Project Statement

Orbital Colony

A cloud covered vista of Earth passes below the fully inflated Genesis II spacecraft. Bigelow's designs incorporate inflatable module technology developed by NASA during the TransHab program. (Bigelow Aerospace)

Background

The development of practical space travel in the middle of the last century provided the opportunity for humans to finally live beyond the Earth. On April 19, 1971 Russia launched Salyut 1 the first space station into Earth orbit. Since then man has launched eight other manned space stations, culminating in the ongoing construction of the International Space Station by a partnership of 15 nations. While the first of these temporary outposts were being launched, scientists and visionaries dreamed of space habitats far larger than the small aluminum shells launched by the rockets of the day; true space colonies capable of supporting a population of thousands. Such habitats would form the basis of a space faring society living and working beyond a planetary surface, a dream that has yet to come to pass.

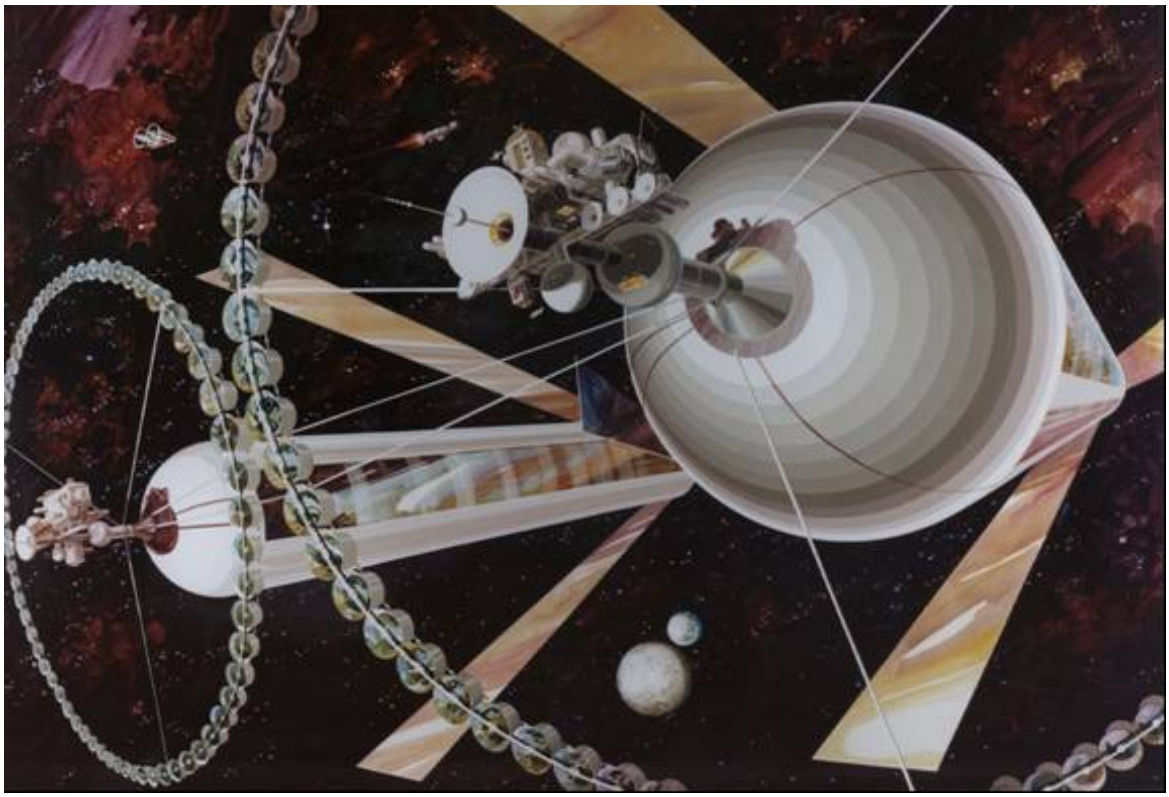
In July 2006, a private unmanned space station module called Genesis I was launched into orbit by Bigelow Aerospace as the first of several technology demonstrators in support of the company's plans to build a functioning orbital hotel by 2012. A second demonstrator, Genesis II, was launched in June of 2007. The growing commercial movement to develop a thriving space tourism movement could one day lead to a movement towards more permanent residences, true space colonies.

Objective

The Year: 2035
The Place: Space, the Final Frontier…

For decades people have visited space for short periods of time; vacationing in orbiting hotels and serving on scientific outposts. Now a group of private investors making up the Moku Group wants to change all that by building an orbital colony capable of supporting a sustainable population of settlers willing to take the next great leap into space.

