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Special Design Project Issue

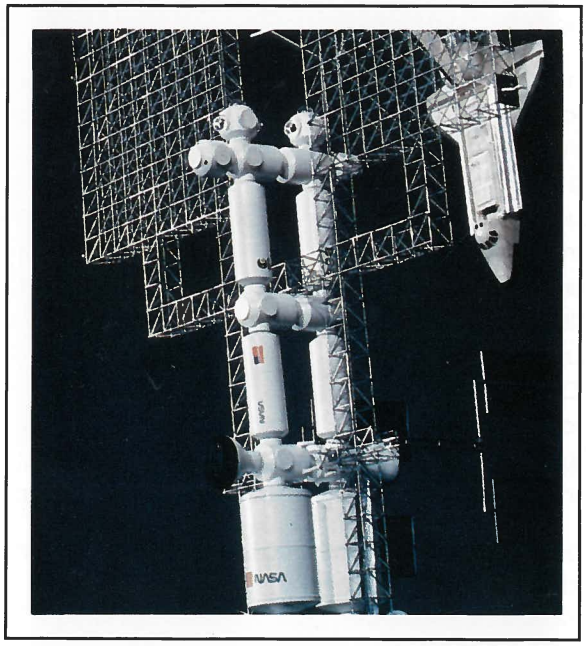
SICSA OUTREACH

Sasakawa International Center for Space Architecture

The SpacePOST Project

SICSA is studying requirements and developing concepts for a second generation space station. Its purpose is to support man-intensive, on-orbit warehousing, assembly, checkout and cargo transfer operations associated with advanced lunar and planetary missions. The project is being undertaken in cooperation with the ***NASA-Ames Research Center's Space Human Factors Office*** in California.

Dubbed the ***Space Planetary Operations Support Terminal (SpacePOST)***, the proposed facility combines "standard" 14 ft. diameter (work) modules currently planned for the international Space Station with 27 ft. diameter (habitat) modules to be delivered by Heavy Lift Launch Vehicles (HLLVs). Also featured are two large Payload Attachment and Servicing Fixtures (PASFs), a thermal dynamic power system and four 8-person escape capsules. Crew accommodations for as many as 27 people are provided.



Space Planetary Operations Support Terminal

Initiated in Fall, 1986, SpacePOST has involved faculty and students in the ***Experimental Architecture*** graduate program. The primary purpose of this ongoing study is to create a reference design and staging strategy to assist planning for advanced space missions. Simultaneous investigations are correlating SpacePOST, lunar base and manned Mars mission support relationships.

Assumptions and recommendations presented in this report are offered for peer review.

SpacePOST Purposes

- Staging base for manned lunar and planetary missions.
- Warehouse and repair facility to support LEO and GEO operations.
- Service station for orbital maneuvering and transfer vehicles.
- Hotel for space construction and research/development personnel.

A Publication of the University of Houston's College of Architecture

SpacePOST Rationale

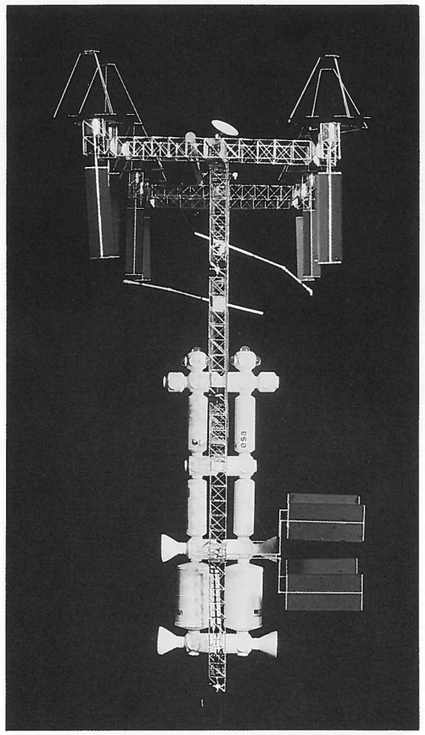
The basic project rationale parallels the case that was made by the NASA-Johnson Space Center for a ***Space Operations Center (SOC)*** during the late 1970's. As envisioned at that time, the key purpose for a U.S. Space Station would be to serve as an orbiting service depot to extend and support capabilities of the Space Transportation System (STS). Since that time, the Space Station program priority has shifted to laboratory applications such as microgravity material processing, space physics and life sciences. Intensive manned operations associated with STS servicing and refueling operations could be expected to degrade the microgravity purity required for many of these uses.

