, including therein the maximum number of illustrations and photographs.	Had a manual with proper safety precautions outlined been available to personnel using the system during the test, some of the incidents reported in paragraph 2.17, section 2, possibly could have been prevented.
e. A safety-of-flight release was not provided for the dispenser rack.	Secure a safety-of-flight release from USAAVCOM to include clearance to jettison.	
f. Spreader bars were not designed for a load-bearing capability and were not attached to net to provide distribution of load.	None.	
g. Neither the reel nor the dispenser rack was satisfactory in the test configuration for laying nets.	None.	It is assumed that the reel will no longer be considered for adoption as a component of the system.

<u>Deficiency</u>	<u>Suggested Corrective Action</u>	<u>Remarks</u>
h. Design of the platform was such that it did not give best load distribution on the nets, and it was unstable due to high centroid location.	Redesign platform to provide better load distribution to the nets and improve stability by lowering the centroid of the platform.	
i. The hoist on the platform did not provide adequate means for securing the hoist cable when not in use.	Provide a snap-type clamp for securing the cable safely but retain quick access to use of the cable.	

2. Shortcomings. This section contains a list of shortcomings which, if corrected, would improve the suitability of the system.

<u>Shortcoming</u>	<u>Suggested Corrective Action</u>	<u>Remarks</u>
a. There was no commonality of parts such as nuts, bolts, etc.	Provide standard nuts, bolts, etc., to permit interchangeability from component to component.	
b. There was too much loose auxiliary equipment associated with the system.	Provide a kit for auxiliary equipment as a part of the platform.	

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