Vol. 1, No. 8: July-Sep., 1988
Special Design Project Issue

SICSA OUTREACH
Sasakawa International Center for Space Architecture

The Antarctic Planetary Testbed (APT): A Planned International Initiative

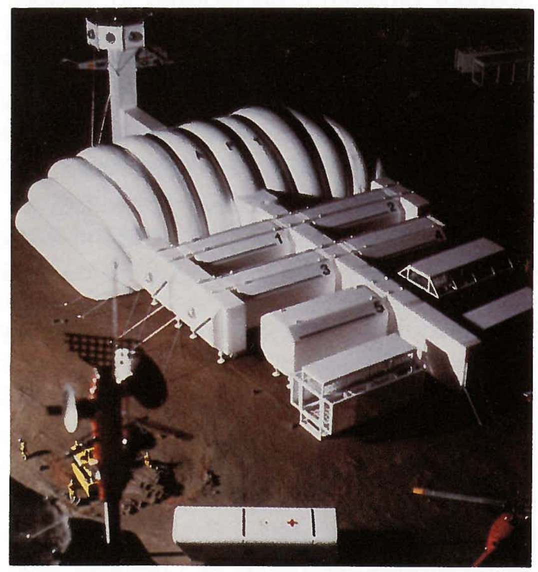
The Plan in Brief

Antarctica contains areas where the environment and terrain are more similar to regions on the Moon and Mars than any other place on Earth. These features offer opportunities for simulations to determine performance capabilities of people and machines in harsh, isolated locales.

SICSA plans to create a facility in Antarctica for research, planning and demonstrations to support planetary exploration. The ***Antarctic Planetary Testbed (APT)*** will be financed and utilized by public and private organizations throughout the world. Established on a continent owned by no country, it can serve as a model for cooperation between spacefaring nations.

APT science and technology programs will expand knowledge about the nature of our Solar System. They will also support preparations for human settlements beyond Earth which may occur within the first quarter of the next century.

The initial APT facility, conceived to be operational by the year 1992, will be constructed during the summer months by a crew of approximately twelve. Six to eight of these people will remain through the winter. As in space, structures and equipment systems will be modular to facilitate efficient transport, assembly, and evolutionary expansion. State of the art power, waste recovery/recycling and robotic/automation systems will be applied and tested.



Antarctic Planetary Testbed Facility Concept

Important Program Goals

Advance Planetary Mission Planning

- *Support space science programs.*
- *Test procedures and technologies.*

Realize Cost-Benefit Advantages

- *Promote international cost-sharing.*
- *Accommodate some near-term Earth research/technology applications.*

Build Support for Future Space Programs

- *Organize international cooperation.*
- *Motivate private sector participation.*

An International Program

The National Commission on Space report titled ***Pioneering the Space Frontier***, May, 1986, recommended that a permanent lunar outpost and human visitation of Mars be realized early in the next century. The more recent ***Presidential Directive on National Space Policy*** released in February, 1988, supports such bold new manned space exploration initiatives. One of the goals established by the Reagan Administration is "... to expand human presence and activity beyond Earth into the Solar System".

Enormous program costs required to establish a lunar base or to undertake manned missions to Mars will likely be too expensive for even the wealthiest individual nations to justify. International cost-sharing will enhance economic feasibility and also help to ensure that mission purposes will benefit the world community. Antarctica, an international territory, is an ideal place to demonstrate that such cooperative programs can work.

Exploration of the Solar System includes research to yield an improved understanding of planet Earth. The APT facility will support scientific investigations of causes and effects of weather patterns and atmospheric changes that influence our human destiny; forces and evolutionary processes that shape the composition and distribution of natural resources; and ways to accomplish social progress and prosperity while also protecting fragile ecosystems. Such issues are of vital importance to all world populations.

APT planning will address international space-related concerns. Important considerations must include distribution of costs and benefits, technology transfer constraints, and special needs associated with accommodating culturally and professionally mixed crews.

SICSA is contacting science and technology leaders from many countries to invite their participation. These experts represent government, university, and private organizations spanning a broad range of disciplines and resources.

Antarctic - Planetary Analogs

Environmental Characteristics

- *Antarctica, which averages 8,000 ft. above sea level, is the Earth's highest and driest continent with a relatively low atmospheric pressure most like Mars.*
- *Antarctica receives some of the highest levels of solar radiation on Earth.*
- *Antarctica, having temperatures as low as -100°F, and even colder at the South Pole, has similarities to the Moon and Mars.*
- *Coastal antarctic winds range from a 15 mph average, to 200 mph and more. Snow storms in these locations have similarities to dust storms on Mars.*
- *Antarctica and the Moon experience long days and nights which affect surface operations. Antarctica has 3 months of darkness/extreme cold while the Moon has 14 days.*

Geological Features

- *Antarctica is a large, mostly virgin land mass, about the combined size of the U.S. and Mexico. It has a variety of landscape features and many sites suitable for planetary mission simulations.*
- *Antarctica's rock bed terrain includes areas with sterile soils devoid of any life forms, similar to conditions found on the Moon and Mars.*
- *Polar ice caps on Antarctica and Mars are rare in our Solar System. Earth and Mars are the only planets believed to possess these features.*

Programmatic Aspects

- *Antarctica, like the planets, belongs to no nation. Current and future treaties governing its use can provide a model for cooperative international space initiatives.*
- *The antarctic ecosystems must be respected and protected. Similar conservation priorities apply in planning orbiting and planetary habitats.*
- *Antarctica's remoteness imposes space-like living, work and resupply constraints. Facilities should be easy to construct, and self-sufficiency should be optimized.*

Key APT Purposes

Social and Life Sciences

- *Psychological and social dynamics experiments involving mixed/international crews under severe, isolated conditions.*
- *Controlled scientific monitoring of human adaptation and performance in harsh environmental conditions.*
- *Experiments involving contained food production and waste recycling systems.*

Earth and Planetary Sciences

- *Atmospheric, weather and meteorological studies applicable to Earth/planets.*
- *Geological, geophysical and physical chemistry research experiments.*

Technology Demonstrations

- *Partially closed-loop life support systems.*
- *Waste reclamation, treatment and recycling systems.*
- *Advanced power generation and distribution systems.*
- *Soil sampling and material processing methods under harsh/isolated conditions.*
- *Construction/assembly systems and procedures under harsh/isolated conditions.*
- *Automation/robotic systems versatility and reliability in harsh/isolated conditions.*

Training Ground for Planetary Missions

- *Crew observation for candidate selection and team assignments.*
- *Crew preparation for long-duration planetary missions under simulated conditions.*

International Model

- *Create and demonstrate participatory agreements which prepare the groundwork for future international initiatives.*
- *Encourage international cooperation in advanced space mission planning.*
- *Demonstrate economic and mission benefits to be gained through international investment and participation.*
- *Serve as tangible expression of commitment to future planetary initiatives.*

Social Research Emphasis

An important APT function will be to serve as a controlled psychological and social research laboratory. Space mission simulations will afford opportunities for crew training and selection.

Extended lunar surface missions and long manned voyages to Mars and other planets will pose great psychological and physiological demands on crews. Abilities of a crew to work well as individuals and as members of a team under prolonged and difficult circumstances is an urgent concern.

U.S. and Soviet space missions to date demonstrate that social interactions are often complex and unpredictable. Successful team efforts require that individuals like, respect and adjust to one another on a very personal basis. Learning to depend upon each other's judgement and technical knowledge is also essential. Such vital group "chemistry" is difficult to predict based exclusively upon psychological profiles of crew candidates.

