ARCHITECTURE DEPARTMENT
DESIGN-O-CRATS

Architecture on Mars

INTRODUCTION

The human exploration of Mars would be a complex undertaking. It is an enterprise that would confirm the potential for humans to leave our home planet and make our way deep outward into the cosmos. Though just a small step on a cosmic scale, it would be a significant one for humans, because it would require leaving earth on a long mission with constrained return capability. The commitment to launch is a commitment to several years away from Earth, and there is a very narrow window within which return is possible.

NASA MARS HABITAT DESIGN CHALLENGE

1. MARSHA –

CONS- The habitat is on the surface and too complex to construct for the first habitat. Its been made by a big robotic arm which will be difficult to transport.

2. CAVE STRUCTURE –

CONS- The cave structure is made in favour of prevention from radiation. We need another habitat inside it to be fully functionally sealed. And it could collapse during storms.

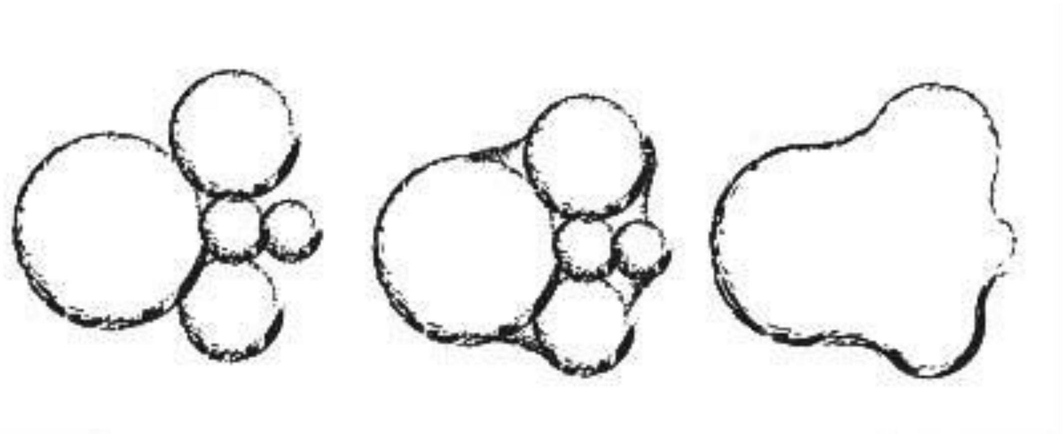
PROBLEMS TO BE FACED

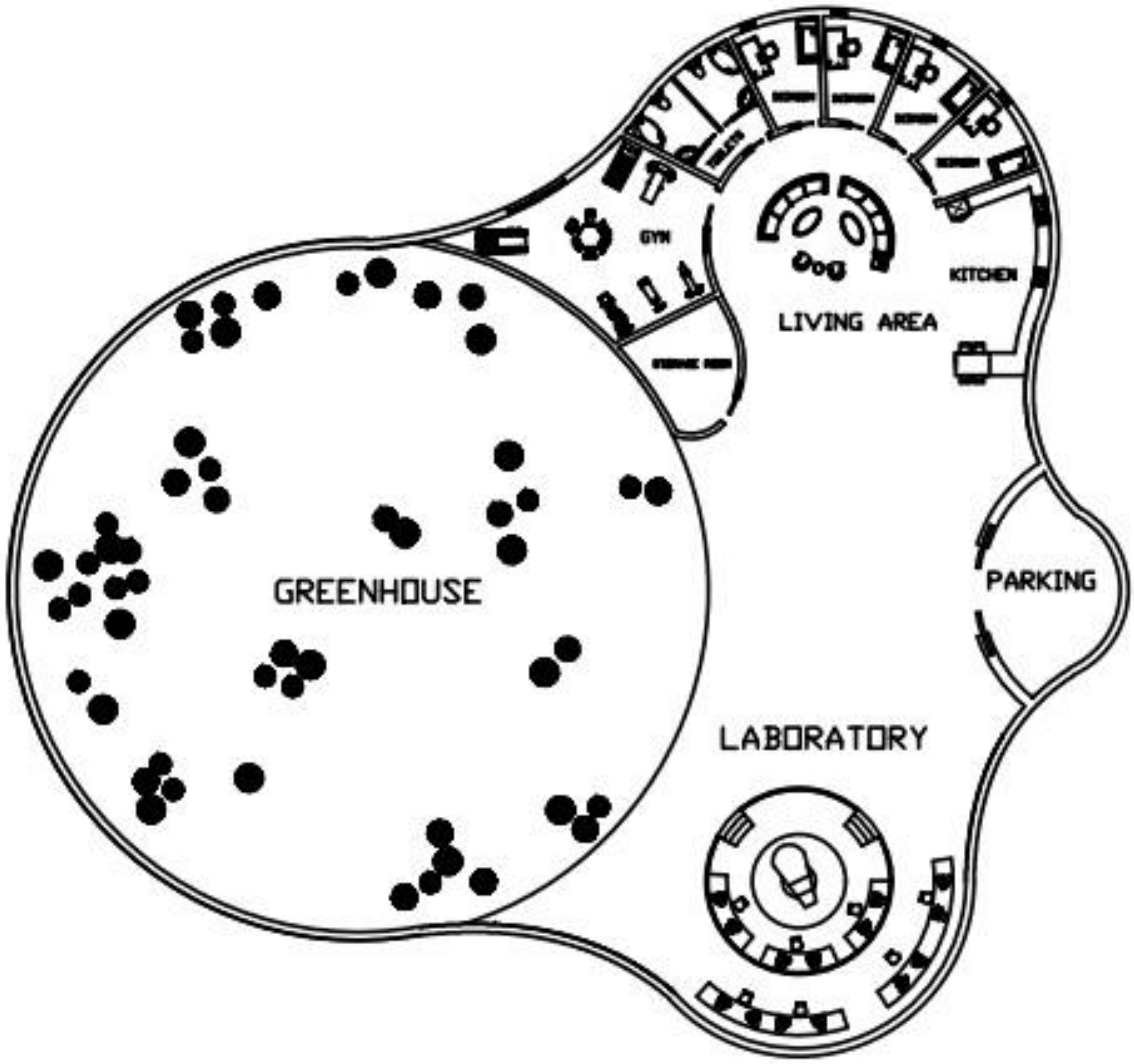
- DUST STORMS- The astronauts on the martian surface inevitably would be exposed to local martian materials such as dust.
- WEATHER- The surface of Mars is very cold and dry; in most places, it is too cold or dry to permit the growth and reproduction of Earth organisms.
- RADIATION- Radiation on the surface of Mars is more than twice the one experienced at the International Space Station. Solar particle events also occur without warning and bombard the place. Something needs to be done to address the radiation problem because it would mean that colonists would have to live short and sickly lives.
- SPACESUITS- Colonists would have to use spacesuits in Mars but these could also fail. Accidents that damage the spacesuit could be fatal. Once spacesuits fail, the colony can also only do some repairs but will be unable to produce these suits.
- TRANSPORTATION- Perhaps the greatest challenge in the planning and design of space habitats is that anything delivered from the Earth must travel to the destination surface on a large, expensive transportation system. Payload mass is always at a premium in cost and propellant. The discussion of space habitats often centers upon how the mission architecture packages the habitat for launch and landing.

SOLUTIONS

- DOME- The environment of Mars is full of dust particles which sometimes produces dust storms. A curved structure isn't easily affected by storms.
- NACRE – it exhibits high strength and toughness. Here, we present a route to build nacre-inspired hierarchical structures with complex three dimensional shapes by electrically assisted 3D printing.

