SPACE STATION STRUCTURES

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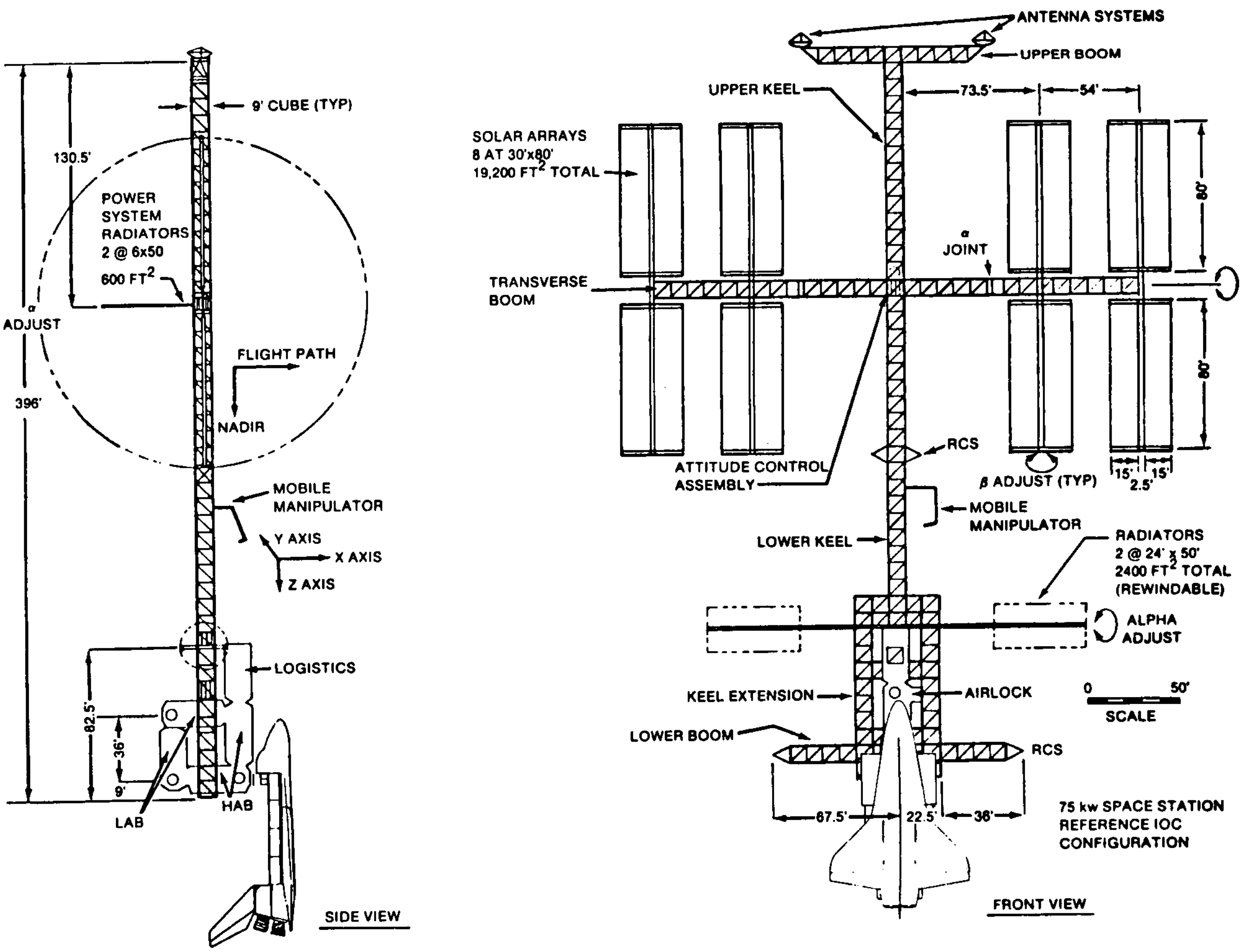
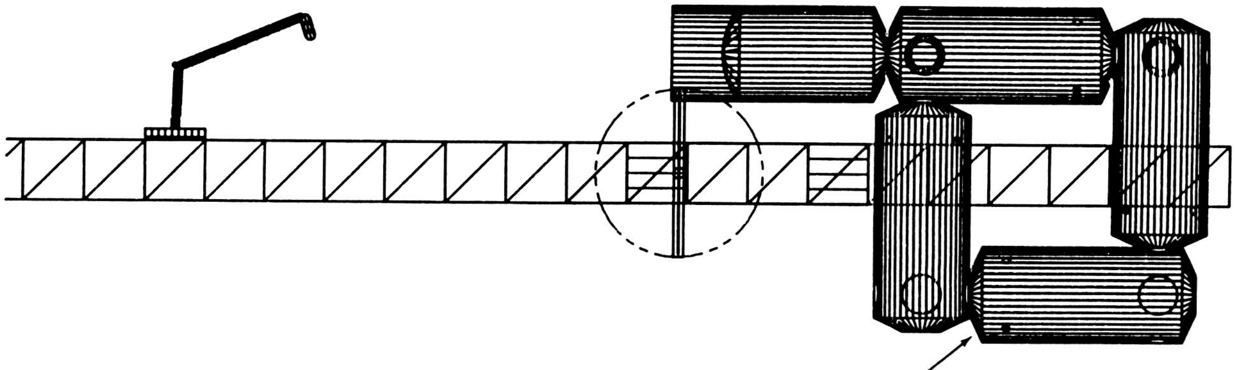
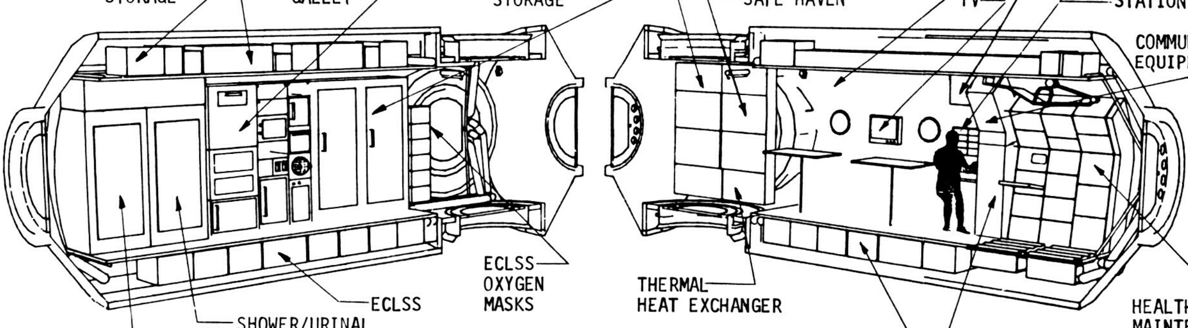
- 0 WILL PRESENT BRIEF OVERVIEW OF SOME STRUCTURAL RESULTS THAT CAME FROM SPACE STATION "SKUNK WORKS"
  - 0 PRESSURIZED MODULES
  - 0 PRIMARY TRUSS STRUCTURE
    - 0 DEPLOYABLE SINGLE FOLD BEAM
    - 0 ERECTABLE BEAM
    - 0 DEPLOYABLE DOUBLE FOLD
  - 0 TYPICAL TRUSS ATTACHMENT DEVICES
  - 0 DEPLOYMENT BACKUP PROCEDURES
  - 0 CONCLUDING REMARKS



REFERENCE CONFIGURATION

I. PRESSURIZED MODULES





HAB MODULE

THE PRIMARY STRUCTURE OF THE MODULES USES TYPICAL AIRCRAFT CONSTRUCTION

O I.E. O SKIN-STRINGER
O HONEYCOMB

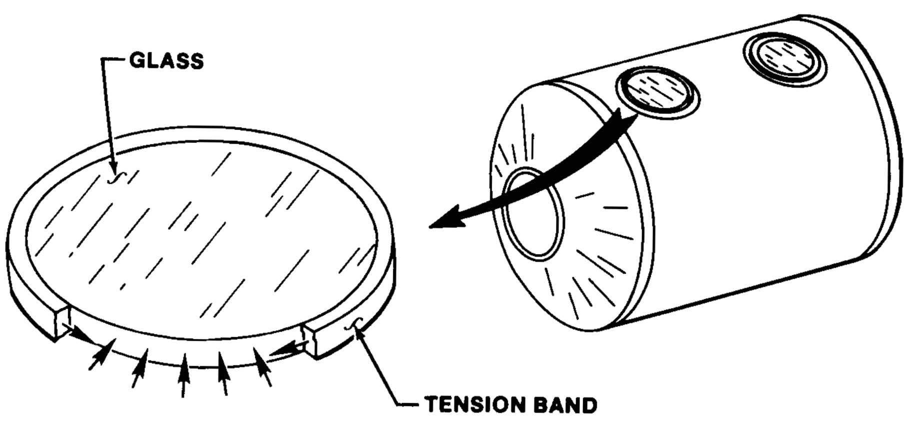
O IT IS DESIGNED PREDOMINANTLY BY ORBITER LAUNCH LOADS.