The ***National Commission on Space*** has proposed that a permanent settlement be established on the Moon by the year 2005 and a manned mission to Mars be undertaken by 2015. Implementation of such missions will require on-orbit means to assemble and check out many equipment items which are too large and/or fragile to launch in a completed form. Also needed will be a place to store spare parts and supplies, park and service Orbital Transfer Vehicles (OTVs), and undertake routine and emergency repairs of critical systems. This will require that substantial numbers of people with appropriate support systems and tools be available to attend to these functions.

The general nature and small crew size of the international Space Station planned for operation in the mid-1990's will severely limit utility for lunar-planetary mission support applications. Accordingly, SpacePOST is conceived to meet these specific needs through an approach that minimizes new technology development and optimizes economies of scale.

Design Emphasis

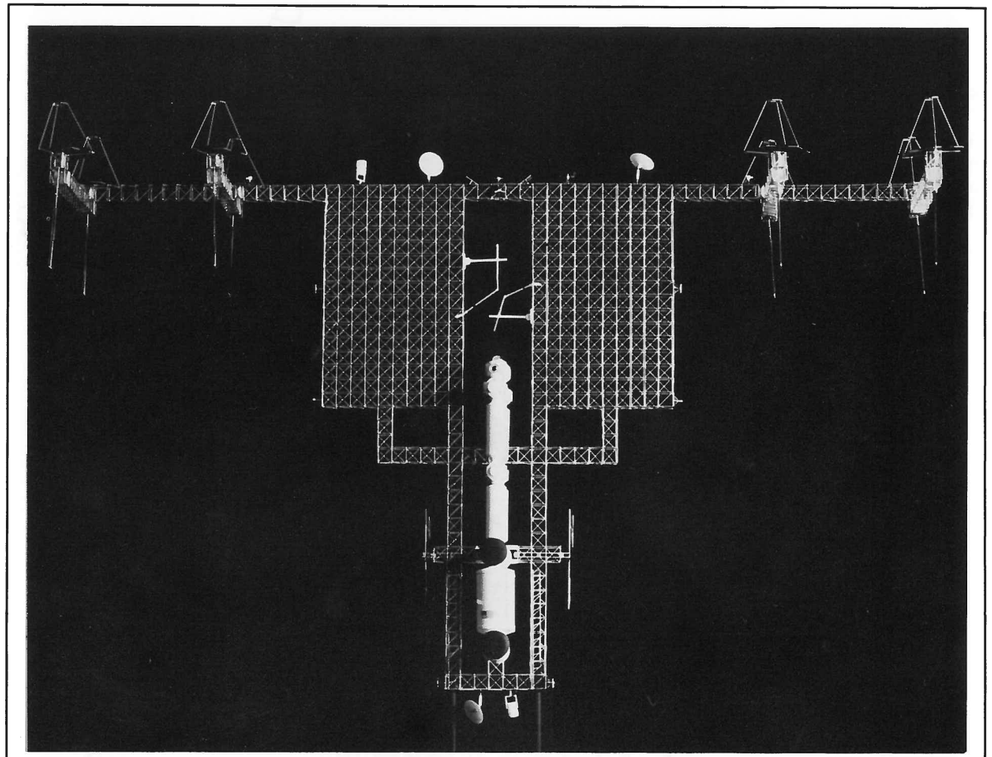
SpacePOST is conceived as a low-Earth orbit (LEO) facility with a high level of gravity gradient stability. Designed with an emphasis upon human accommodations and activities, the facility is not intended to support scientific functions that require microgravity purity or accurate pointing of sensitive instruments... provisions which would add cost and complexity.



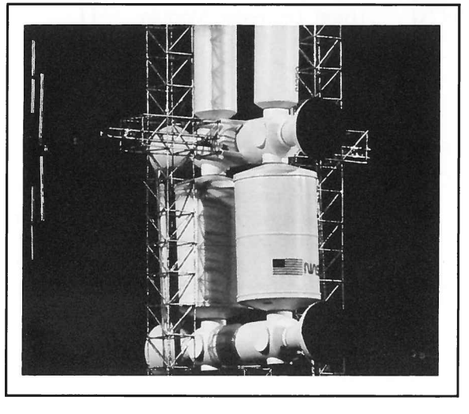
SpacePOST Port Elevation

Basic building blocks are international Space Station-derived modules, interconnects and trusses supplemented by 27 ft. diameter by 36 ft. long habitat modules. The large modules offer good space utilization advantages for efficient clustering of crew sleep accommodations as well as generous group assembly areas.