Most available data pertaining to group dynamics under extended, harsh, isolated conditions is anecdotal and unreliable. While many Soviet space station crew experiences have been of relatively long duration, very little information revealing scientific details about crew interaction, adaptation and performance has been released. Submarine isolation data is not directly applicable since the military profiles, roles and sizes of crew populations are quite different. Scientific lessons derived from conventional arctic and antarctic experiences are limited due to a general reluctance of participants to be subjects of controlled experimental studies.

APT research and demonstration programs will select crew populations and activities to match real mission conditions and objectives as closely as possible. The participants will be international in composition to reveal insights about ways cultural differences and preferences can be successfully accommodated.

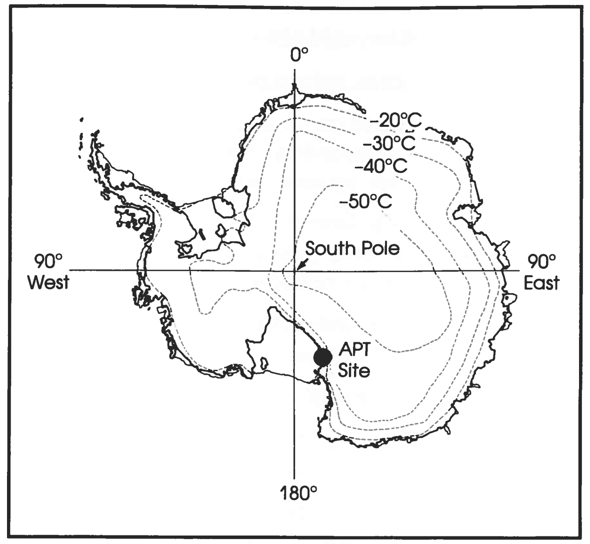
Special Earth Science Benefits

Use of the APT facility for research which is not exclusively space-related can help to cover costs for program implementation and operations. While several nations currently maintain research stations in Antarctica, the APT will be unique as an international base, affording living and work accommodations for a wide variety of cooperative ventures.

A representative APT use is to provide a laboratory for field measurements of seasonal changes in the Earth's upper atmosphere, the stratosphere in particular. Purposes will be to advance our understanding of physical, chemical and meteorological processes that influence perturbations in ozone distribution above Antarctica which were first observed by the British above their Halley Bay Station during the mid-1970's. Since that time, the October mean ozone level measured at Halley Bay has dropped between 40 and 50 percent. Potential enlargement of the 12 million km^2 "hole" is viewed with alarm because atmospheric ozone is responsible for screening out more than 99 percent of the solar ultraviolet radiation that reaches the Earth's atmosphere. APT research can focus international attention on natural and man-made ozone influences and countermeasures.

APT research can also direct international resources and concerns to other issues of global importance. The antarctic continent is a major force driving the Earth's weather systems. Accordingly, APT research can investigate and monitor air and ocean transport of radioactive particulates and toxic chemicals; magnetospheric phenomena and their relationship to the solar wind magnetosphere system; and influences of ice and other surface features upon past, present and future climate conditions.

APT studies of the Antarctic Plate can expand knowledge about the evolution of the Earth's crustal and upper mantle structures. This can lead to a better understanding of the way mineral resources are distributed throughout our planet, whether or not they are to be exploited.



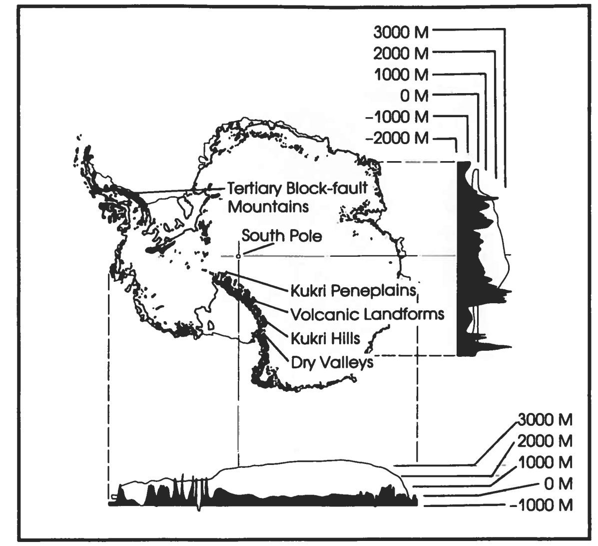
Antarctic Temperature Regions

Antarctic Climate Zones

Large temperature gradients between the cold continent and warm ocean create low-pressure areas which travel eastward and south-eastward with prevailing winds. These wind tracks cause a persistent circumpolar band with low average pressure around the area 60°-65° South. This area, the ***Circumpolar Trough,*** is one of the most cloudy regions in the world, with an average cloud cover of 6/8 and 8/8. The climate is relatively mild with surface temperatures rarely below 14°F.

Antarctica's ***Continental Zone*** has prevailing easterly winds at low altitudes and a much higher proportion of clear days. Summer temperatures are mild under the ocean influence. Typical winter temperatures may reach as low as -40°F and -60°F, except around the northern end of the Antarctic Peninsula, an area with a maritime climate.

The ***Continental Interior*** presents the lowest temperatures. A high pressure region at the center of the polar plateau is responsible for predominantly clear skies with periods of cloud cover accompanied by warm maritime air. This plateau reaches surface altitudes of more than 4 kilometers above sea level. Temperatures range from -4°F during short summers, to -76°F a few months later. A record low temperature of -128°F was recorded at Vostok, a manned station.



Antarctic Regions

Antarctic Surface Features

Antarctica has diverse terrain and environmental features. Some regions, which are the driest, windiest and coldest places on Earth, are similar to the Moon and Mars.

The ***Kukri Peneplains*** is the oldest antarctic erosion surface. Located in part of South Victoria Land, this area stretches more than one thousand miles from the Horlick Mountains to Terra Nova Bay. The flat and gently undulating surface is overlain by sandstone.

Tertiary block-fault mountains, are believed to have been caused by differential tilting of the Kukri Peneplain surface and topographical modifications resulting from glacial and flurial (preglacial) erosion.

Widespread ***volcanic landforms*** such as Victoria Land, Byrd Land and the sub-antarctic islands, feature broad basins, craters, breached cones, somma ridges and composite volcanoes. The highest volcano, Mount Erebus, rising 13,000 feet high, is still active.

Five ***dry bedrock valleys*** extend 30 miles from the continental ice sheet west down to McMurdo Sound on the east. The Mackey and Ferrar Valleys are occupied by outlet glaciers. Others (the Victoria, Wright and Taylor Valleys) are essentially ice-free.

Technology Demonstration Applications

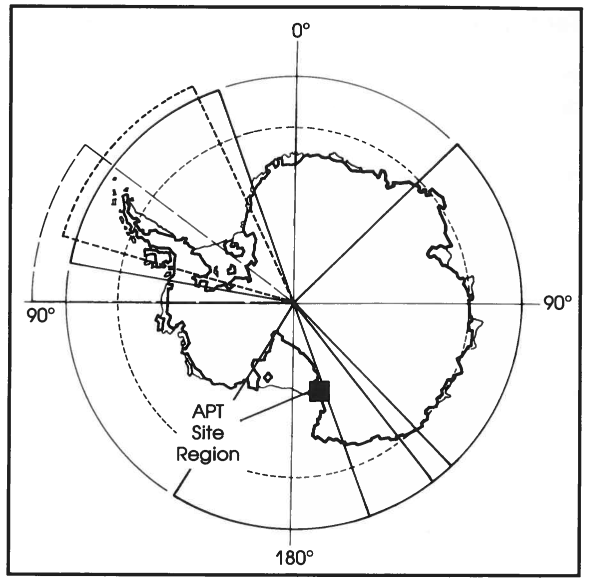
Severe environmental conditions on the Moon and Mars will pose hardships for people and machines. Failure to validate procedures and systems under realistic conditions is likely to be costly in terms of human life and/or failed missions. The APT facility will afford a valuable environment for realistic simulations and assessments.