SOME UNIQUE ITEMS THAT ARE BEING STUDIED FOR POSSIBLE USE ON THE MODULES ARE:

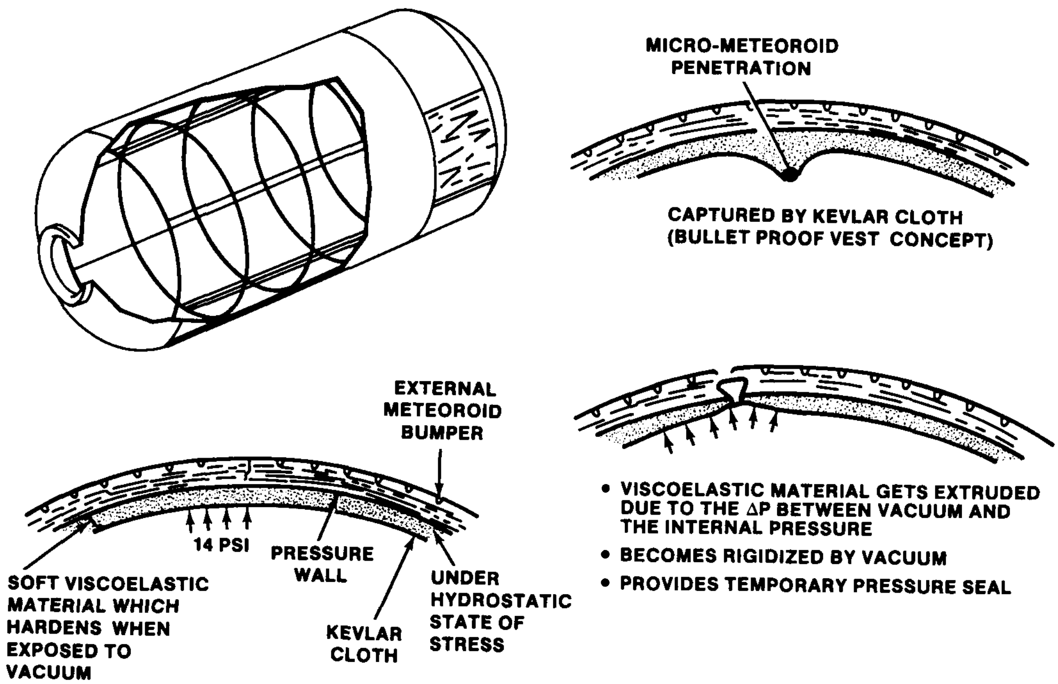
O MECHANICALLY PRESTRESSED CIRCULAR WINDOWS
O PENETRATION TOLERENT STRUCTURE

MECHANICALLY PRESTRESSED CIRCULAR WINDOWS

- GLASS FLAW GROWTH RELATED TO TENSILE STRESS
- WINDOWS SENSITIVE TO SURFACE DAMAGE
- TEMPERED WINDOWS FAIL WHEN SURFACE COMPRESSION PENETRATED
- MECHANICAL PRESTRESS MINIMIZES TENSION IN GLASS
- MECHANICAL PRESTRESSED WINDOW DEVELOPMENT SUPPORTS LONG TERM SPACE PROGRAMS



PENETRATION TOLERANT STRUCTURE



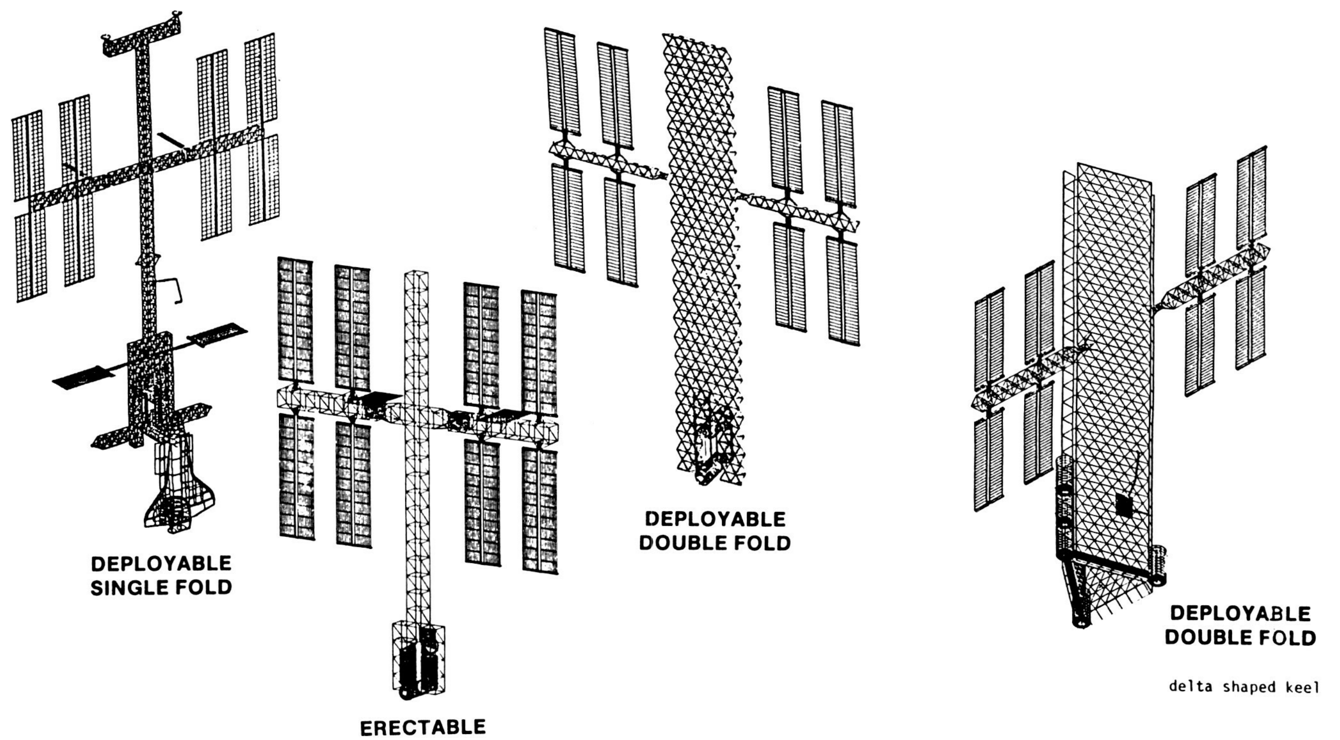
II. SPACE STATION PRIMARY TRUSS STRUCTURE

- O NUMEROUS SPACE STATION CONFIGURATIONS WERE CONSIDERED BUT A GRAVITY GRADIENT STABILIZED STATION WAS SELECTED AS A REFERENCE