CONCEPT DEVELOPMENT





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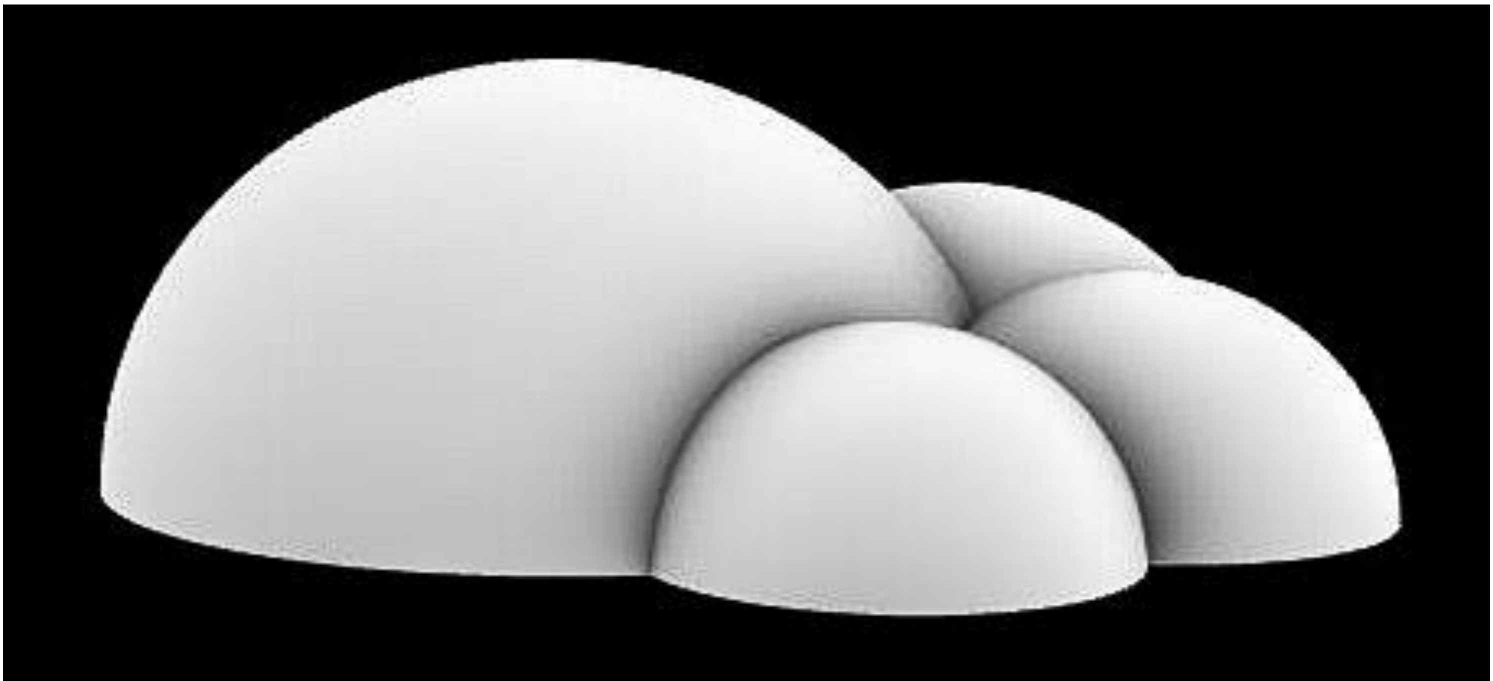