The APT initiative will also provide opportunities and incentives to advance technologies for terrestrial uses. The antarctic environment and demanding APT performance requirements will offer useful tests and testimonials for companies developing commercial products. The APT's remote location and extended duration crew duty cycles will encourage innovations to achieve high yield, efficient food and energy production. APT's space-applicable methods to treat and recycle wastes will demonstrate that human settlements can be nonpolluting and environmentally responsible.

A key APT objective will be to realize a high level of self-sufficiency through local growth and processing of food sources. Severe limitations upon environmentally controlled volume and manpower will demand careful selection of nutritious, rapid-growth plants and animals that are easy and efficient to attend. Hydroponic agriculture, including fish and shrimp farming, are candidate approaches. Organic wastes will be recycled for reuse to the extent possible.

Another priority will be to implement and evaluate autonomous power generation and storage systems. Candidate technologies include biomass systems that produce gas from organic wastes; fuel cells which produce electricity through a reverse osmosis process; wind turbines; and small nuclear generators if subsequently allowed by treaties.

APT operations will provide challenging applications for robotic and other automated systems. Experiments will include obtaining mineral resource samples, in situ material processing, and advanced construction techniques.

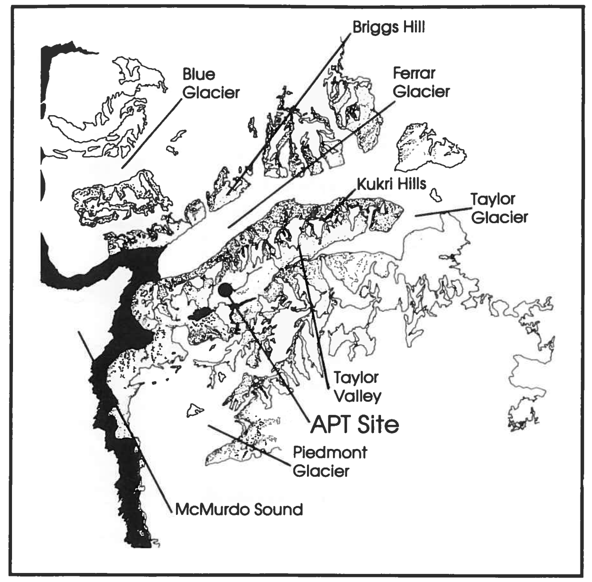


Proposed Site Location in Antarctica

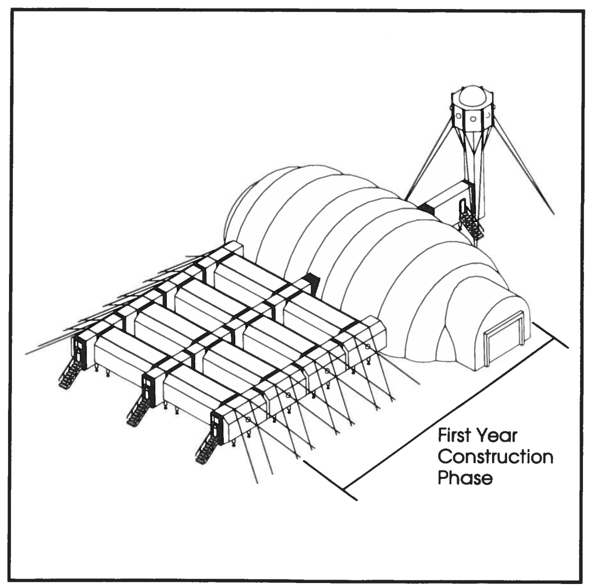
Proposed Site

The APT site selection process has correlated key lunar and Mars mission simulation objectives with environmental, geological and programmatic features of various candidate locations. Three types of areas located in the general region of the U.S. McMurdo Station were given priority attention based upon cargo transfer and emergency rescue advantages: dry bedrock valleys, the polar cap, and Marble Point on the Ross seacoast. A dry valley site was selected as the preferred option because of similarities to a harsh Martian environment and the bareness of a typical lunar landscape.

After reviewing several dry valley possibilities, a proposed location was selected in the Taylor Valley about 80 miles northwest of the McMurdo Station. This site is close enough to the U.S. base to be reached by a fully loaded Sikorsky S-64 Skycrane helicopter. An important consideration was to avoid use of large transportation means requiring major road beds or runways which would disturb the environment. Accordingly, cargo will be transported by helicopter from McMurdo Station following delivery by ship. Transport by air or sea will be limited to four months of the year due to severe weather and ice conditions.

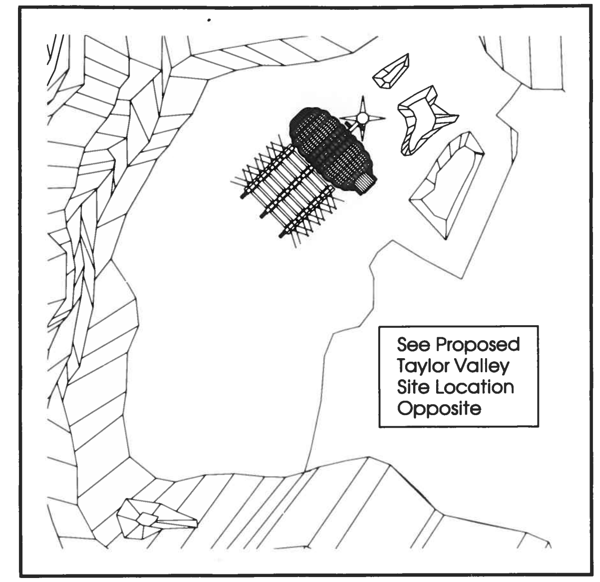


Proposed Taylor Valley Site Region

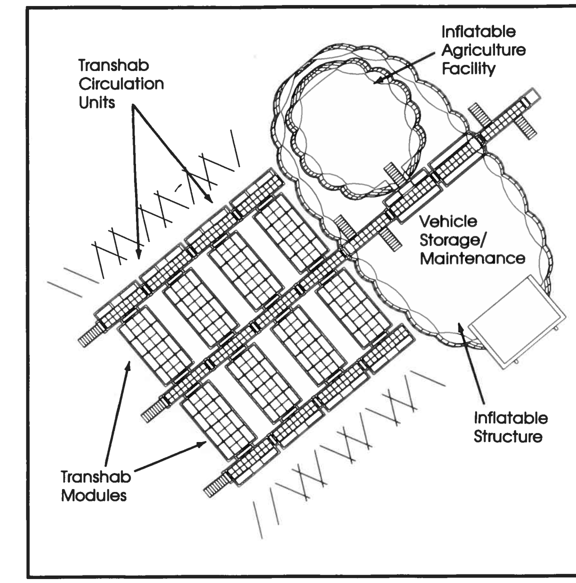


APT Facility Configuration

All possible precautions will be taken to preserve the pristine environment of the dry valley site. This will be accomplished by minimizing the amount of surface excavation and construction; limiting crew population size; an emphasis upon reprocessing, reuse and control of waste materials; and use of nonpolluting power generation sources. Application of state of the art technology to collect, treat and recycle waste materials will also help to reduce resupply requirements.