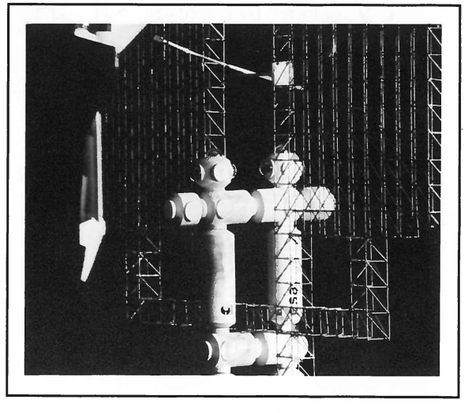
The smaller Space Station-derived modules efficiently accommodate standard equipment racks, applying structures, utilities, environmental controls and other systems which will require little or no new engineering development and test validation. Launch and assembly can be accomplished using the Shuttle and/or HLLVs.



SpacePOST Front Elevation



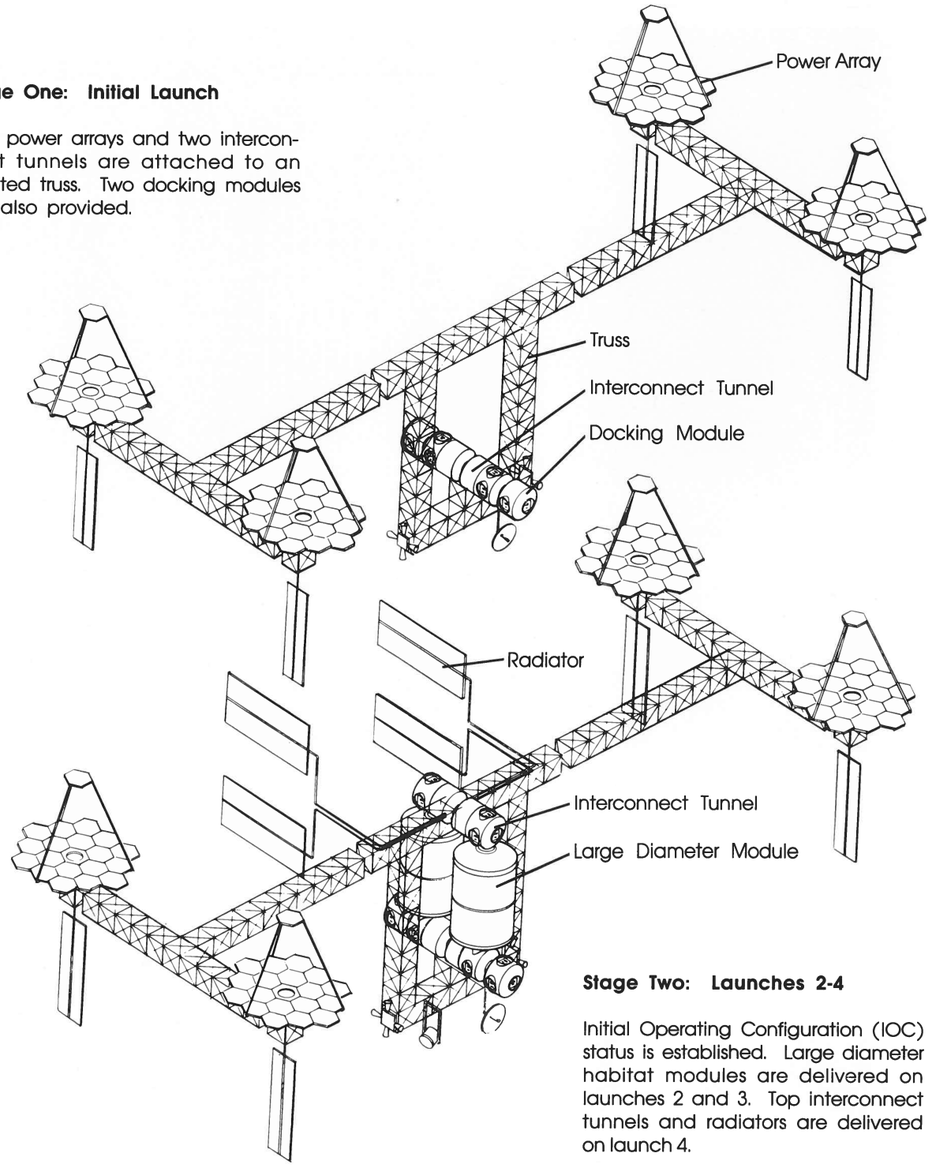
Large Habitat Modules



