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DESIGN AND FABRICATION OF THE NASA HL-20 SUPPORT CRADLE AND INTERIOR MOCKUP

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FINAL REPORT

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This work was performed under NASA Grant NAGW-1331
(Sub Contract #88-0512)

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ABSTRACT

An extensive test program involving analysis in both the horizontal and vertical attitudes of the HL-20 will be conducted by NASA, Langley Research Center in Hampton, VA. This necessitated the fabrication of a steel support cradle for the composite PLS model and an internal mockup to simulate the pilot and passenger compartments

INTRODUCTION

A cradle was fabricated for the HL-20 Personnel Launch System (PLS) for support during testing. It will also support the HL-20 during transportation. Construction techniques were developed to ensure maximum safety for crew during testing. Extensive use of undergraduate students was an objective of the project so as to encourage their involvement in the space technology program.

The cradle is a steel tube space frame structure 23 ft. long, 8 ft. wide and 3 ft. high. It is made up of an upper and lower assembly. The primary purpose of the cradle is to support the HL-20 fully loaded and to raise it from a horizontal to a vertical position. While in a vertical position, studies will be made of crew ingress and egress. To accomplish this, the upper assembly of the cradle can be elevated to a vertical position. The assembly rotates about a pivot pin mechanism located on the rear of the platform. The tri-structure can be raised using a hydraulic system or a crane. A removable out-rigger can be attached to the front of the tri-structure for lifting by a crane.

HL-20 PROJECT

The Tri-Structure (Upper)

The upper assembly of the cradle is a triangulated round tube structure. The HL-20 is attached to the cradle tri-structure at three hard points on the bottom of the vehicle. A clevis assembly is used to attach the HL-20 to the cradle tri-structure. One half of the clevis is welded to steel plates which are attached to the three hard points on the HL-20. The other half of the clevis is welded to the tri-structure. Three pins are used to attach the two halves of the clevises.

The tri-structure is attached at the aft end of the cradle through a 3" pivot pin assembly that allows it to be raised in a vertical position while being supported by the platform (lower part) of the cradle.

Additional plating and tubing is added to the tri-structure to maximize its strength while supporting the HL-20 in its vertical position.

Lifting the tri-structure into a vertical position can be accomplished with a crane or self contained hydraulic system.

HL-20 PROJECT

Platform

The platform assembly (lower part) is a steel rectangular structure with attachments for anchoring during vertical positioning of the tri-structure. The aft end of the platform is angled upward approximately 40 degrees to allow 36" clearance between the ground and the PLS in a vertical position. This will allow the crew to enter and exit the vehicle when in the vertical position. Fork lift guides and lifting pads on the platform are used for loading and unloading of the cradle to and from a transport vehicle. Attaching screw jacks are used at each corner of the platform to help position the cradle when loading the HL-20 onto the cradle. Once positioned, three clevises pins are installed to secure the HL-20 onto the cradle.

HL-20 PROJECT

Safety Stand

The safety stand is constructed of 4" round tubing with a .250 wall. It is used to give additional support to the HL-20 while in a vertical position. Hard points built into the rear of the HL-20 contact the safety stand at 5 points. These points are adjustable to level the HL-20. Two and 1/4 inch Acme screw rod and nut assemblies were used to fabricate adjusters.

HL-20 PROJECT

Interior Mockup

The full scale PLS mockup will be evaluated in both horizontal and vertical positions. Evaluations will require that humans be inside the mockup. The only active systems will be those for ventilation of heating or cooling, lighting, interactive display/control panels, and a video/audio monitoring and communication system. The mockup will have two exits (a top and a rear hatch), ten seats, pilot control stations, and simulated storage and sub-system placement.

The PLS mockup of the interior covers 277 inches or 23 feet of tubular fuselage which varied in ceiling height from 51 inches to 77 inches accommodating eight passengers in addition to the pilot and co-pilot.