Proposed Site Plan



APT Facility Elements

APT Facility Planning Considerations

Building Systems

- *All elements designed for transport by Sikorsky S-64 Skycrane helicopter to site.*
- *System design to avoid the need for heavy construction and transportation equipment.*
- *Construction planned to minimize impacts upon the environment.*
- *Habitat, laboratory and storage facilities designed to enable simple and rapid construction.*
- *Modular design to enable easy and versatile expansion, reconfiguration and equipment changeouts.*

Utility Systems

- *Use of nonpolluting power systems.*
- *State of the art systems to collect and recycle waste materials.*
- *Utility interfaces to accept standardized Space Station-like experiment racks and functional units.*
- *Automation and robotic systems emphasis to reduce labor and demonstrate space applications.*
- *Data busses and computing systems to control and monitor diverse experiments.*
- *Communication and telemetry systems.*

APT Facility Elements

Living Accommodations

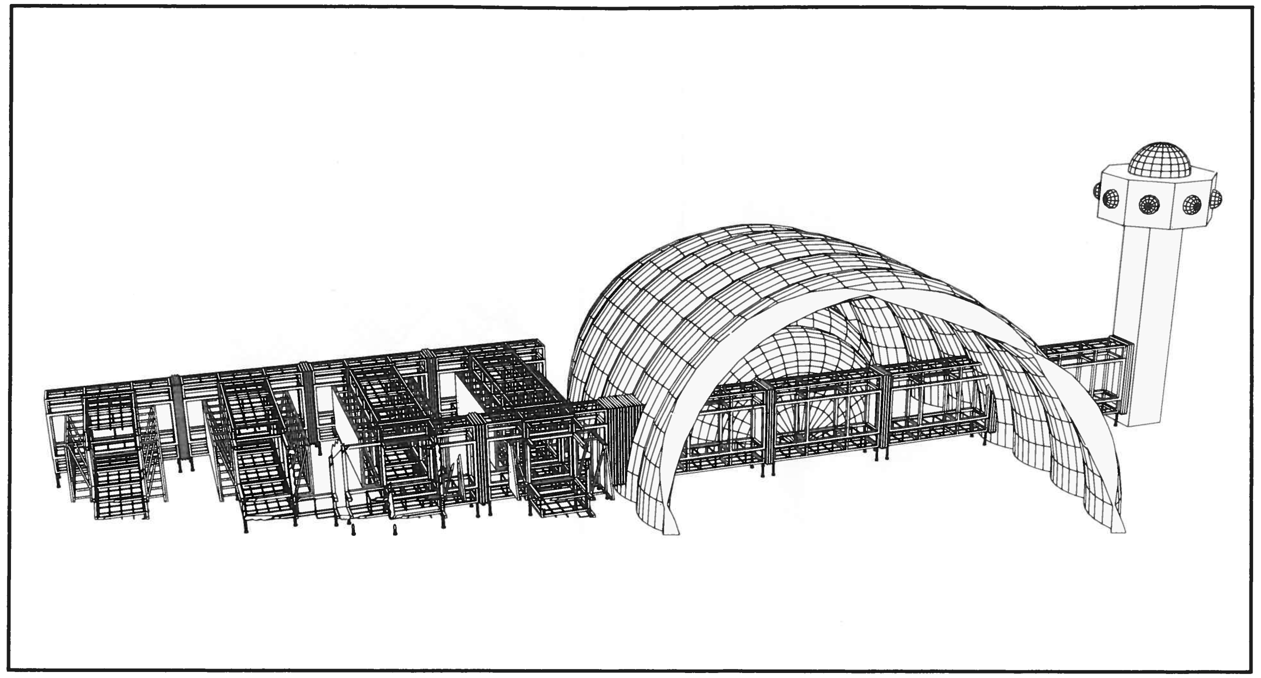
- *Crew quarters for 12 people (summer) and 6-8 people (winter).*
- *Galley and wardroom similar in size and menu provisions to Space Station.*
- *Basic exercise, toilet, shower and laundry equipment.*
- *Small health maintenance facility for routine and emergency medical care.*

Research Accommodations

- *Facilities for human, animal and plant life science research.*
- *Laboratory space with work benches, experiment racks and storage.*
- *Maintenance and parts room with basic tools and calibration equipment.*

Grounds and Ancillary Structures

- *Greenhouse/biosphere for plant growth.*
- *Observation tower for monitoring site activities.*
- *Staging area and equipment for Earth and planetary science experiments.*
- *Space construction and assembly simulation area.*
- *Vehicle repair and storage facilities.*
- *Helipad and fuel storage depot.*

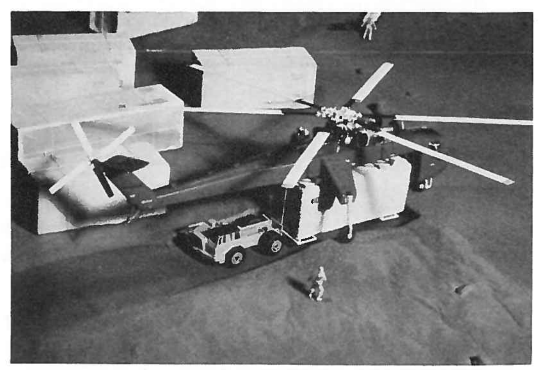


Section Through APT Facility Structure

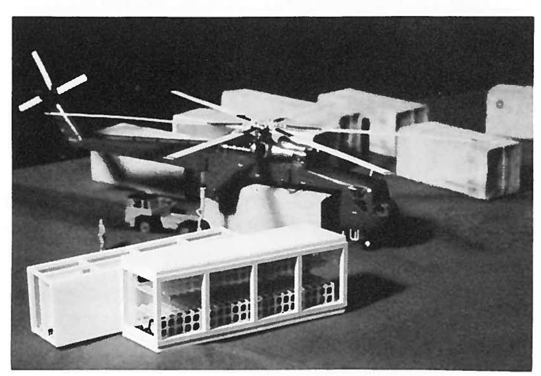
Modular and Inflatable Elements

Habitat and laboratory modules comparable in size to those planned for the Space Station will be assembled on site from prefabricated kits transported by ship and helicopter. These *Transhab Modules,* which will be specially created for APT, will offer advantages of volume-efficient delivery and rapid, easy deployment. Each 27 ft. long,13 ft. tall, 14 ft. wide module will arrive in two payload packages. The core structure containing utilities and central circulation will be expanded from a 27 ft. long by 8 ft. square package to a 13 ft. tall, 8 ft. wide unit of the same length. Two side units contained in the second package, each measuring 27 ft. long by 3 ft. wide, will be attached to the core structure, extending the width to 14 ft. The modules will be connected together by 20 ft. long, 5 ft. wide circulation units, some with attached 3 ft. wide side units.

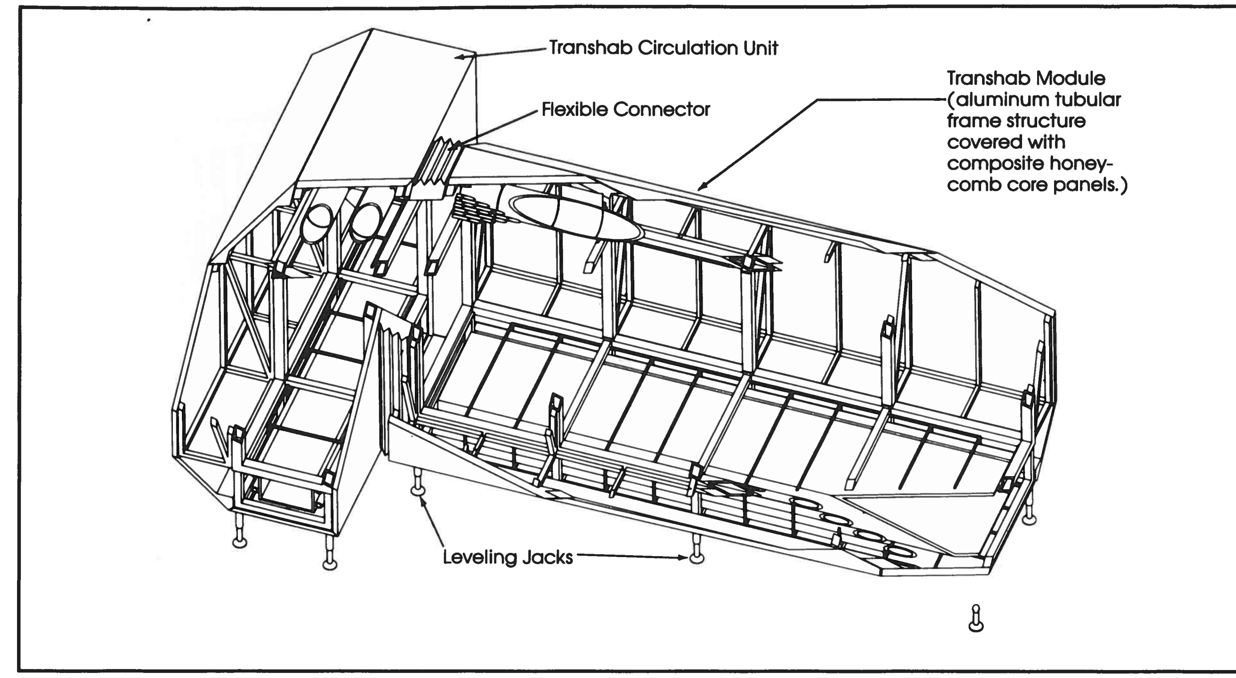
A large inflatable agriculture and vehicle storage facility will be incorporated at an advanced site development stage. Also planned for later implementation is an observation tower constructed in a manner similar to Transhab Modules.