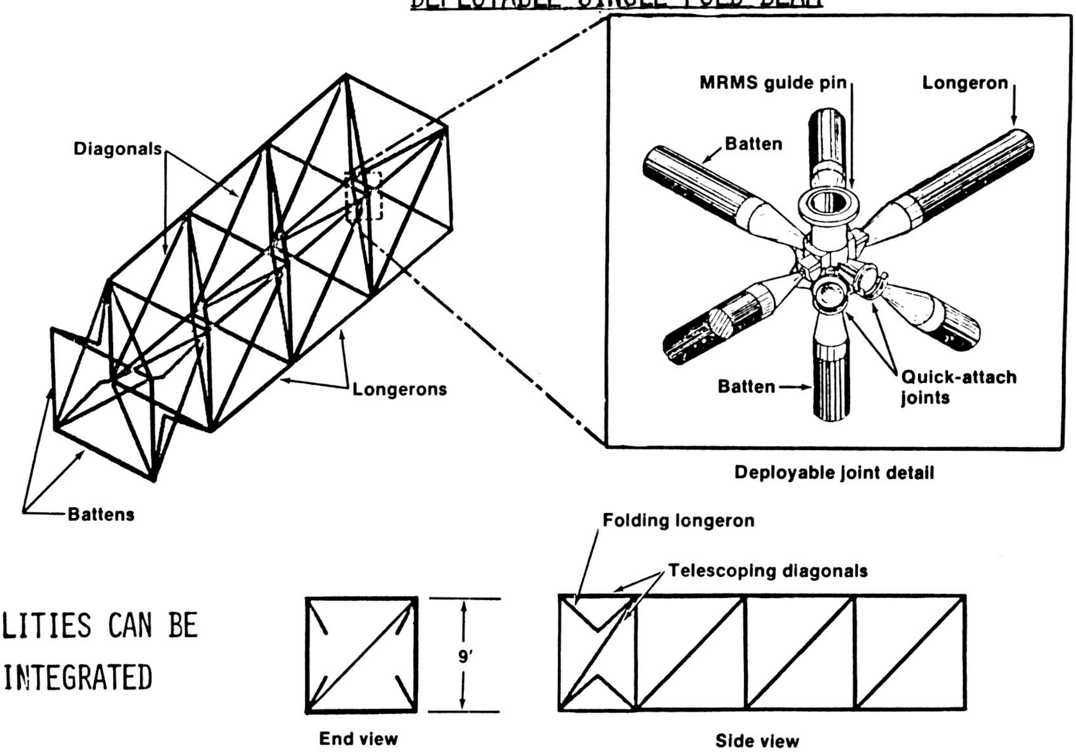
- O SUCH A CONFIGURATION USES A LONG TRUSS (400 FT) BEAM AS ITS BACKBONE TO WHICH ARE ATTACHED SUCH COMPONENTS AS THE PRESSURIZED MODULES, SOLAR COLLECTOR STRUCTURE, VARIOUS PAYLOADS, ETC.