The Moku Group is seeking design proposals for their orbital colony. The colony will be the permanent home to at least 200 people. More than a resort, the colony must be its own self contained community including homes, entertainment, and jobs for its residents just as in any on Earth. The colony should be placed in an advantageous orbit, and be an attractive place for prospective businesses and residents to relocate to. The design should be as self-sufficient as possible to minimize operating costs for the investors. Residents must be protected from the dangers of micrometeoroids, solar radiation, and the negative health effects of microgravity. Design teams are highly encouraged in the proposals to look at innovative ways to reduce construction time and costs.



One of the most ambitious colony designs is the O'Neill Cylinder, named after its designer Gerard O'Neill. Each rotating cylinder consists of three inhabited sections and three transparent panels to let in sunlight reflected by large external mirrors. The huge four mile wide and twenty mile long cylinders could house millions in an Earthlike environment complete with a blue sky and clouds. The Earth and Moon can be seen in the background from the vantage of the L5 Lagrange point where the colony is located. (NASA Ames Research Center)

The first space colony does not need to be as huge as the grand plans from the 70's. A smaller orbital habitat can be built from large sections launched by heavy lift rockets. Some designs propose using empty rocket fuel tanks to build the station's modules from; recycling what would otherwise reenter the atmosphere as space debris. The station in this graphic is constructed from modified space shuttle external tanks with their interiors replaced with living space once they are in orbit. (Space Island Group)

Mission Requirements

1. The colony will be located somewhere in the Earth-Moon system. The exact orbit of the colony is up to the design team, with possibilities including but not limited to LEO, GEO, and the stable Lagrange Points.
2. To provide a viable long term living environment the colony must support at least 200 inhabitants. Designs can exceed this number. Items to consider in support of this population include, but are not limited to:
    - Living and recreational space.
    - Maintenance of a breathable atmosphere.
    - Waste handling.
    - Sources of electrical power and heat.
    - Sources of food and water.
    - Protection from cosmic radiation and solar storms.
    - Employment opportunities for residents.
    - Docking areas for receiving and launching spacecraft.
    - Quality of life for residents in the colony.

3. The colony should be as self sufficient as possible to minimize the amount of outside resources that need to be imported (air, water, food, etc).
4. Prolonged exposure to microgravity can have crippling health effects due to weakening of bones and muscles. The design must incorporate some way to prevent these effects from harming its future residents.
5. Teams should include how the colony will be constructed as well as types and sources of materials to be utilized.
6. Discuss options for handling future population expansion in the colony.