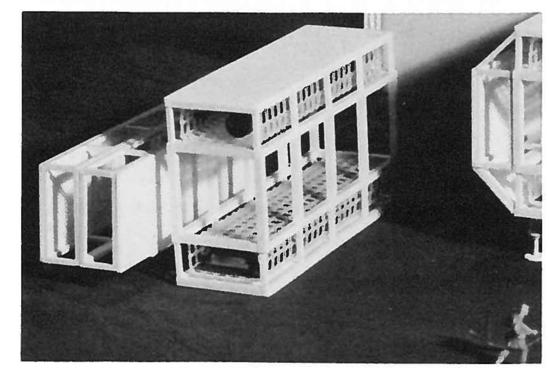
Transhab Package Being Delivered to Site



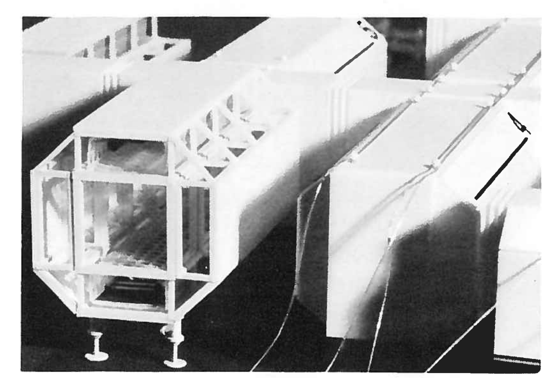
Packages with Components for One Module



Section Through Transhab Module and Circulation Unit



Transhab Module Central Core Extended



Module Side Racks and Corner Panels Attached

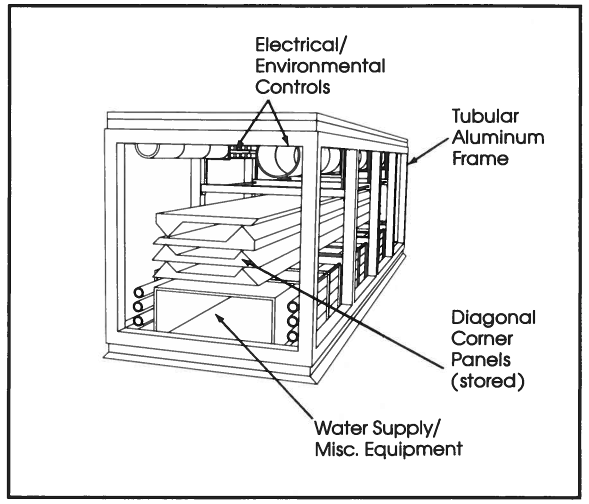
Facility Design Guidelines

Safety

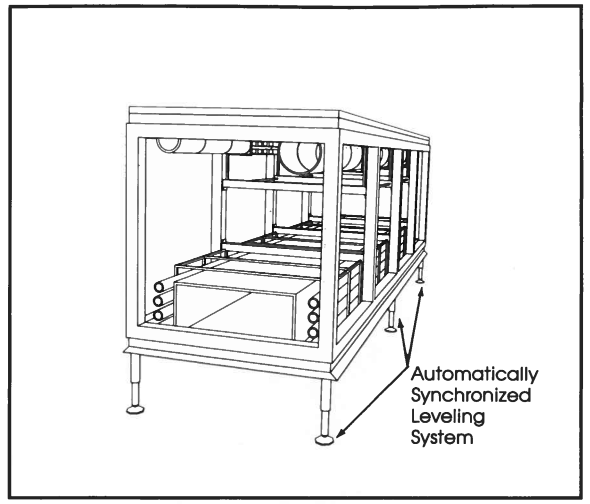
- *Provide safe haven with food and shelter.*
- *Design structures and select materials to reduce fire hazards in the dry climate.*
- *Design structures to withstand lateral loads caused by high winds.*
- *Provide emergency health care equipment and supplies.*
- *Provide backup power and communication systems.*
- *Design systems for reliability, easy maintenance and repair.*
- *Provide means for emergency crew evacuation.*

Economy

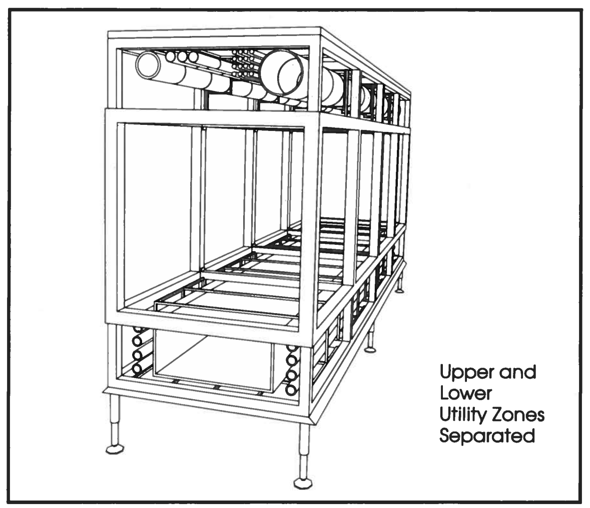
- *Provide well insulated, tight construction to minimize heat loss.*
- *Provide economical, nonpolluting energy sources for heating and power systems.*
- *Size and package construction payloads for efficient helicopter/ship transport.*