Exposed interior rib/storage modules were fabricated of 3/4 inch marine plywood in two halfs to facilitate installation and future removal from the spacecraft. The modules being 17 inches wide were placed 17 inches on-center to provide individual storage space to each seat passenger. Also twice this dimension, 34 inches, would accomodate the standard seat spacing. The plywood modules were covered with aluminum sheet at the base and fiberglass sheet at the walls where individual lighting and air conditioning was provided.

Through the use of photographs and high density foam blocks, simulating avionics, electro optics and computers, a very realistic pilot/co-pilot cockpit platform was fabricated.

The interior was trimmed out in soft pastel tones of off-white and blue with complementing earth tone carpeting. Ten seats were provided - two abreast - using a 14 inch wide, two position locking mechanism.

The HL-20 evaluation will include determination of anthropometric fit, subjective acceptability, pilot viewing capabilities, and emergency egress procedures and completion times using volunteers ranging in size between the 5th and 95th percentiles. After the initial evaluations, astronauts will be invited to evaluate the mockup design. Suggested changes will be considered and incorporated to eliminate excessive re-working during the manufacturing process.

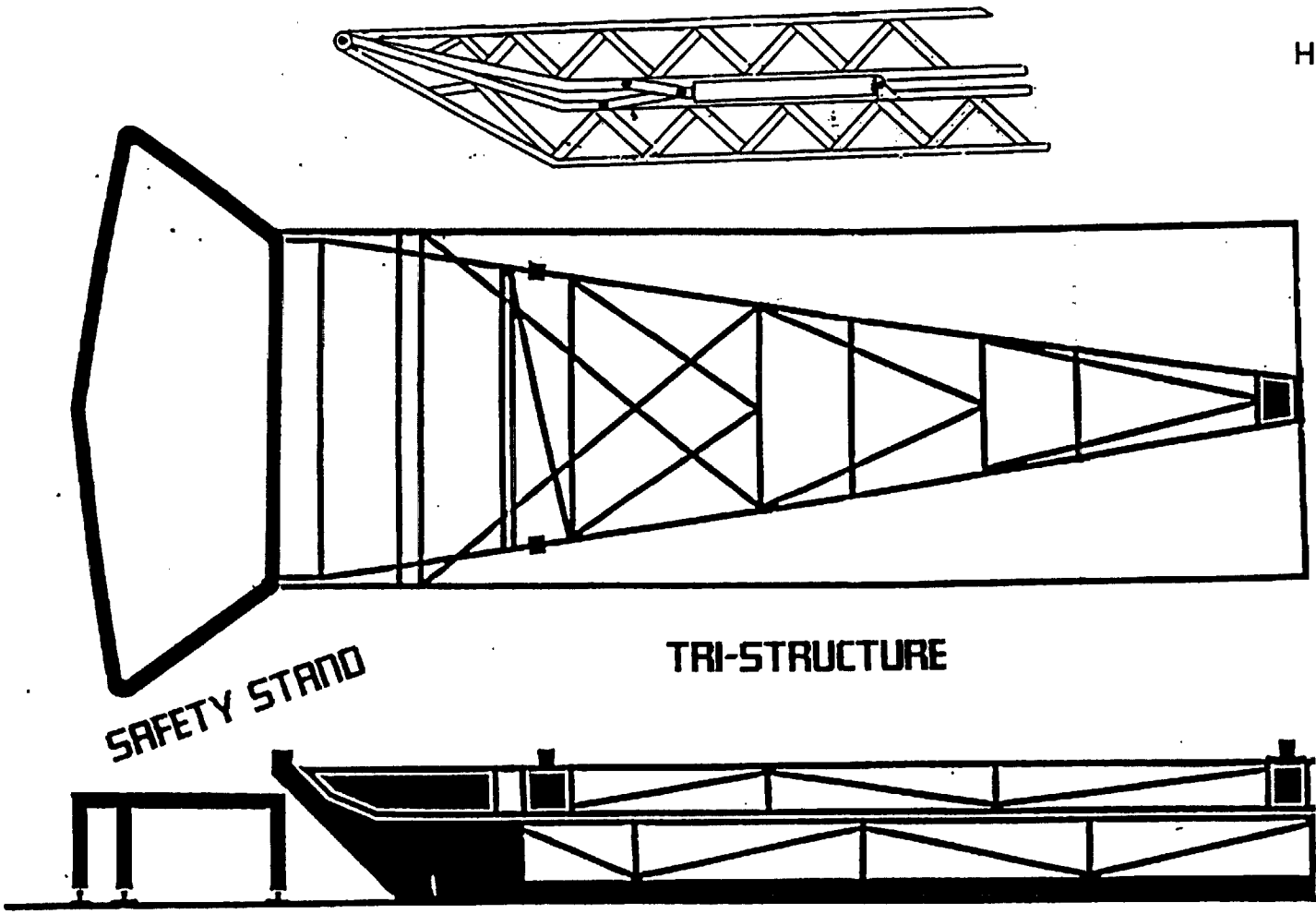
ACKNOWLEDGEMENTS

I would like to acknowledge the efforts of the student participants and Dr. Raj Chowdhury from the School of Technology and Dennis Hugley; William H. Piland, Howard W. Stone from NASA and other NASA personnel; and Dr. Fred DeJarnette, Director of the Mars Mission Center.