- O ALL COMPONENTS MUST BE BROUGHT TO ORBIT BY THE SPACE SHUTTLE AND ASSEMBLED IN SPACE

- O VARIOUS DEPLOYABLE AND ERECTABLE STRUCTURES ARE BEING CONSIDERED FOR THE PRIMARY TRUSS

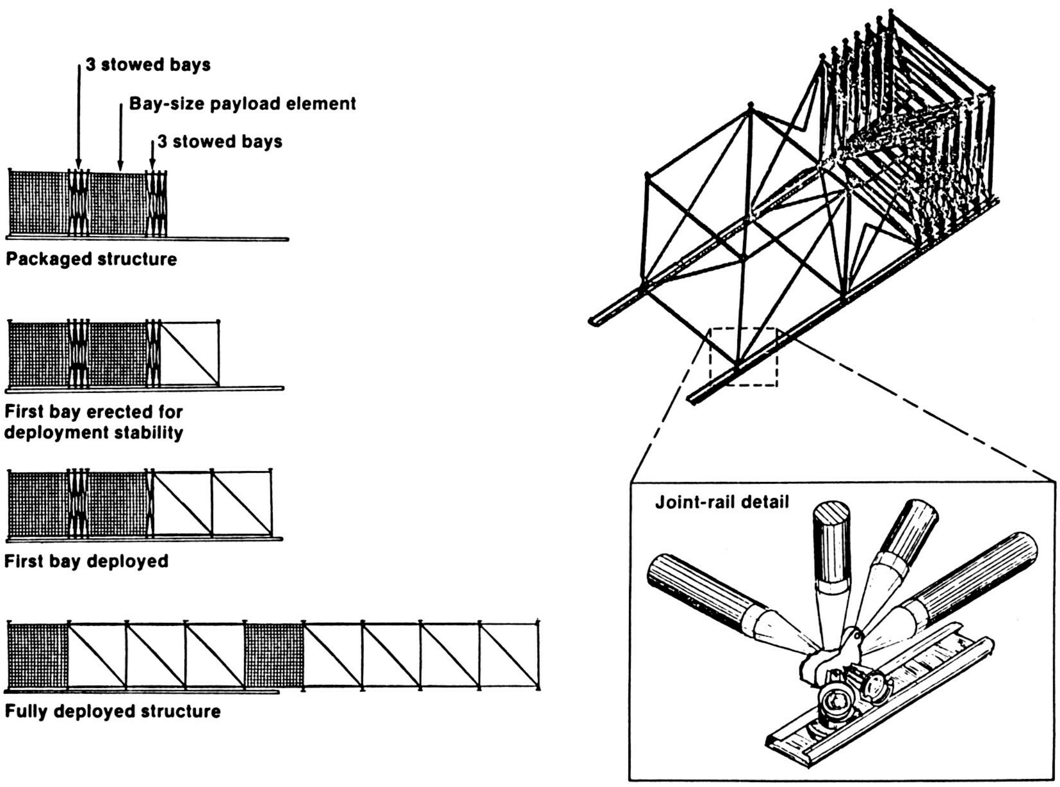


DEPLOYABLE SINGLE FOLD BEAM

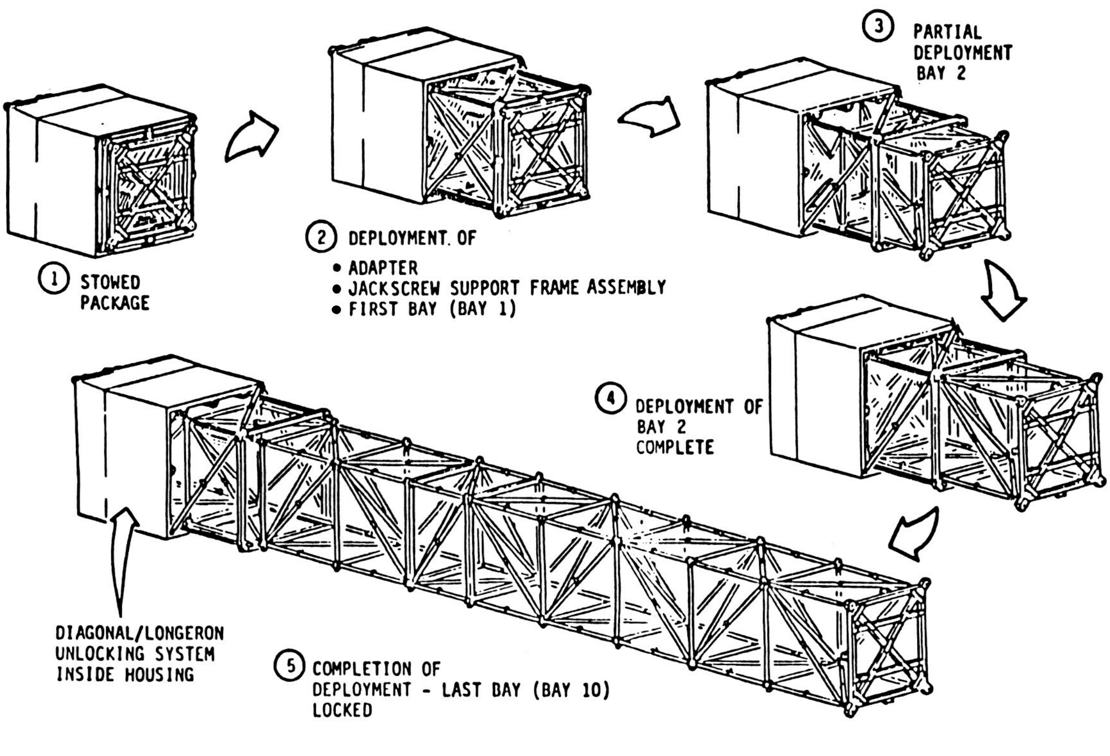


O UTILITIES CAN BE
PREINTEGRATED

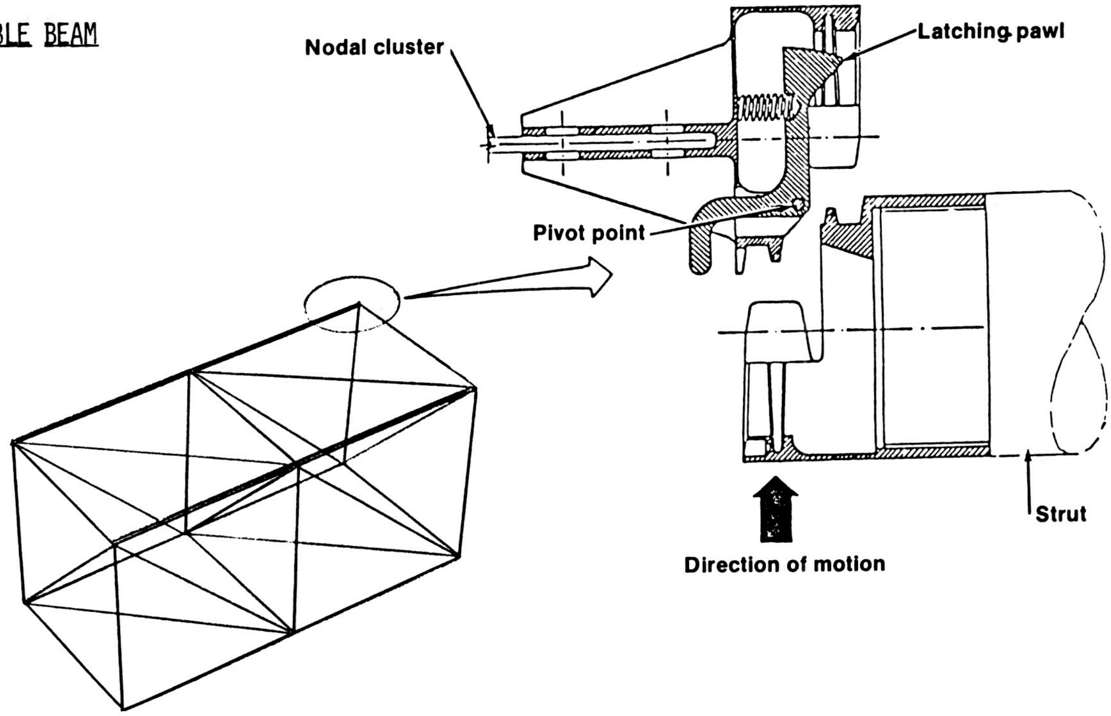
Schematic of deployable beam showing one bay being deployed and detail of joint.



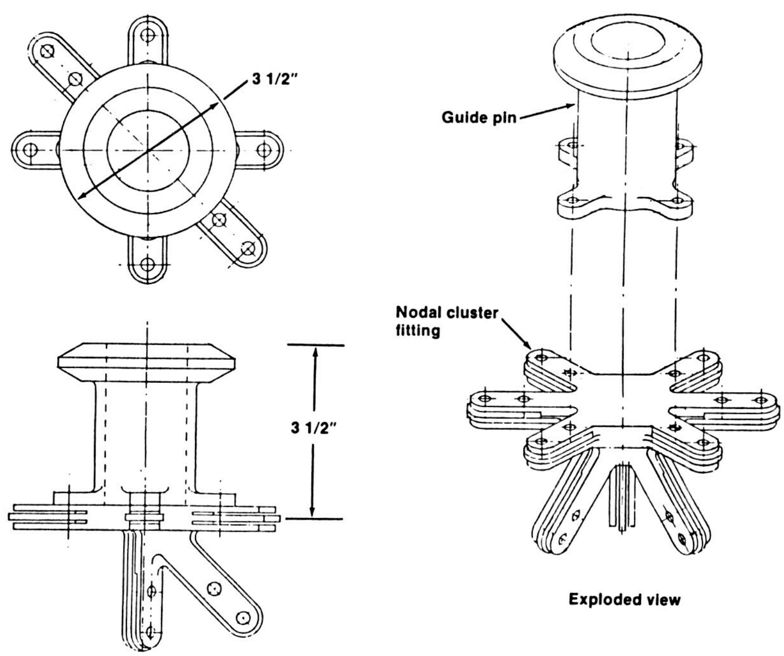
Truss deployment sequence and rail detail.



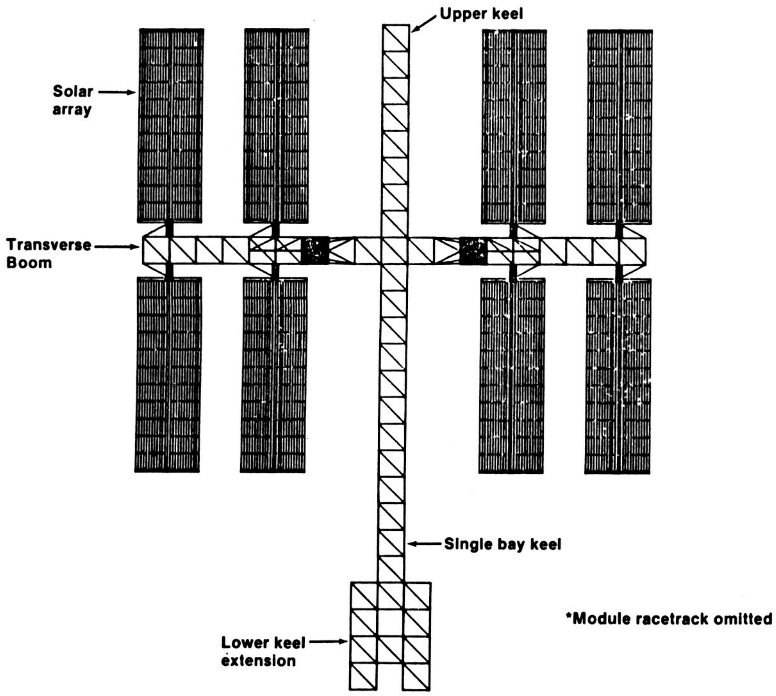
ERECTABLE BEAM



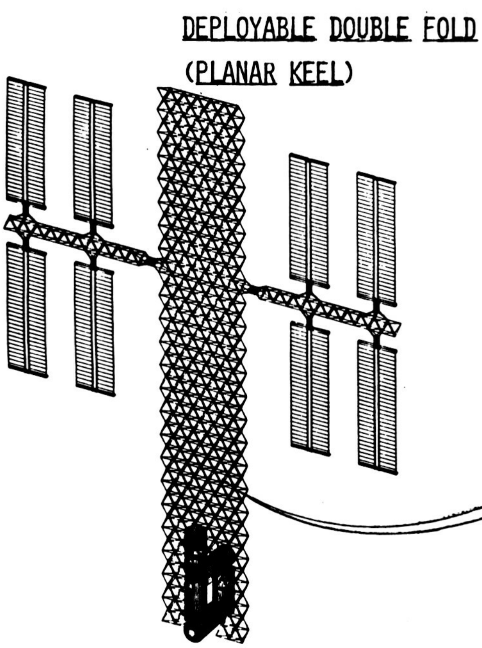
Erectable strut quick attachment joint.