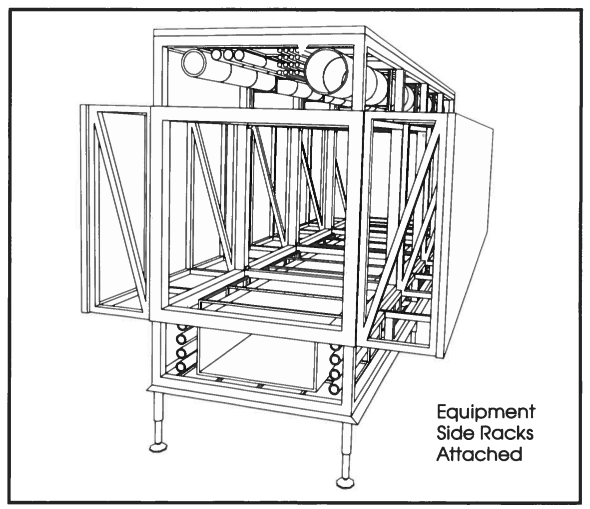
Step 1: Module Core in Packaged Mode



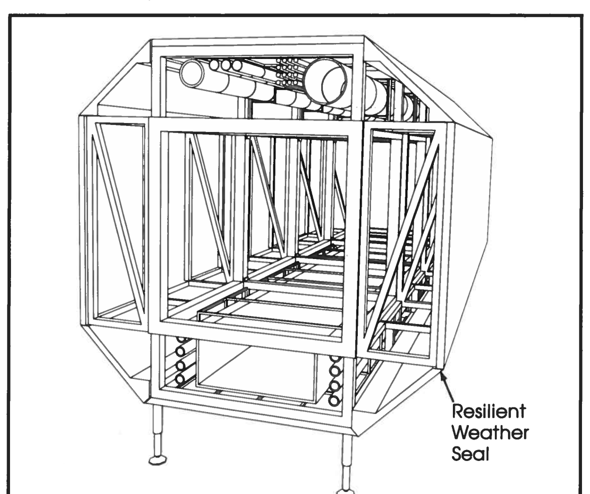
Step 2: Module Core Positioned and Leveled



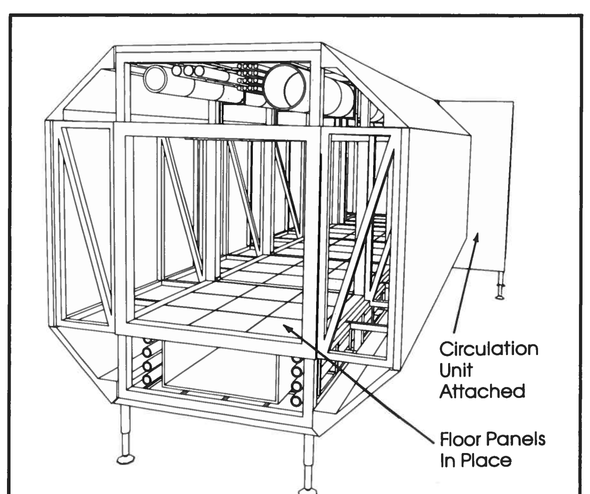
Step 3: Module Core Extended



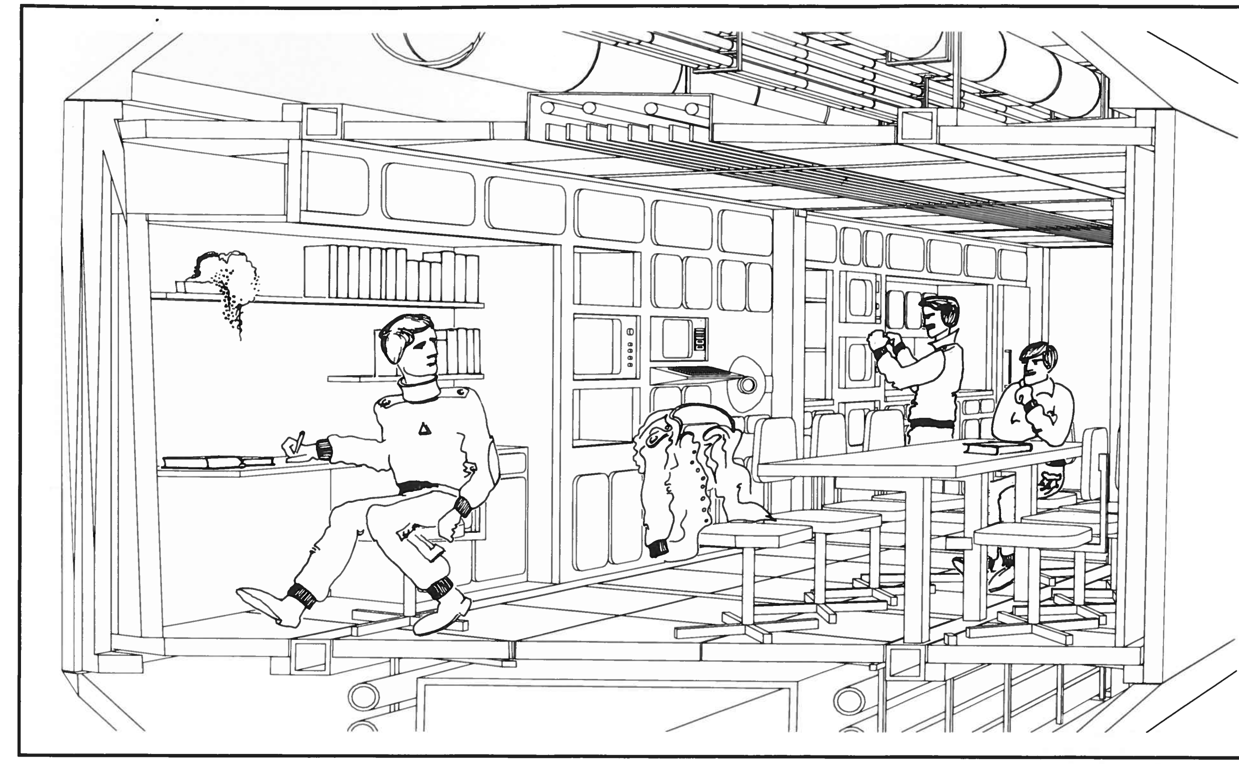
Step 4: Side Units Attached



Step 5: Diagonal Corner Panels Attached



Step 6: Module Assembly Completed



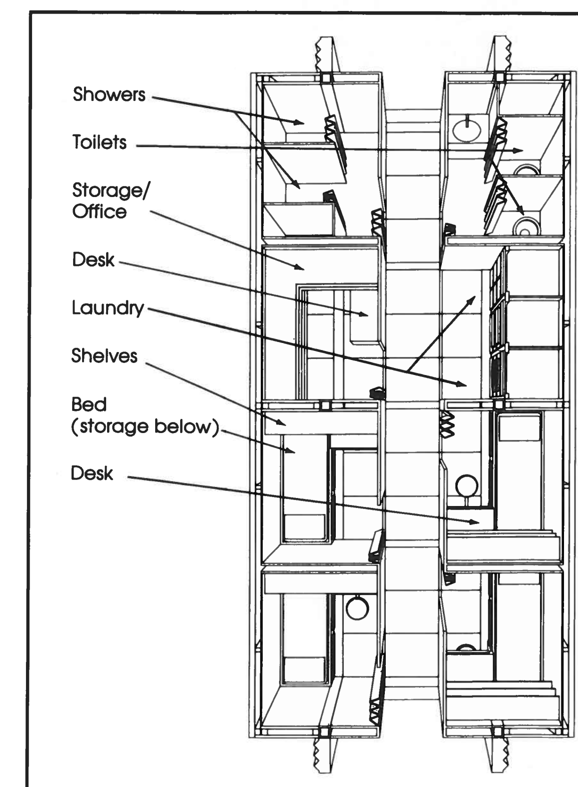
View Showing APT Galley and Wardroom Area