Dimensions: 23 Ft. Long
8 Ft. Wide
3 Ft. High

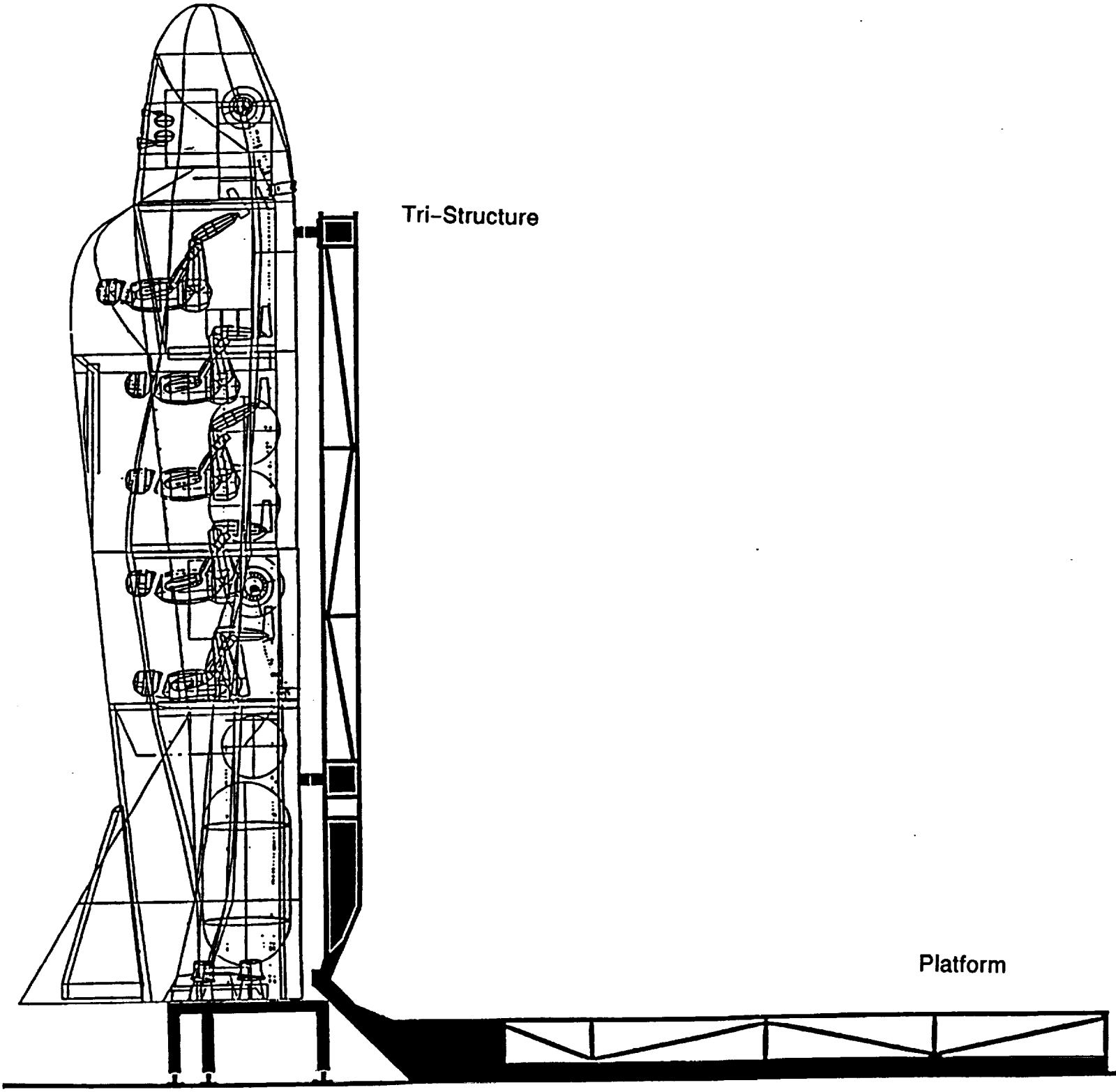
Approx. weight: 6,000 pounds