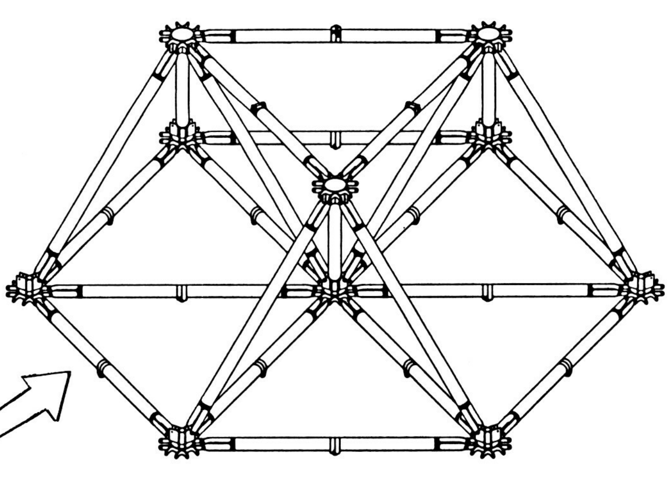


Nodal cluster fitting and MRMS guide pin.

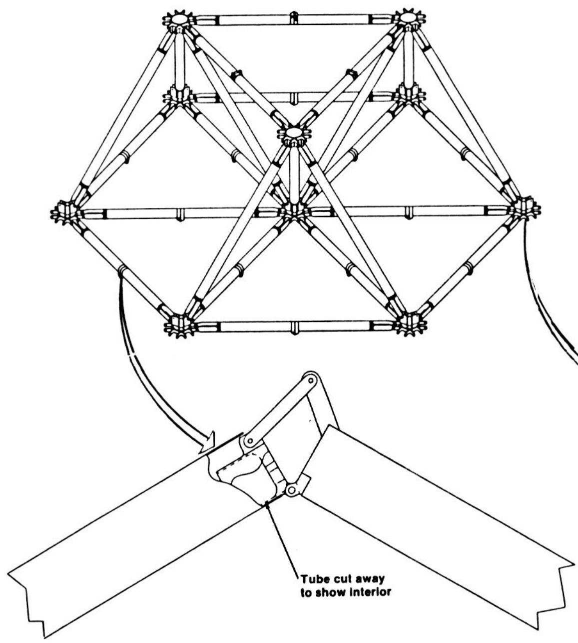


Space station 15-foot beam structure.

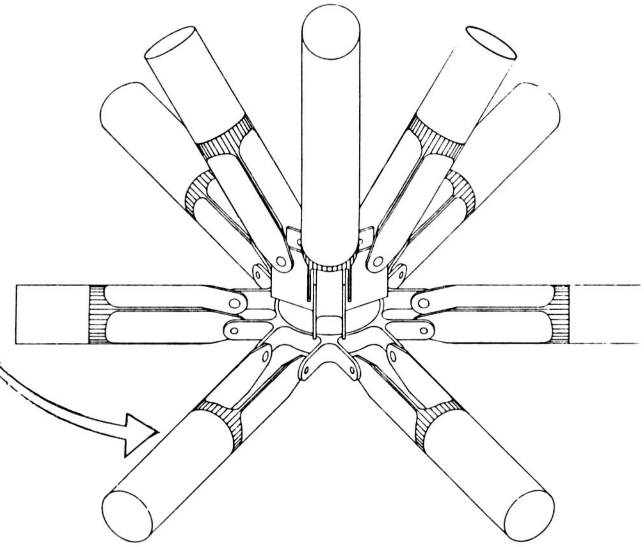




Typical cell of tetrahedral truss.



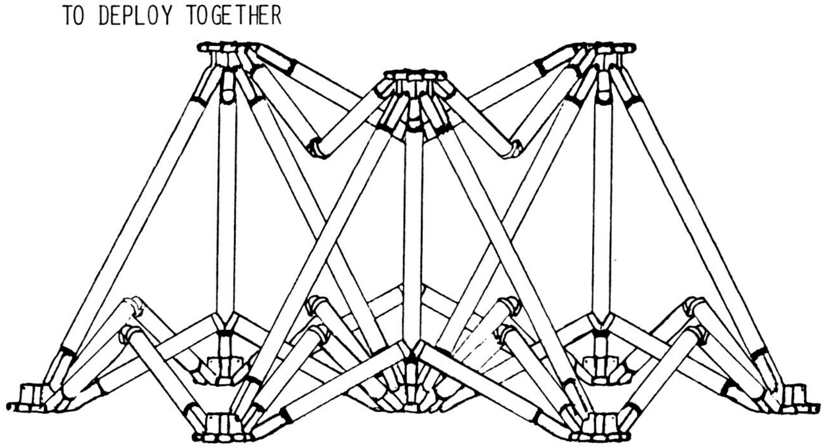
Over center hinge joint in surface struts.



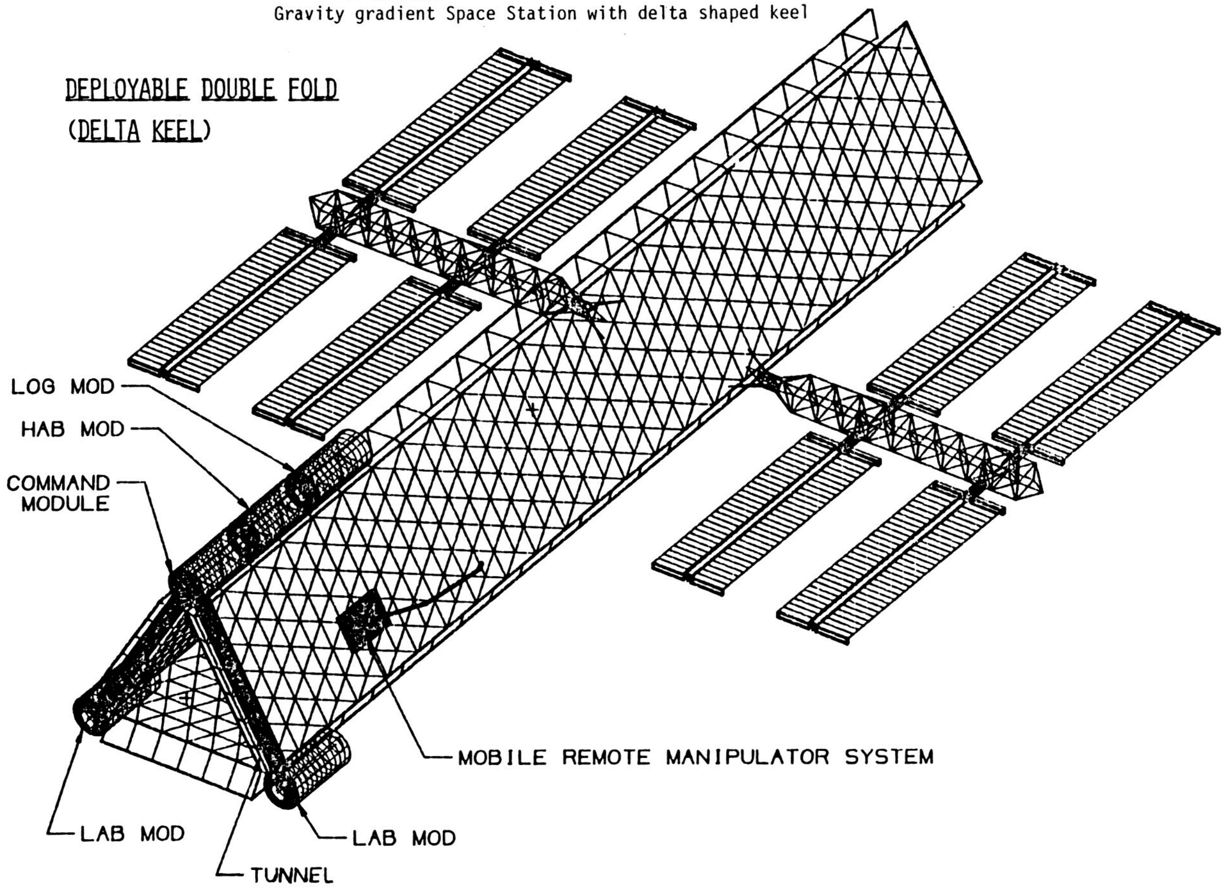
Close up of nodal fitting.