Space Station-Derived Modules

Stage One: Initial Launch

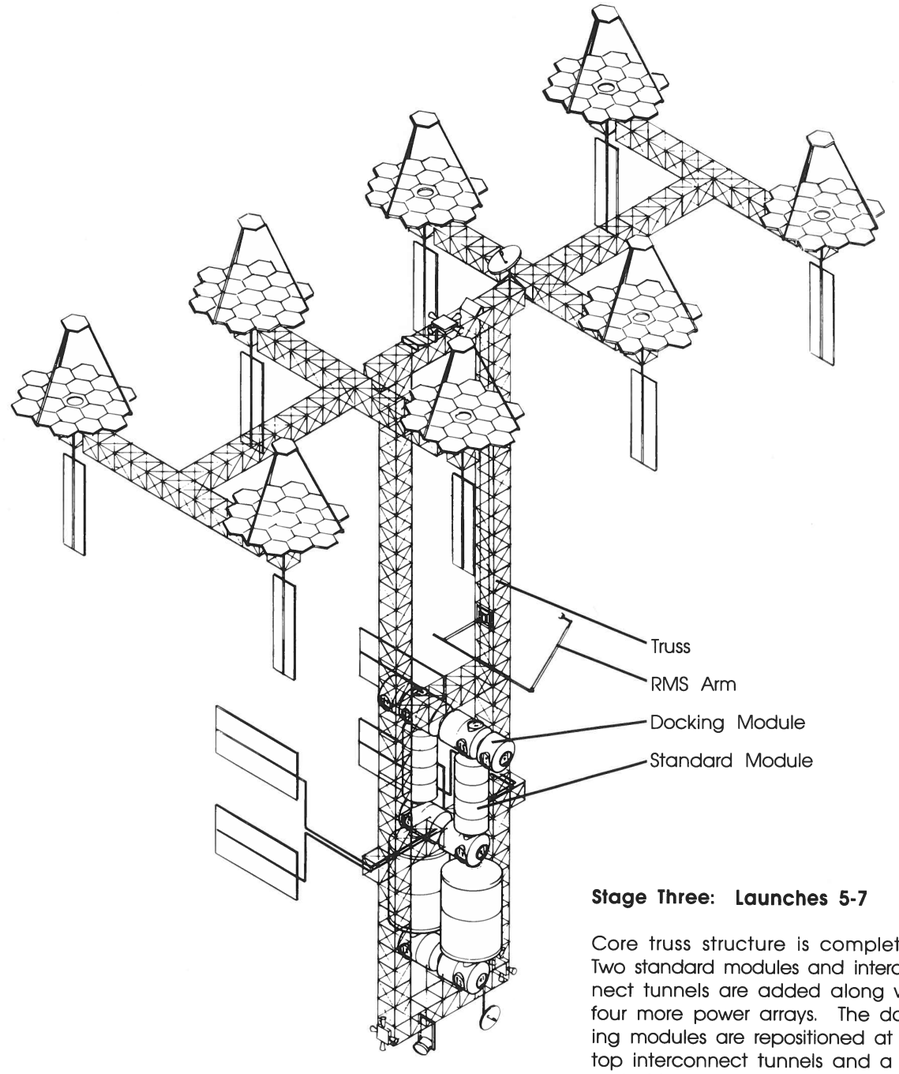
Four power arrays and two interconnect tunnels are attached to an erected truss. Two docking modules are also provided.



Stage Two: Launches 2-4

Initial Operating Configuration (IOC) status is established. Large diameter habitat modules are delivered on launches 2 and 3. Top interconnect tunnels and radiators are delivered on launch 4.