Heil-arc welded high strength steel



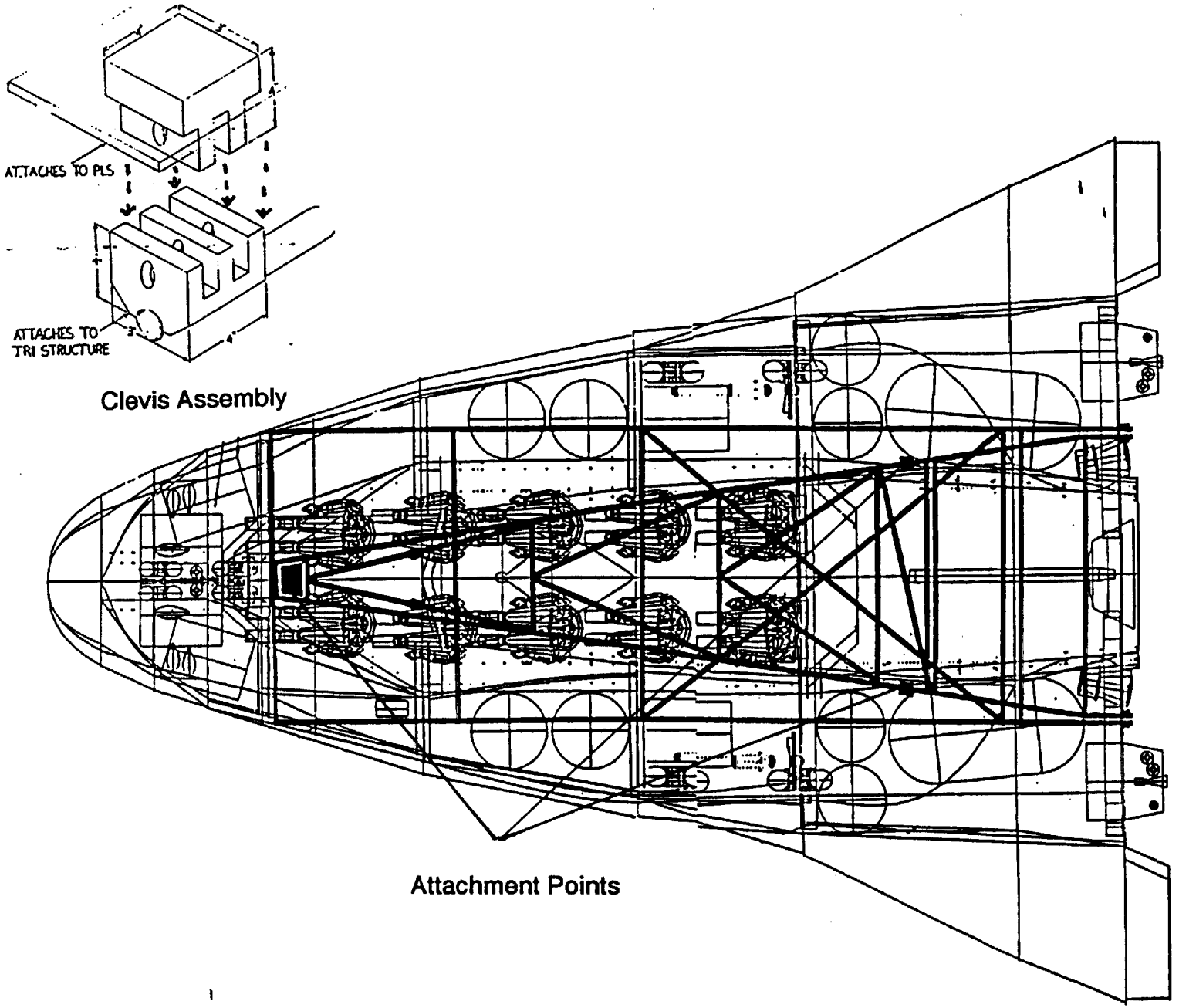
PLS SUPPORT CRADLE

Figure 1



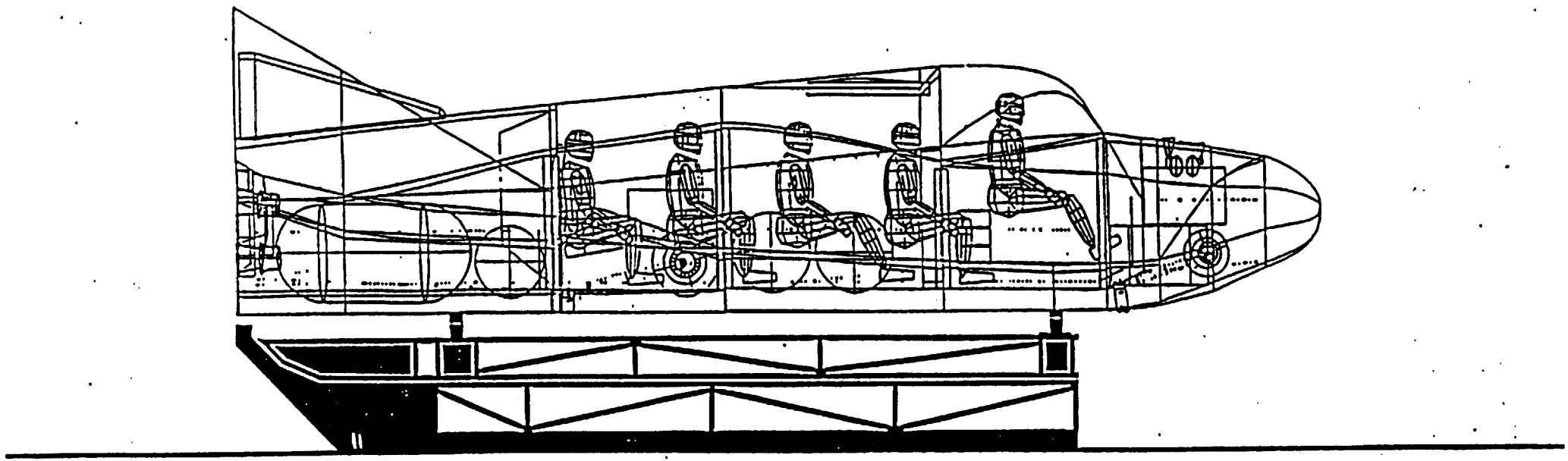
PLS IN VERTICAL POSITION

Figure 2



ATTACHMENT POINTS FOR PLS TO CRADLE

Figure 3



HL-20 POSITION ON SUPPORT CRADLE

Figure 4