APT Facility Construction

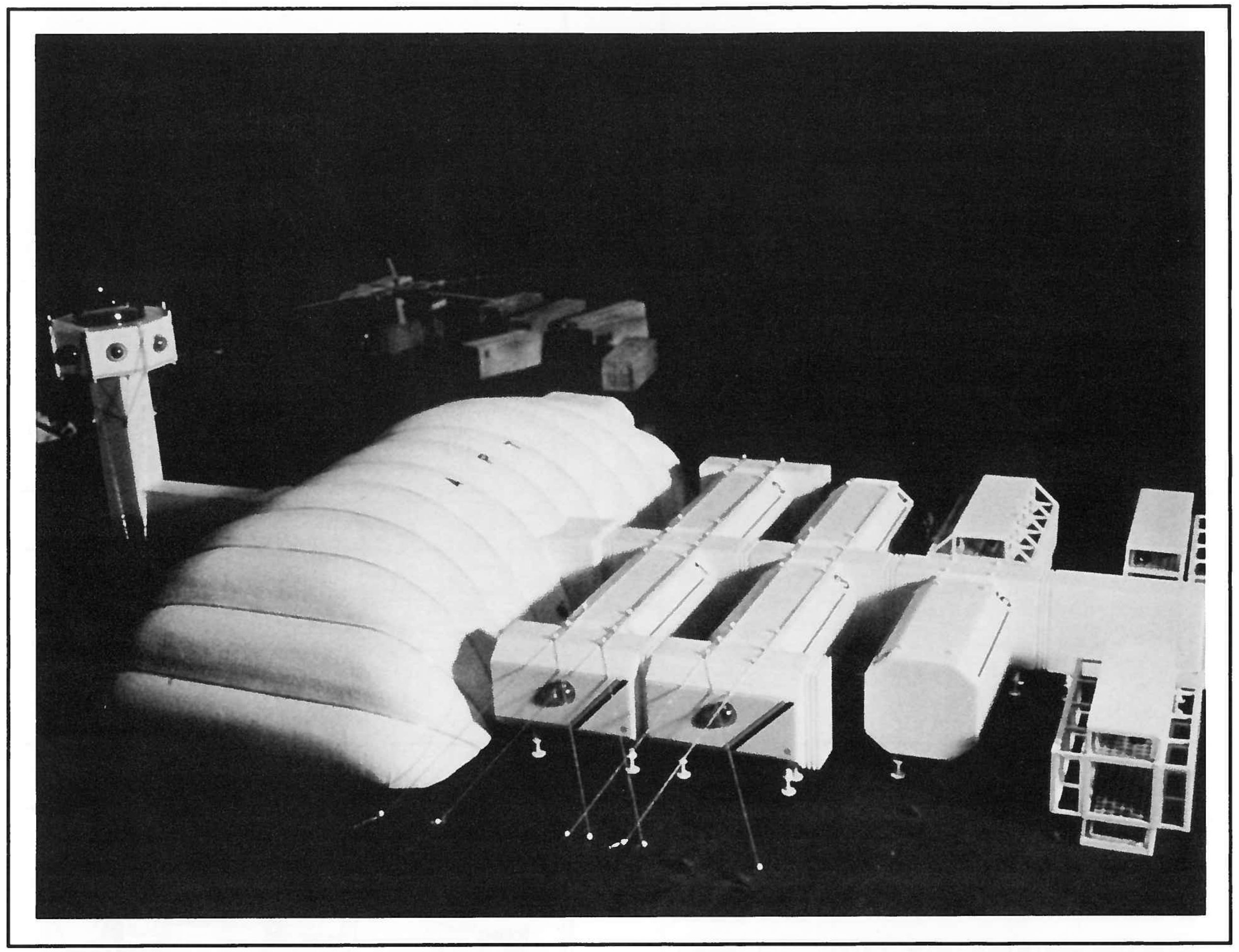
APT Transhab Modules will be constructed primarily of aluminum-faced honeycomb core panels attached to aluminum alloy frames. The honeycomb core will be made of HRH-10 Nomex aramid fiber sheets, each cell filled with fiberglass batting insulation. A sheet of aluminum alloy 6061-T6 will be fixed to the core using a modified epoxy film. These lightweight panels will provide high strength at low densities, fire resistance, and low heat transfer.

Transhab framing members will be made of aluminum alloy 6063-T6 extrusions which are heat treated for extra strength. This material, which is only about one-third as heavy as steel, was selected to facilitate transport and on-site handling.

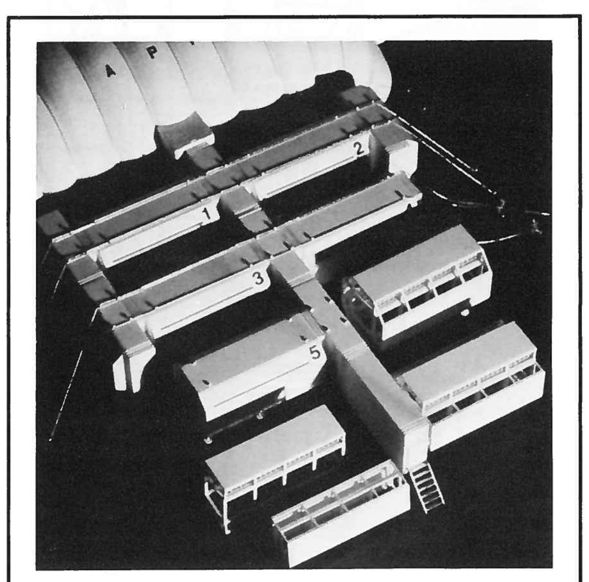
A proposed inflatable agricultural and vehicle storage facility will be constructed of three polyester fabric layers; a thermal inner layer; a foil-faced energy shield middle layer, and a polyvinylchloride and Tedlar covered outer layer.



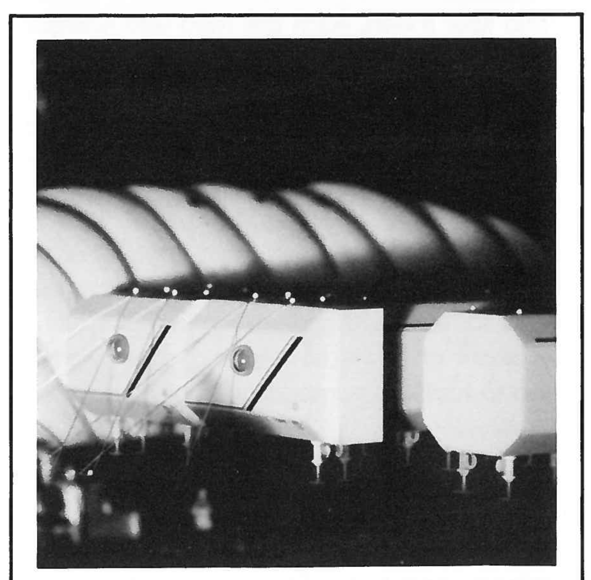
Plan View Showing Sleeping Quarters



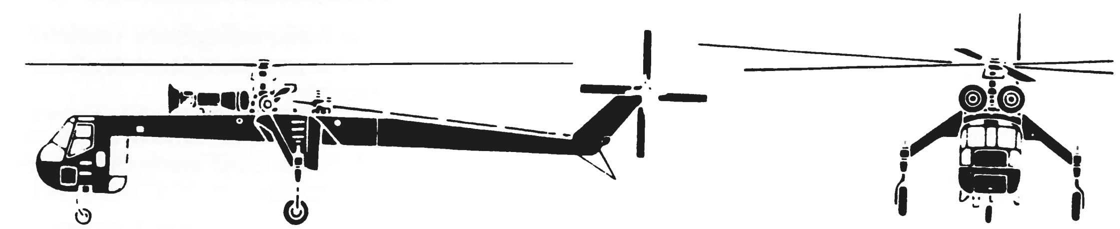
APT Construction Site



Construction at Advanced Stage



Circulation Units Being Assembled



Maximum speed (sea level)	126 mph	Maximum payload weight	20,000 pounds
Maximum range (depends on load)	60-230 miles	Maximum payload size	27x8x8 feet

Sikorsky S-64 Skycrane Transport Capabilities

Implementation Steps	Number of Trips	Time Required
Safe Haven	1	1 day
Vehicle Delivery	4	2 days
Module Components	32	26 days
Other Structures	4	8 days
Equipment	7	5 days
Fuel and Supplies	13	N/A

Payload Trips and Assembly Time (6 Modules)

Major Payload Items	Package Dimensions	Pkg. Wt. Pounds
Module Central Core	27'x8'x8'	15-18 k
2 Module Side Units	27'x6'x8'	10-15 k
Circulation Unit	20'x4'x8'	7-9 k
Circulation + Side Unit	20'x7'x8'	9-12 k
Obs. Tower Base	27'x8'x8'	12 k
Inflatable Structure	27'x8'x8'	16 k
Heavy Duty 4WD Truck	25'x9'x11'	18 k
Light 4WD Vehicle	15'x8'x10'	6 k
Tracked Prime Mover (split packages)	24'x9'x10' (per/pkg)	20 k

Estimated Payload Sizes and Weights

Transportation to APT Site

APT's remoteness will create access problems which are similar in principal to circumstances encountered in planning future planetary bases. This isolation and the requirements it imposes upon APT development and operations are intentional, bringing levels of realism to the program which will maximize its value.

