**Moving to Mars Exhibition**

The Moving to Mars Exhibition was hosted at the Design Museum in London from mid-October 2019 until late February 2020. The exhibition features immersive environments and around 200 objects including contributions from NASA, the European Space Agency and SpaceX. The exhibition is now touring internationally, and is currently on display at the Tekniska Museet in Stockholm

HASSELL designed the main feature of the exhibition - a full scale version of a Mars Habitat. This was a fully immersive installation that allowed visitors to step into the physical habitat, which included a kitchen, dining area, science lab and digital fabrication facilities. The habitat is furnished with recycled 3D printed furniture specifically designed for the exhibition. Visitors also have a view of a CGI Martian landscape which is displayed on a video wall and was produced by Lightfield London. Along with the installation there are also a range of scale models, a video and technical drawings that explore how we might bring a human perspective to life on Mars.

**Why Mars?**

HASSELL's original concept for Mars was developed in response to NASA's 3D Printing Habitat Centennial Challenge. The project's goal was to explore the potential for 3D printing to be used in the construction of human habitats on Mars.

However, HASSELL took the opportunity to go beyond NASA's original brief. HASSELL's speculation on Mars has become the ultimate example of creating places people love. It has given us the freedom to experiment with notions of robotic construction, sustainability and human centric design, and move beyond the confines of a typical project to discover new ways of solving perennial problems.

We now look forward to bringing this cutting edge thinking back to the benefit of our clients on Earth.

**Not a base but a home**

Human comfort has traditionally taken a backseat in space exploration. The majority of missions to date, such as the International Space Station, have seen astronauts spend relatively short periods of time in highly engineered environments. However, due to the distance between Earth and Mars, the first astronauts on the red planet can expect to be away from home for more than three years, with no direct contact with people on Earth.

With this in mind, the HASSELL team chose to put the human experience at the heart of the design. We brought our international experience designing for people to shape a habitat that moves beyond the idea of astronauts as purely operators, to create a place where people could not only endure life on Mars, but really thrive in the isolated environment.

This human-centric approach led to design developments that would be relatively simple to achieve on Earth, but present considerable technical challenges in the Martian environment. For example, rather than a solid wall to protect against deadly solar radiation, we incorporated a covered courtyard which offered the same level of protection, in addition to views across the Martian landscape.

**System Architecture**

That is not to say the systems design wasn't a priority. The HASSELL team collaborated with space systems engineers from the University of Cranfield to optimize our design and ensure our proposal was a fully integrated, viable system.

This involved addressing all the requirements of earth-bound projects, ensuring people have access to ventilation, light, food and water, heating, etc. while also addressing the more extreme requirements relating to oxygen supply, radiation protection, and extreme weather conditions.

**Extreme Sustainability**

Sustainable reuse and the responsible harnessing of natural resources is increasingly driving the design agenda at HASSELL. The Mars Habitat presented an opportunity to evolve our current thinking in sustainability and test these in the most extreme and isolated of environments.

With the astronauts limited to only what they can take with them, harnessing and using the natural materials on Mars in a sustainable way, was a primary focus. We applied this theory to the design of the radiation protection shield.

On Mars, unlike Earth, there is no magnetic field or thick atmosphere to protect people from harmful solar and cosmic radiation. One way to protect the astronauts would be to build a thick concrete shell structure, however this is not viable due to the costs associated with transporting concrete to Mars.

We worked with the structural engineers at Eckersley O'Callaghan, to develop a shell structure made solely from locally sourced material: Martian dust or its more scientific name, regolith. The shell would be built ahead of the astronaut's arrival using autonomous robots.

Besides working with local materials, the astronauts would be recycling air, water and even up-cycling some of their consumables. We collaborated with furniture designer Manuel Jimenez Garcia from Nagami. He designed furniture for the Mars Habitat that is 3D printed from the plastic packaging materials used to contain the astronauts' food.

We also collaborated with fashion designer Christopher Raeburn to understand how the astronauts might make their own clothes from the parachutes that were used to land on the Martian surface.

This idea of re-use was also employed in the habitat's interior design. The design is largely modular and works with a radial rack system that can be plugged into a standard interface. Each of these racks offers a variety of functions including storage, workspace, kitchen, lab, sleeping pod and even fitness station. Spaces can be repeatedly repurposed for a variety of uses over the lifetime of the mission.

**Open Collaboration**

Collaboration is central to the success of HASSELL projects – and the Mars Habitat is no exception to this. From the earliest stages of the NASA challenge, the HASSEL team welcomed open collaboration with a range of experts from a variety of backgrounds.

We worked with radiation experts, mining engineers, roboticists, Mars meteorologists, polar explorers and even space anthropologists.

This cohort of experts played a vital role in challenging, pushing and refining our design to ensure it would truly stand up to the challenges of its extra-terrestrial environment.