DEPLOYABLE TETRAHEDRAL TRUSS

- o THE TORSIONAL AND BENDING STIFFNESSES OF THE DIAGONAL AND THE FOLDABLE STRUTS (IGNORING JOINT TOLERANCES) FORCE NODES TO REMAIN PARALLEL AND RESTRICT JOINTS TO DEPLOY TOGETHER

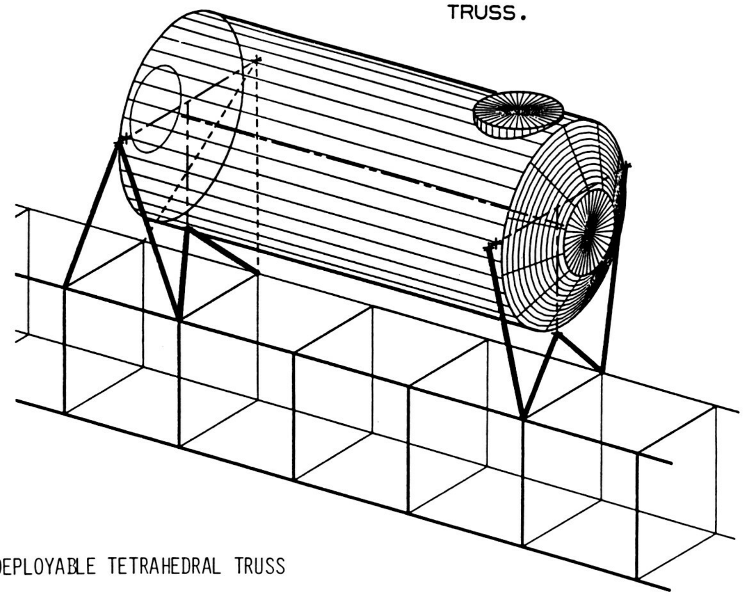


Gravity gradient Space Station with delta shaped keel



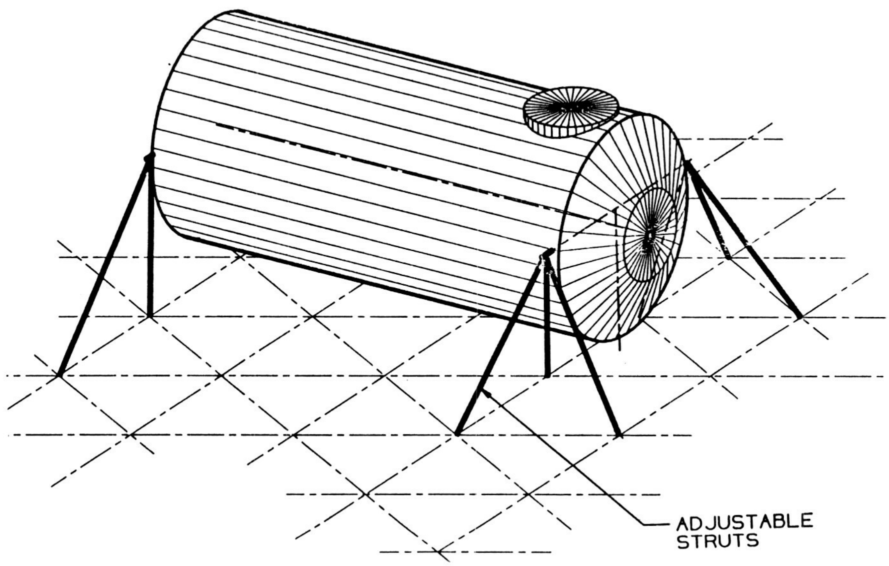
III. TYPICAL TRUSS ATTACHMENT DEVICES

MODULE ATTACHMENT TO 9 FT SQUARE TRUSS.

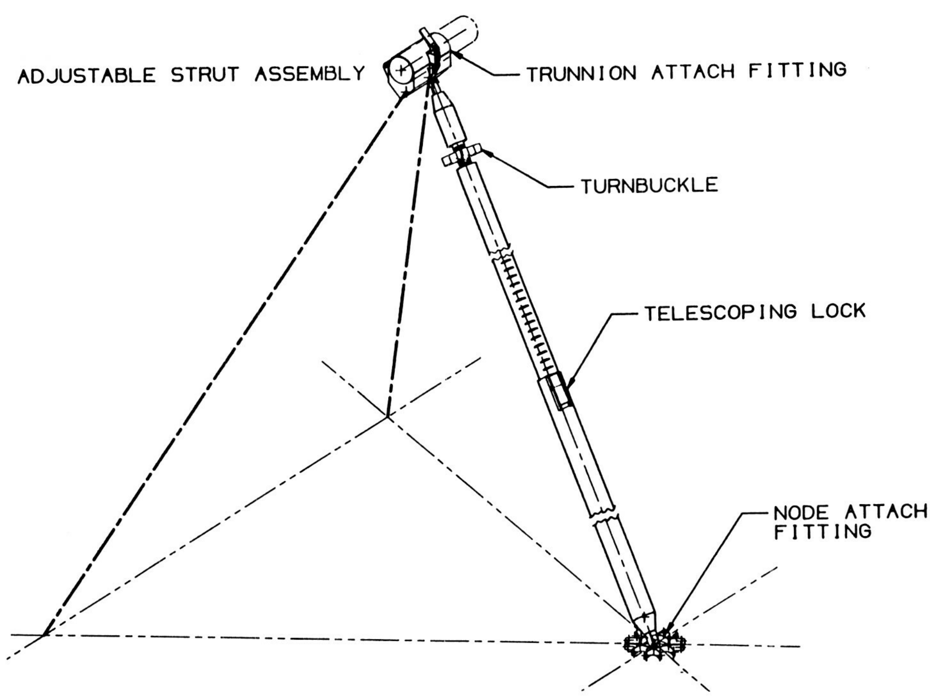


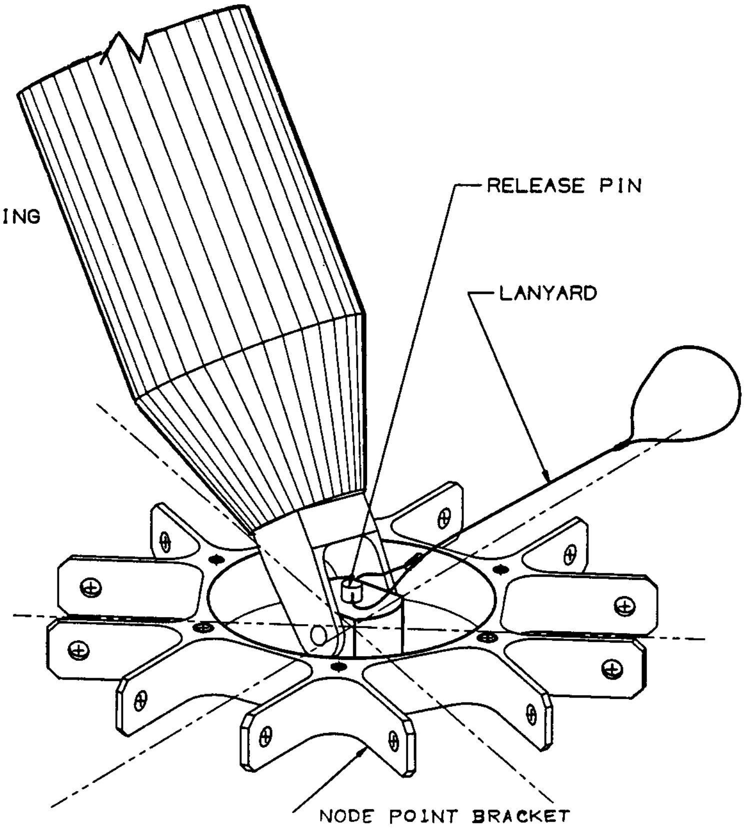
DEPLOYABLE TETRAHEDRAL TRUSS

MODULE ATTACHED TO FLAT SIDE OF TRUSS.