Weather and ice conditions restricting delivery and resupply schedules present access constraints which are analogous to space missions. Large freight ships with ice strengthened hulls can only travel to Antarctica from about mid-December to early March. Other freighters, under escort by Coast Guard icebreakers, have access to some antarctic ports from late November to April. Air travel is less dependent upon seasonal weather conditions but is more expensive. Popular antarctic aircraft are the Lockheed *C-130 Hercules*, Lockheed *C-141 Starlifter*, and Antonov *An-22 Cock*.

Rugged terrain conditions make access to the APT site from McMurdo Station possible only by air. Helicopters which do not require long and expensive runways represent the preferred choice, but their use is hampered by extreme weather conditions. Accordingly, supply and crew rotation events are planned to be limited primarily to warm summer months.

APT Organization Options

Since the central goal of the APT program is to advance peaceful space initiatives that will benefit the world community, international participation should be realized in its management and use. Two general organizational approaches are being explored: an internationally financed initiative governed by a Board of Owners; or alternatively, a U.S. Government-sponsored operation which invites the involvement of foreign partners.

The multinational Board of Owners approach has a precedent in other international space organizations such as Intelsat and Inmarsat. These organizations provide at least one body that decides issues on a one nation, one vote basis (traditional international law) and a second body that apportions power and profits based on share ownership (a flexible, more capitalistic and less statist approach). Intelsat, created in 1965 largely as a U.S. initiative, serves as a successful and continuing model for organizations that desire to develop and share resources and other benefits in a multinational extraterritorial format.

The U.S. Government-sponsored approach envisions a U.S. facility which would invite international use in exchange for financial and in-kind service support. Key organizing sponsors might be the National Aeronautics and Space Administration and the National Science Foundation. This approach may be the easier of the two to implement and manage, but has more limitations as a model for future large-scale international ventures in space.

Program financing for either approach can be provided through a combination of government grants, private sector investments and APT user fees. Corporations will be encouraged to donate state of the art hardware in return for R&D and prestige benefits. Such a unique facility in a scientifically important dry valley location will represent a valuable real estate investment and an important asset to advance world progress and cooperation.

Benefits for APT Participants

Government Sponsors

- *Reflects a national/agency commitment to advance progress towards Solar System exploration.*
- *Facilitates and demonstrates development of advanced systems for space and terrestrial uses.*
- *Encourages and directs private sector participation and investment in space initiatives.*
- *Brings non-aerospace organizations and technologies to light which represent new capabilities.*
- *Produces new knowledge and experience to reduce risks and costs for future space initiatives.*
- *Fosters and symbolizes a commitment to international cooperation.*
- *Offers a potential model for future international space initiatives.*

Commercial Organizations

- *Provides opportunities to demonstrate and publicize current technologies and capabilities.*
- *Provides means for organizations to better understand and prepare for future government and commerical space business opportunities.*
- *Creates a service market for APT construction and operations support.*

Research Organizations

- *Affords extended access to Antarctica for space and other research.*
- *Provides opportunities and means to conduct unique research.*
- *Provides opportunities for networking and participation with other government and private research organizations and sponsors to advance science objectives.*
- *Presents occasions to share experiences and knowledge with people from other nations/cultures.*
- *Presents opportunities to test systems and procedures under rigorous conditions.*

APT Implementation Activities

Identify Candidate Participants

- *Contact and brief candidate sponsors and technical participants.*

Determine Site and Facility Requirements

- *Visit site to conduct surveys/evaluations and determine APT placement.*
- *Finalize facility design requirements based upon participant inputs.*

Develop Implementation Plans

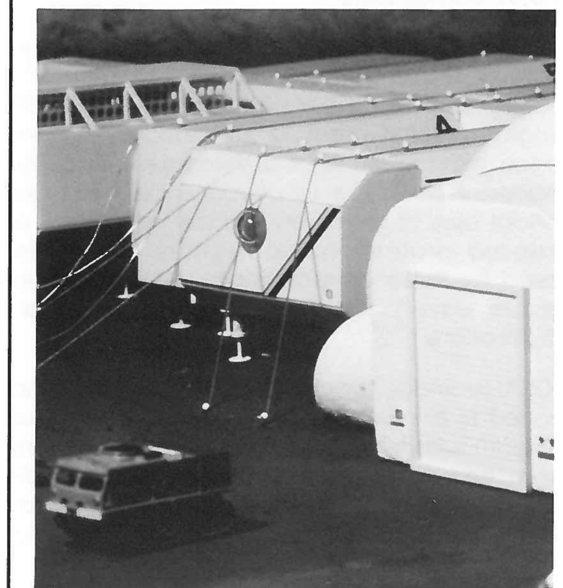
- *Prepare detailed engineering plans.*
- *Determine construction, transportation and operational costs.*
- *Prepare a detailed business plan.*
- *Determine management structure and participation.*

Obtain Necessary Approvals

- *Conduct environmental impact studies.*
- *Secure government approvals.*
- *Secure sponsorship and user participant agreements.*

Implement Construction and Operations

- *Contract for construction, equipment purchase and transportation.*
- *Select and train antarctic crew members.*
- *Transport and assemble APT facility components.*



The APT project is planned to be implemented by 1992 as a significant and appropriate International Space Year accomplishment. This time period has additional historic significance to the United States, representing the 500th anniversary of the arrival of Columbus to the new world.

Planning activities are being coordinated with many organizations and individuals in the U.S. and abroad. Networking includes scientists and technology development experts from diverse government, corporate and institutional entities.

APT Implementation Schedule

Activities	1988		1989				1990				1991				1992	
	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48
Identify Candidate Participants	▨	▨	▨	▨	▨	▨	▨	▨								
Determine Site and Facility Requirements			▨	▨	▨	▨	▨	▨								
Develop Implementation Plan			▨	▨	▨	▨	▨	▨								
Obtain Necessary Approvals							▨	▨	▨	▨	▨	▨				
Implement Construction and Operations											▨	▨	▨	▨	▨	▨

SICSA Background

SICSA is a nonprofit research, design and education 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.

SICSA's APT Planning Team
Alejandro Bottelli, Muhammad Siddiqui
Mashid Ahmadi, Fernando Brave
Standing: Larry Bell, Guillermo Trotti

The APT project is a major SICSA initiative. Planning began in September 1987 in response to interest generated by a conference that year titled *The Human Experience in Antarctica: Applications to Life in Space* which took place at the NASA-Ames Research Center in Sunnyvale California. The event was cosponsored by the Office of Space Science and Applications and the NSF Division of Polar Programs.

SICSA
Sasakawa International
Center for Space Architecture

Room 122 ARC, University of Houston
4800 Calhoun, Houston, Texas 77004

Budget No. 3310
1440008

Non-Profit Organ.
U.S. Postage
PAID
Houston, Texas
Permit No. 5910

Address Correction Requested