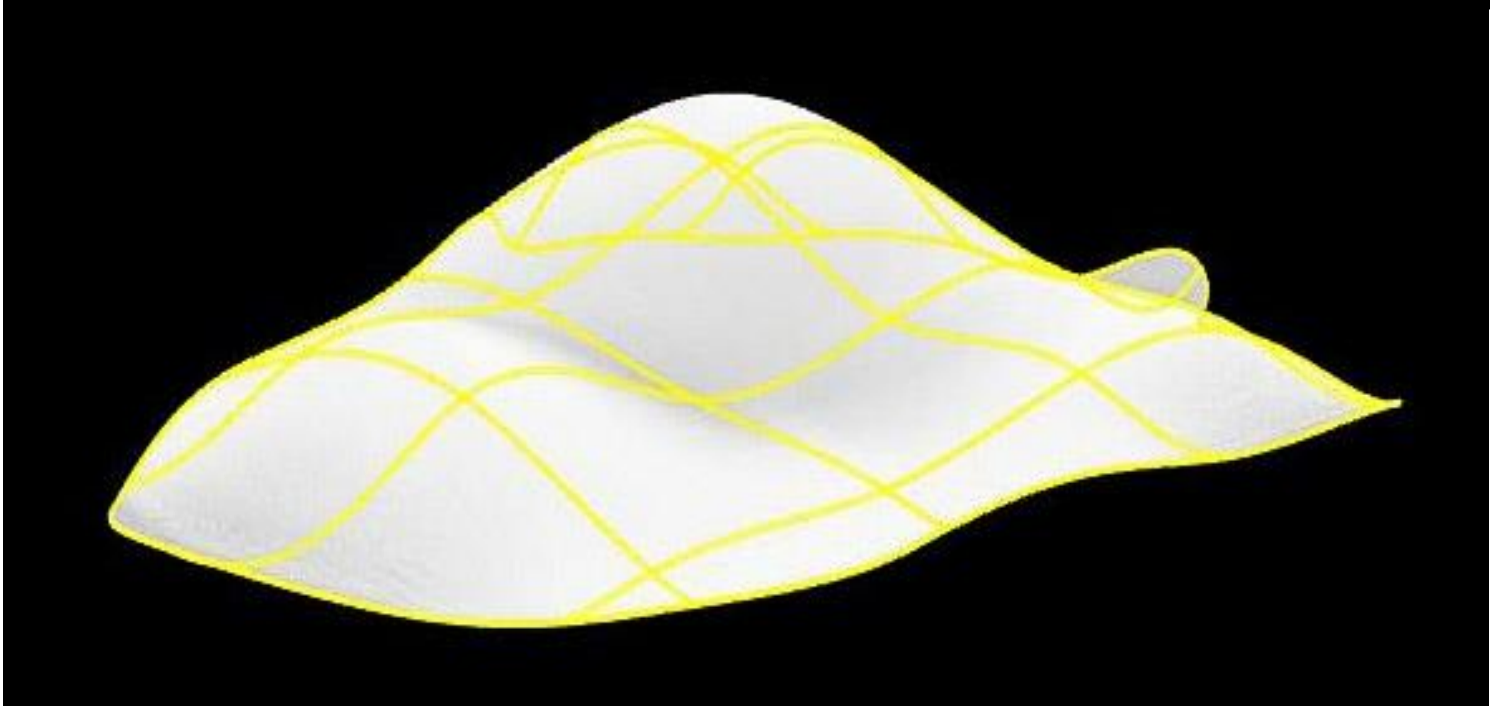
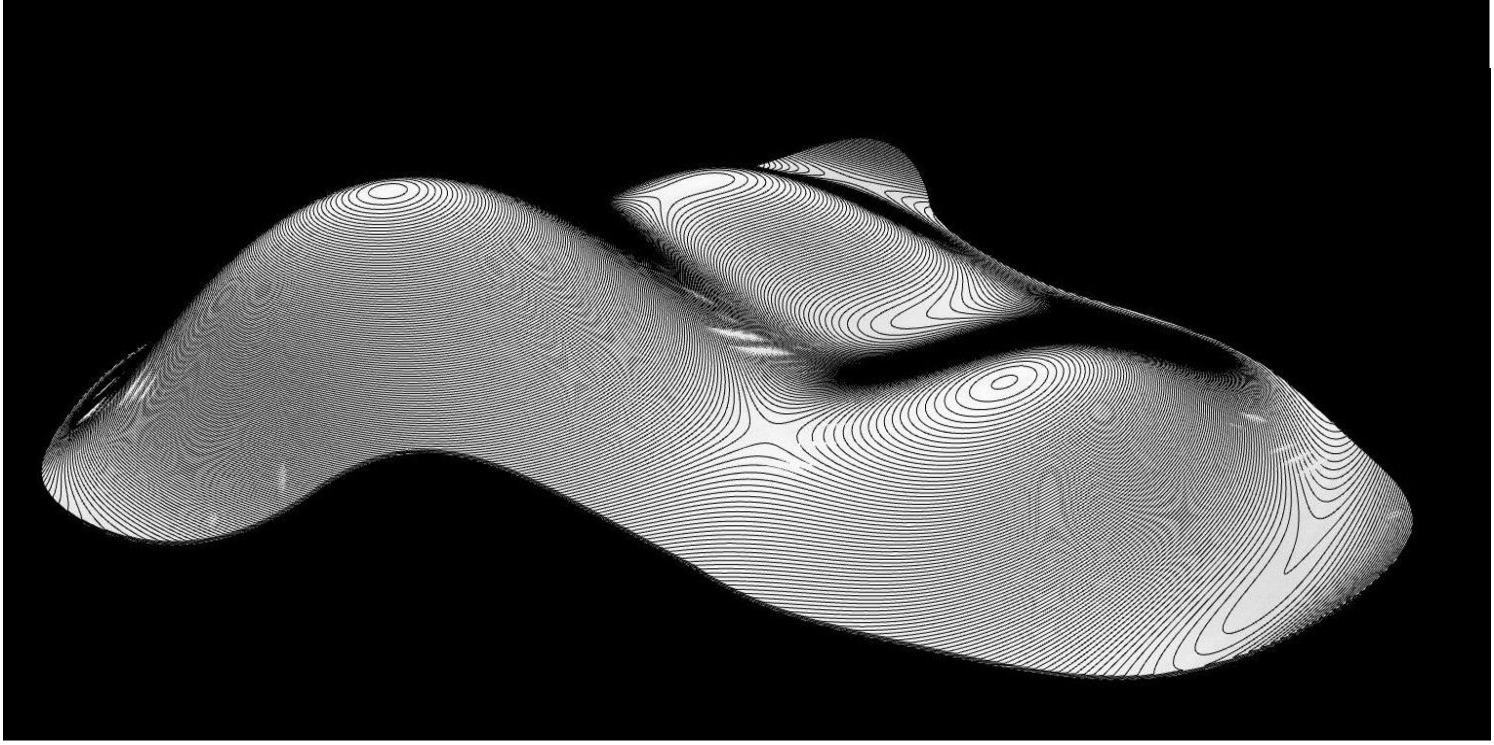