The SpacePOST assembly sequence is based upon assumed HLLV launch capabilities.

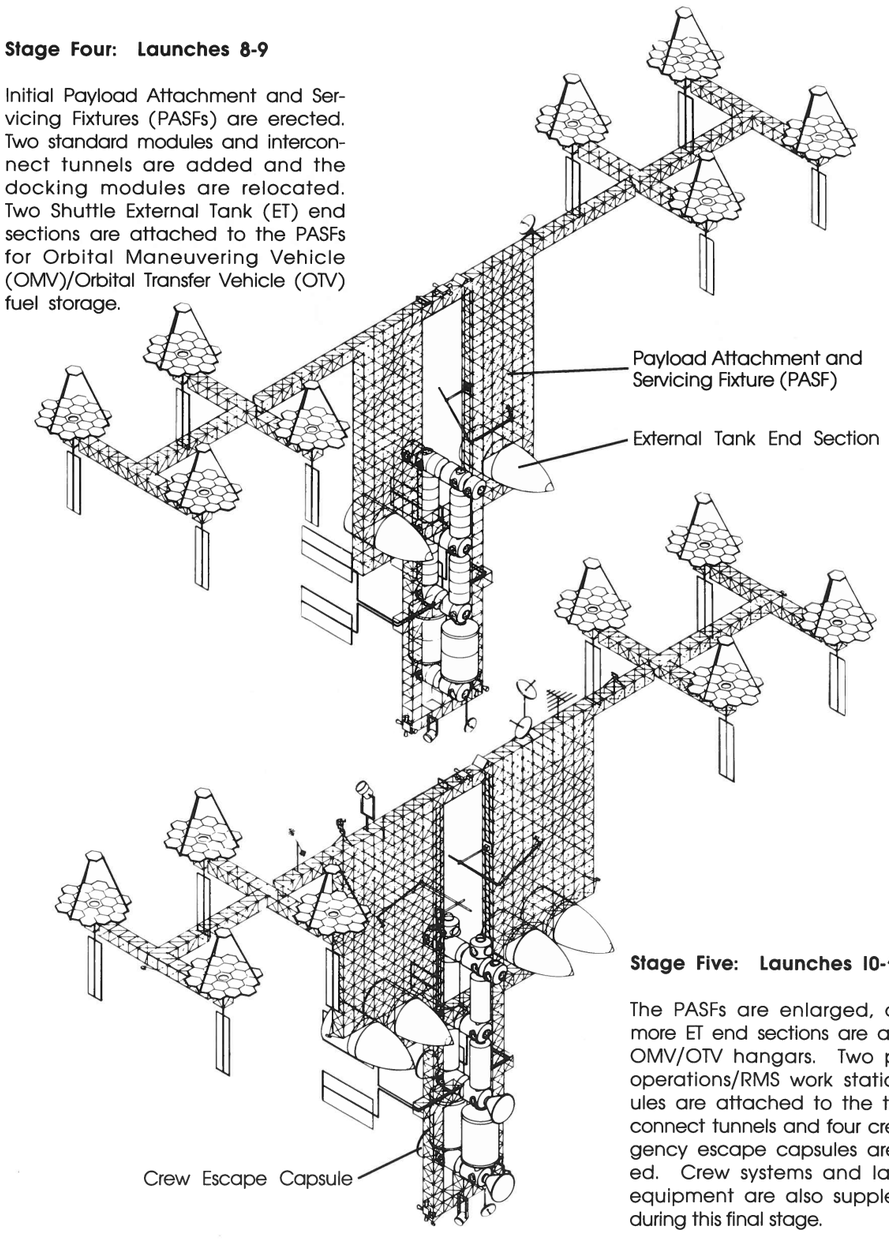


Stage Three: Launches 5-7

Core truss structure is completed. Two standard modules and interconnect tunnels are added along with four more power arrays. The docking modules are repositioned at the top interconnect tunnels and a Remote Manipulator System (RMS) arm is set in place.