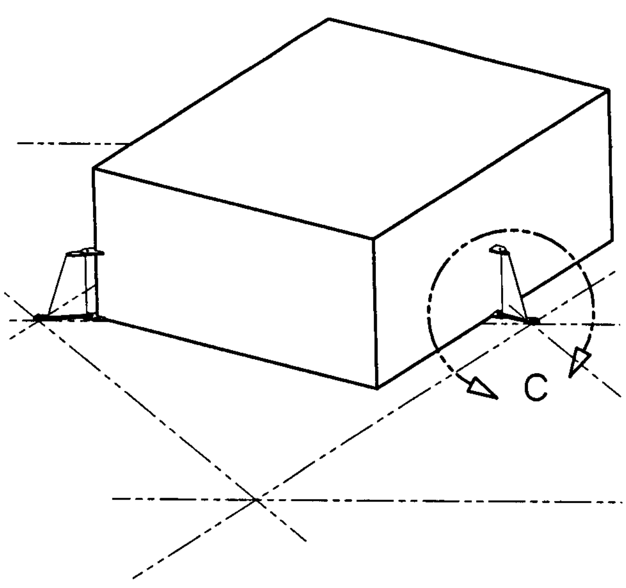


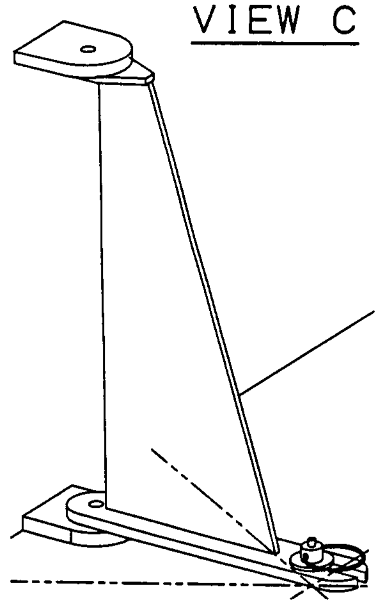
ADJUSTABLE STRUT ASSEMBLY

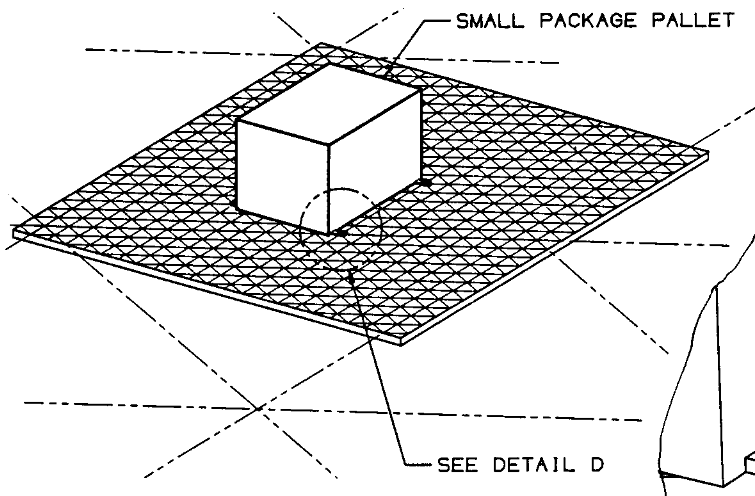




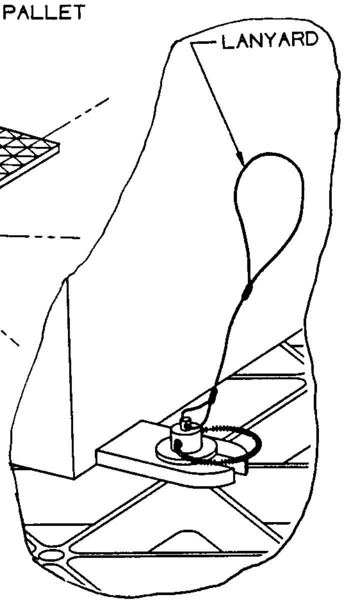
ATTACHMENT OF LARGE PACKAGES TO TRUSS.