MATERIALS USED

1. Kevlar

Kevlar is more frequently associated with its use in bulletproof garments for the military and police. This material has several properties that make it ideal for use in spacecraft. It has strength enough to resist bullets, making it perfect for standing up to impacts from meteors and space junk. Additionally, Kevlar weighs little compared to its durability. It also can experience extreme temperatures without damage to its structure or changing its form.

2. Aluminum

Another common material used in spacecraft is aluminum. Though itself, aluminum does not have the needed strength for space use, when combined with other metals into an alloy, its strength increases while maintaining its signature light weight. Aluminum alloy performs so well in impact testing that the International Space Station uses this material for its window shutters to keep debris from damaging the windows.

3. Reinforced Carbon-Carbon Composite

For the nose of the space shuttle that **encountered temperatures over 1,260 degrees Celsius** (2,300 degrees Fahrenheit), NASA used a reinforced carbon-carbon composite (RCC). Other areas of the space shuttle that experienced similarly hot temperatures used this composite. The benefit of RCC lies in its ability to give off heat applied directly to it as well as indirect heat. The warmth from nearby surfaces on the shuttle travelled to the RCC-covered parts, where the RCC would release the heat, helping the shuttle to cool down, similar to the way a radiator indirectly cools a car engine.

4. Reusable Surface Insulation

High-temperature reusable surface insulation (HRSI) has a black borosilicate glass coating, making this dark surface capable of standing up to the same high temperatures as the nose cone encountered. White parts of the shuttle have low-temperature reusable surface insulation (LRSI) and can only withstand lower temperatures, up to 649 degrees Celsius (1,200 degrees Fahrenheit). The white coloring allows for better control of temperatures inside the shuttle where the astronauts worked.

5. Nomex Felt

For the coldest areas of the shuttle that experienced temperatures no higher than 371 degrees Celsius (700 degrees Fahrenheit), NASA used reusable surface insulation made of coated Nomex felt. The middle and tail end of the craft in addition to the payload doors had this coating.

6. Thermal Glass

The space shuttles needed windows that would allow the astronauts to see out of clearly without allowing heat to pass through the material. Thermal glass proved the solution to protect the astronauts from both high and low temperatures around the windows and the pressures of space travel.

7. Silica

Silica cloth filled gaps on the space shuttle created by moving parts such as around the landing gear or the loading bay. Another part of the shuttle that used silica in its many forms included the RCC nose cone, which used sodium silicate to seal the cracks created during the coating process. NASA selected silica tiles for lower temperatures zones of the space shuttle, and shuttle builders used borosilicate glass coating for the HRSI portions of the ship.

8. Reinforced Polyethylene

Polyethylene is a good shielding material because it has high hydrogen content, and hydrogen atoms are good at absorbing and dispersing radiation.

OBJECTIVES

- Characterize the structure, composition, dynamics, and evolution of the martian interior (core to crust).
- Quantitatively understand martian climate history with attention to the modern climate/weather system to design the best suitable habitat.
- Learn to make effective use of martian resources including providing for crew needs and a homely environment.