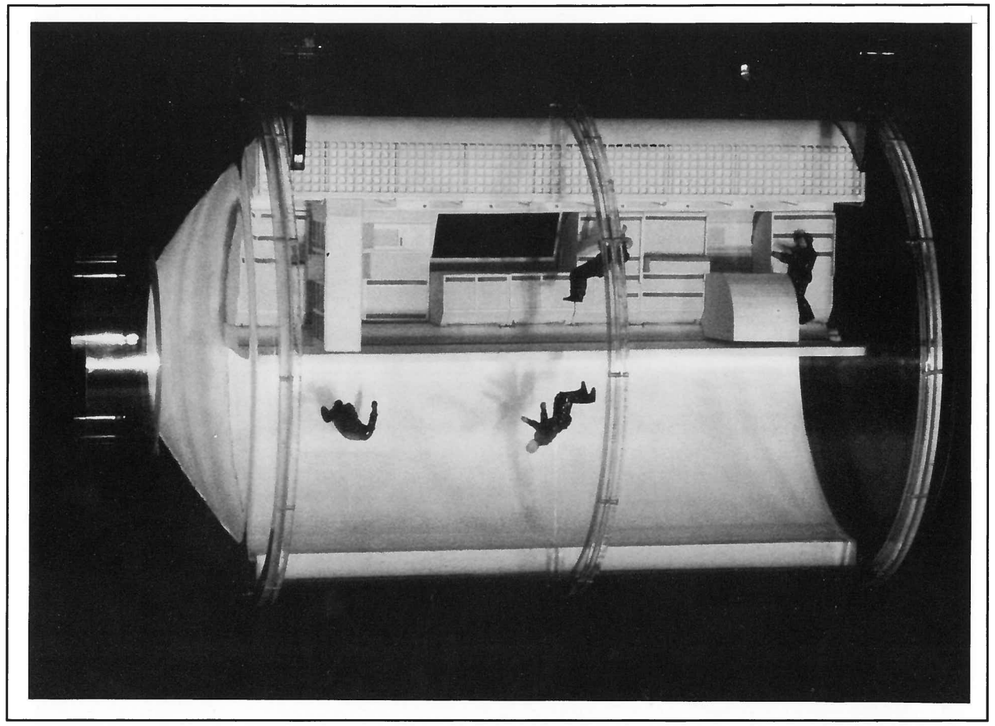
Stage Four: Launches 8-9

Initial Payload Attachment and Servicing Fixtures (PASFs) are erected. Two standard modules and interconnect tunnels are added and the docking modules are relocated. Two Shuttle External Tank (ET) end sections are attached to the PASFs for Orbital Maneuvering Vehicle (OMV)/Orbital Transfer Vehicle (OTV) fuel storage.



Stage Five: Launches 10-11

The PASFs are enlarged, and two more ET end sections are added for OMV/OTV hangars. Two proximity operations/RMS work station modules are attached to the top interconnect tunnels and four crew emergency escape capsules are provided. Crew systems and laboratory equipment are also supplemented during this final stage.