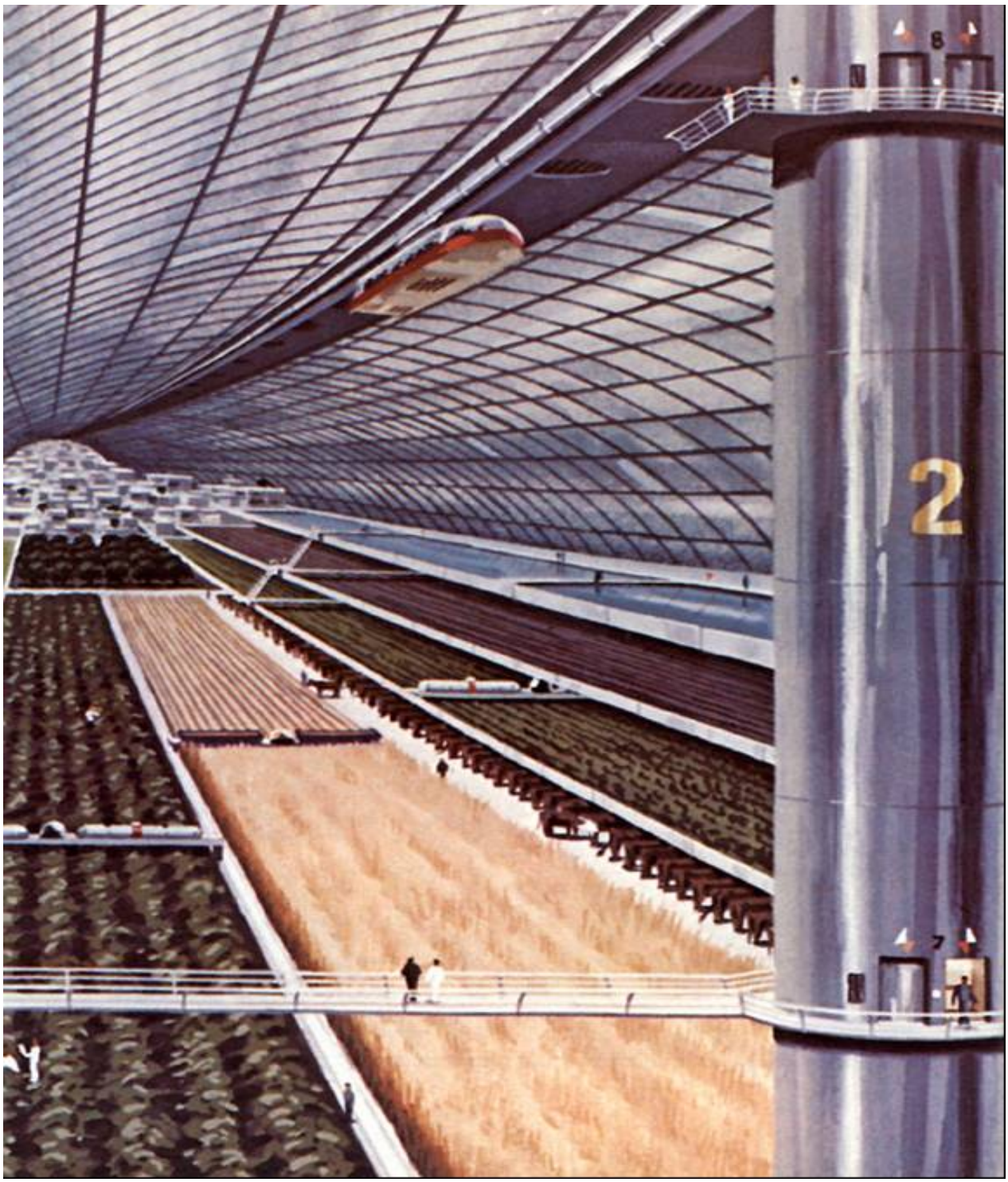
Assumptions

- Some space infrastructure exists, including outposts in Earth orbit and on the Moon.
- The local environmental conditions are consistent with the best current scientific understanding of the near Earth environment.

Sources

1. Bigelow Aerospace website (http://www.bigelowaerospace.com/).
2. O'Neill, Gerard K., *The High Frontier: Human Colonies in Space*. William Morrow and Company Inc., 1977.
3. Space Island Group website (http://www.spaceislandgroup.com/home.html)

In the 1970's, space colony designer Gerard O'Neill envisioned the workers in his orbital habitats building massive solar power satellites for export to Earth. Sitting in geostationary orbit the orbital power plants would beam energy back to receiving antennas on Earth using microwaves. Satellites are not the only things that can be made in space. Microgravity presents unique advantages in many manufacturing processes allowing factories to make a wide variety of products impossible to produce on Earth, ranging from ultra-pure alloys, to advanced semiconductor crystals for computer chips, to pharmaceuticals.(NASA Ames Research Center)



Feeding a colony full of hungry people is a critical task for designers to plan for. As shipping fresh food from Earth would be prohibitively expensive most designers have incorporated some way for the colonists to grow their own. A small colony may survive on greenhouses and hydroponics. Larger designs could include whole farms raising crops and livestock. (NASA Ames Research Center)

Additional Resources

1. The New Mexico Space Design Competition web page: http://www.unm.edu/~isnps/outreach/SDC.html)
2. Scientific and/or engineering libraries at the University of New Mexico, New Mexico State University, New Mexico Institute of Mining and Technology, plus other universities and community colleges.
3. The National Aeronautics and Space Administration (NASA) website (http://www.nasa.gov)
4. The Jet Propulsion Laboratory web sites (http://www.jpl.nasa.gov) and (http://www.nasa.gov/centers/jpl/home/index.html)
5. The Johnson Space Center web site (http://www.nasa.gov/centers/johnson/home/index.html)
6. The Marshal Space Flight Center web site
7. (http://www.nasa.gov/centers/marshall/home/index.html)
8. NASA Technical Report Server (http://ntrs.nasa.gov/) provides a searchable database of NASA reports and publications, many of which are freely available for download in pdf format.
9. The American Institute of Aeronautics and Astronautics (AIAA) website provides a searchable database of publications and papers. At (http://www.aiaa.org), click on "Publications and Papers," then add your search keywords under "Search the AIAA Electronic Library."
10. National Space Society's space settlements website has several useful books hosted from the space colonization movement in the 1970's. (http://www.nss.org/settlement/nasa/onLineSSB.html)
11. Space Studies Institute's website (http://www.ssi.org/) also has some useful information on the subject.
12. Your school library may have access to Research Databases and Indexes, which can provide full text articles. Recommended databases include Compendex Plus, FirstSearch, etc.