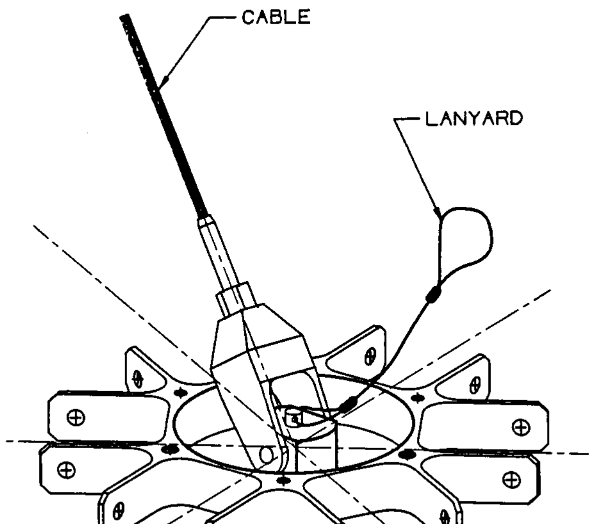




ATTACHMENT OF SMALL PACKAGES TO TRUSS

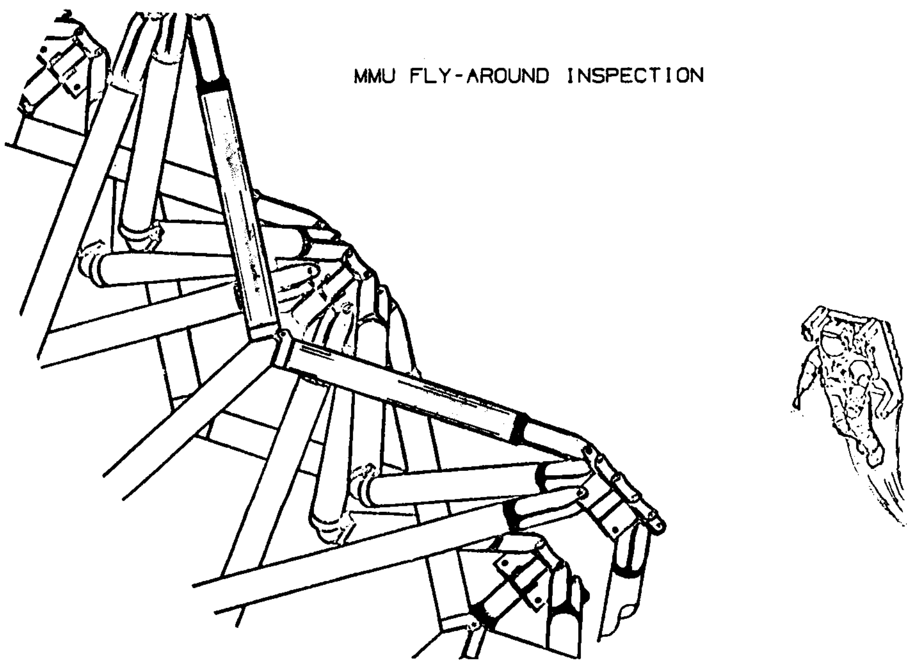


DETAIL D

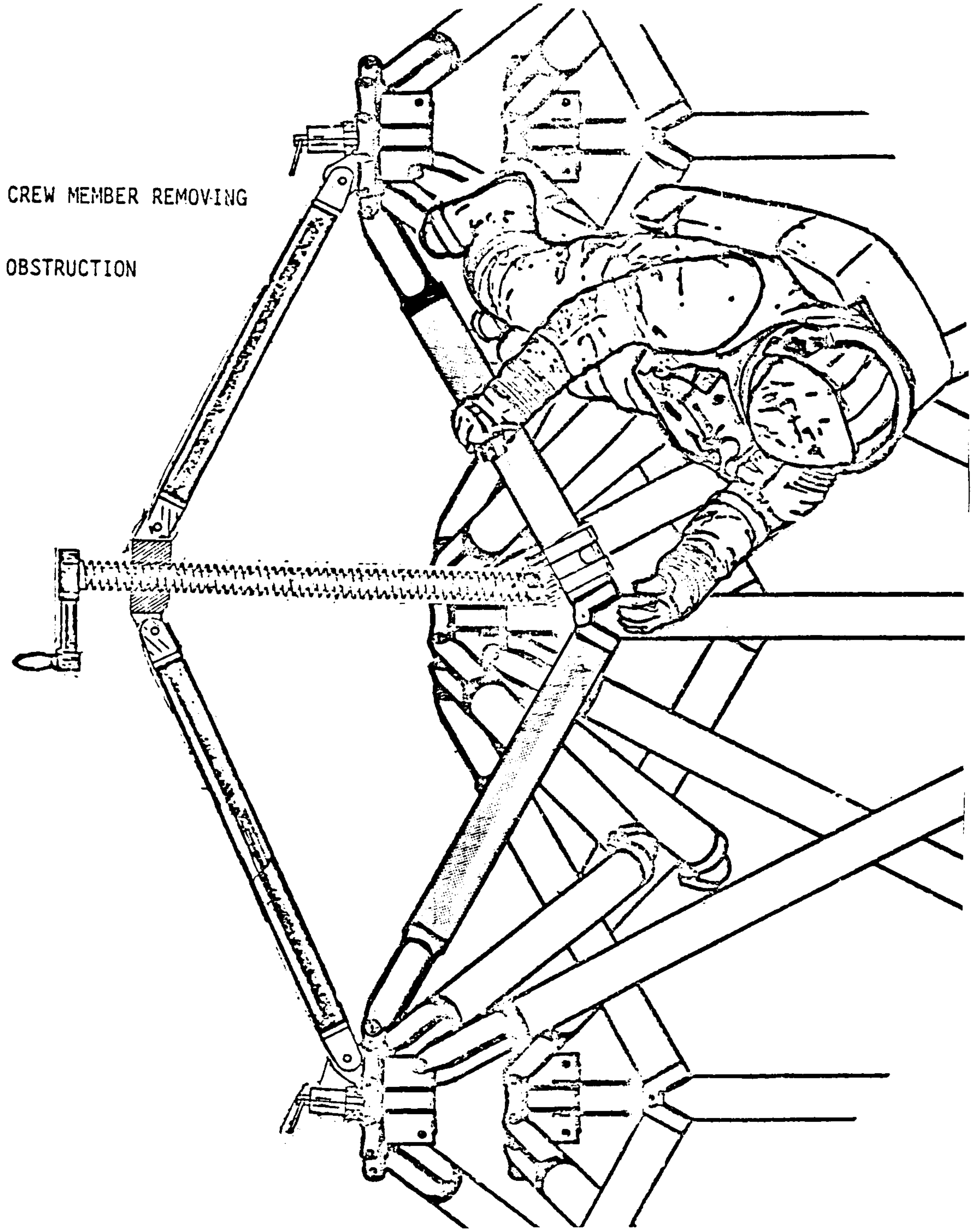


DEPLOYMENT

IV. BACKUP PROCEDURES



ON ORBIT USE OF JACK



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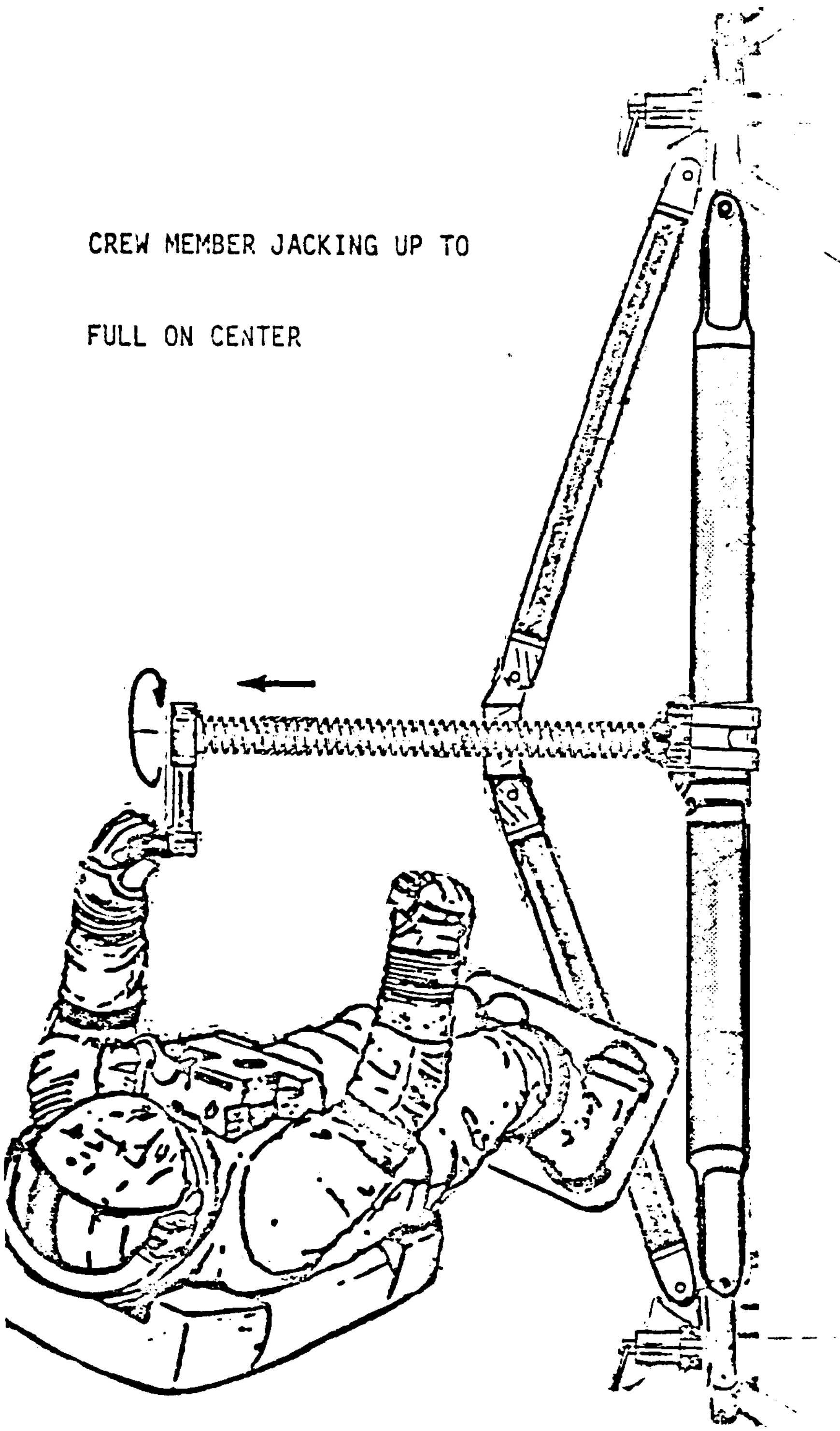

CONCLUDING REMARKS

- O NEXT YEARS WILL BE HEAVILY OCCUPIED WITH CHALLENGING STRUCTURES WORK.
- O THE SPACE STATION IS MORE SPACE FACILITY THAN THE SPACE VEHICLE.
- O LAUNCH VOLUME IS MORE CRITICAL THAN LAUNCH WEIGHT.
- O ONE OF THE GREATEST CHALLENGES PRESENTED WILL BE THAT OF SPACE STATION ASSEMBLY
  - O CONSTRAINTS IMPOSED BY SHUTTLE SIZE AND CENTER OF GRAVITY
  - O BEHAVIOR AT EACH STEP OF CONSTRUCTION
- O WE ARE ON A THRESHOLD OF SPACE WHERE THE CREW MEMBER WILL SHARE WITH THE HARDWARE IN PROVIDING FULL SYSTEM RELIABILITY AND MAINTENANCE.