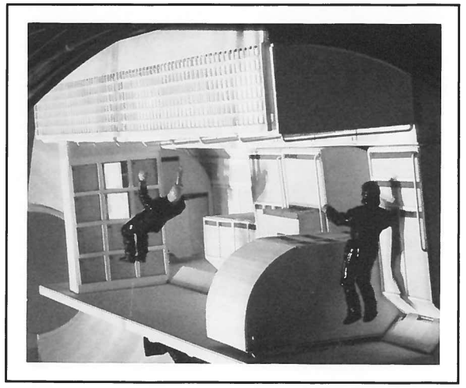


Model of Crew Assembly Module Showing Galley (above) and Wardroom

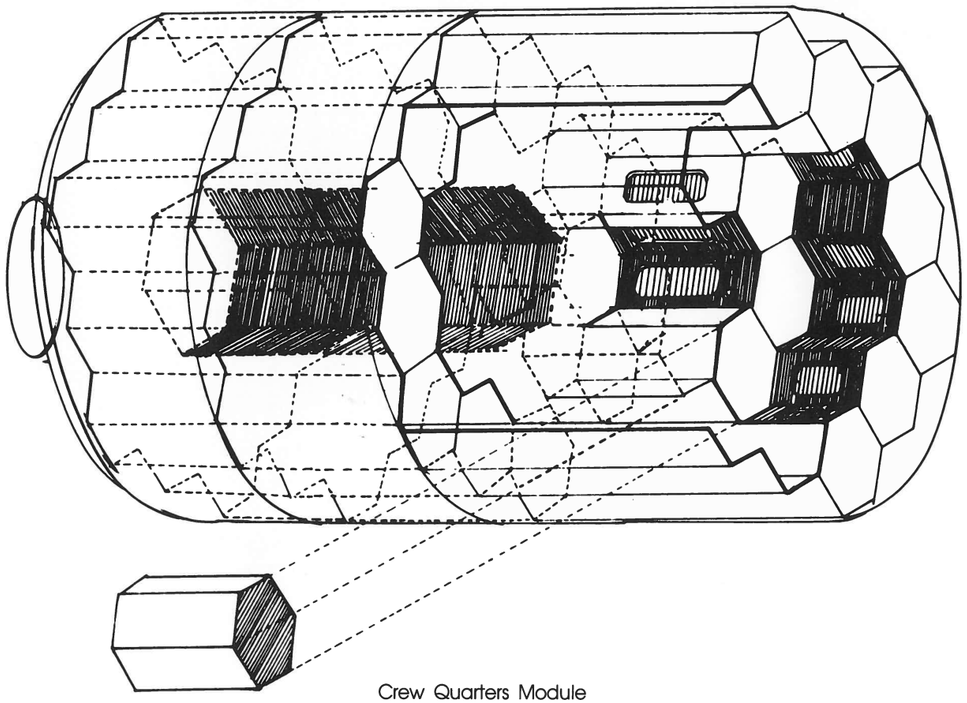
Crew Assembly Module

SpacePOST's 27 ft. diameter modules will offer much more spacious interior volumes than are provided by the currently planned international Space Station. Availability of large open space is of special importance in group assembly areas used for wardroom, dining, crew briefings, entertainment and exercise.

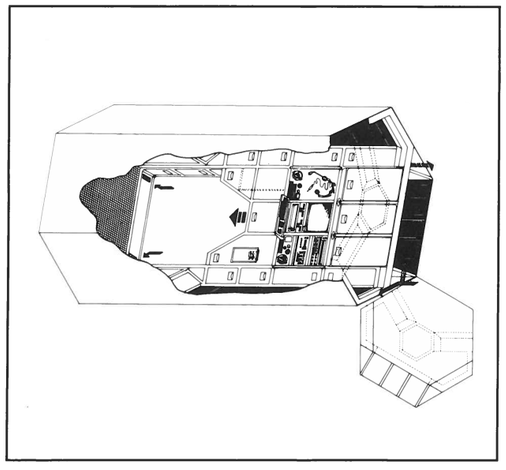
The layout proposed for SpacePOST's Crew Assembly Module longitudinally divides the pressure hull interior into two equal sectors by means of a common floor (a "banana split configuration"). Both sectors are designed with a clear one-G crew orientation (the common floor representing "down").



Food Preparation Area



Crew Quarters Module



Typical Sleeping Unit

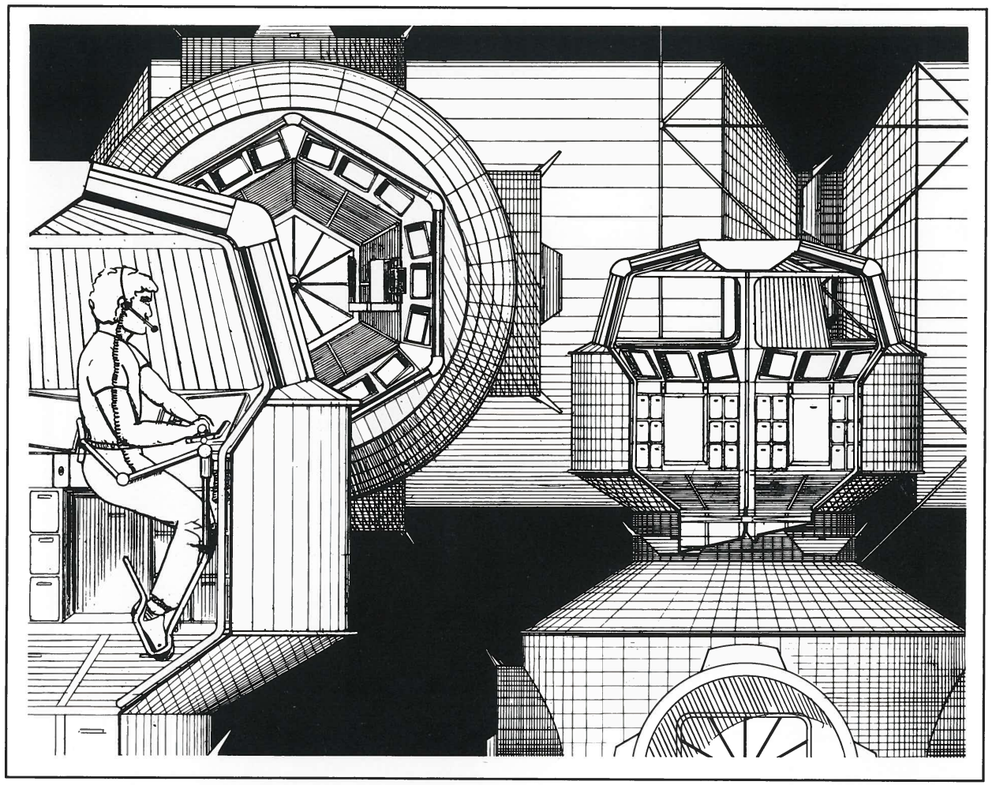
Crew Quarters Module

The Crew Quarters Module is divided into cylindrical sections in a "bologna slice" fashion.

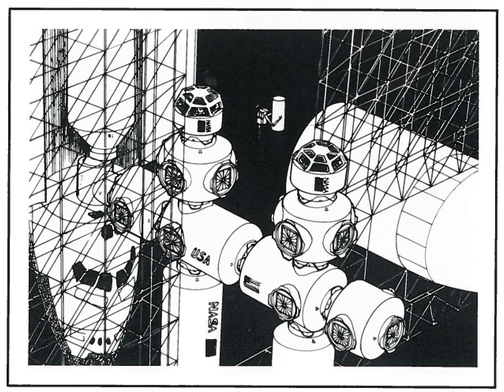
Private hexagonal-plan units contain sleeping bags attached to walls, computer work stations with televisions and VCRs, and personal storage. These areas offer quiet places where astronauts will spend much of their leisure time relaxing, watching extravehicular events, taped programs on their monitor, and preparing for future mission activities. The "beehive" arrangement maximizes efficiency.

A separate sector at one end contains toilets and showers. This arrangement isolates noises and odors from sleeping locations.

Mockup of Sleeping Unit Interior



SpacePOST Cupola



Cupolas Attached to Interconnect Nodes

Cupola Work Stations

The cupola work stations are designed to enable one or two crew members to direct and monitor the movements and activities of people and spacecraft outside SpacePOST. Good viewing is necessary to afford visual surveillance of EVA maintenance and space structure assembly processes, incoming and departing vehicular traffic, and docking/cargo transfer operations.

Six console panels contain telecommunications equipment, computers and Remote Manipulator System (RMS) controls.

A special moveable body restraint is provided to secure working astronauts in place.

Mockup of Cupola Work Station

SICSA Background

SICSA is a nonprofit research, design and educational entity of the University of Houston College of Architecture. The organization's purpose is to undertake programs which promote international responses to space exploration and development opportunities. Important goals are to advance peaceful and beneficial uses of space and space technology and to prepare professional designers for challenges posed by these developments. SICSA also works to explore ways to transfer space technology for Earth applications.

SICSA provides teaching, technical and financial support to the ***Experimental Architecture*** graduate program within the College of Architecture. The program emphasizes research and design studies directed to habitats where severe environmental conditions and/or critical limitations upon labor, materials and capital resources pose special problems. Graduate students pursue studies which lead to a Master of Architecture degree.

SICSA Outreach highlights key space developments and programs involving our organization, our nation, our planet and our Solar System. The publication is provided free of charge as a public service to readers throughout the world. Inquires about SICSA and Experimental Architecture programs, or articles in this or other issues of *SICSA Outreach* , should be sent to Professor Larry Bell, Director.

Project Team

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SpacePOST is being undertaken as a graduate research and design study within the UH Experimental Architecture program under supervision of SICSA faculty and staff. Ongoing work is being supported by a ***NASA/USRA Advanced Design Program*** grant which was awarded to SICSA in September 1987. Graphic panels, models and full-size mockups illustrating the project are on display in the Arnold Space Hall of the ***Houston Museum of Natural Sciences.***

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