

# INNER DESIGN OF A HABITAT MODULE FOR PLANETARY SURFACES

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## Summary:

The main goal of our study is the determination of an inner design of a habitat module, which is capable supporting prolonged stay on the surface of a planetary body, e.g. Moon or Mars, while withstanding the external effects encountered on the planetary surface.



Fig.1. The Eötvös József High School of Tata

## Introduction:

In the Eötvös József High School of Tata the student circle for Space Research and Robotics is operational since 2007. Based on its activities the student circle is in connection with several Universities including the Eötvös Loránd University (Budapest, Hungary), and the members of our circle are attending lectures and hands on sessions. During the work of the circle the students can become familiar with the latest results of space research and robotics, and they can also participate in independent research activities at high school level.

As a result of our circles activities, the members of the circle sent several publications for the Lunar and Planetary Science Conferences [1,2,3] and for the Lunar Exploration Analysis Group conferences [4]. In the present abstract we wish to summarize our recent activities related to space research and planetology, and the technical aspects of space exploration, during which we cooperated with the projects hosted by the ELTE Cosmic Materials Space Research Group.



Fig.2. Circle meeting with some members

## Background:

Overview of the functions of a „house” built on a planetary surface, regarding its functioning as a house and as a space station. What are the habitat module's most essential functions? It has to provide general means for technical activities, support for human presence, atmosphere, temperature, light, water circulation, food, storage, waste disposal and recycling. Energy supply is required for heating, temperature control, lightning, general maintenance of the habitat module. Human activities: work, sleep and rest, social activities and recreation.

## Functional analysis:

In this study we examined a multi level habitat modul with a preferably spherical structure. In its multi level structure different levels can have different uses.

• **Lower levels:** energy source and support, storage area for supplies, tools, and waste, solid waste circulation.

A limited reuseability of solid waste must be provided, thus a method for waste recycling is to be developed. Storage for water and other fluids, such as clean (drinking) water. This requires a full scale waste water management and circulation, where large part of the produced waste water can be reinserted to the clean water reservoirs, and the side-products (waste sludge) can be stored elsewhere.

The surface gravity of the planetary body, e.g. Moon or Mars helps the handling of fluids, because it creates similar circumstances present in Earth (in contrast to micro-gravity environments). When pumped upwards under pressure, the waters later accumulation is helped by gravity. Requirements for gas storage and gas circulation: storage of gases required for human presence (oxygen, nitrogen).

The composition of the internal atmosphere must be regulated, oxygen must be inserted and CO<sub>2</sub> must be filtered from the internal atmosphere.

• **Middle levels:** Living areas and rooms, additional working areas, sport and recreational facilities.

• **Upper levels:** working spaces, laboratories for scientific activities. The upper level provides better view and panorama of the surroundings, thus providing an ideal place for a control center. Transportation: At the center of the modul, a vertical elevator, staircase, or shaft could provide means for movement between the levels.

## Practical considerations:

Joining to another topic of the Cosmic Materials Space Research Group of the Eötvös Loránd University the chosen shape of the studied habitat module is a truncated icosahedron.

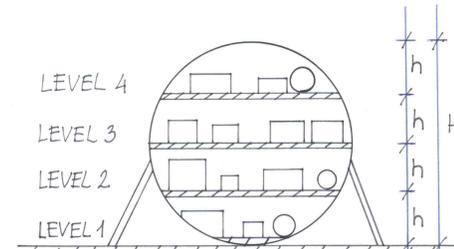


Fig.3. Cross section of a possible spherical planetary surface habitat modul



Fig.4. View from the Martian surface

## Implementation on the Moon:

We must take the external Lunar circumstances into account:

- No outside atmosphere, an artificial internal atmosphere must be supplied (approx 0.8-1 bar)
- Completely airtight structure is required: Every door and window must be completely air and pressure tight
- Day and night cycle is 14-14 days long. For human activities a continuous inner illumination must be provided, also an artificial 24 hour day and night cycle must be created for the comfort of the inhabitants.
- Smaller surface gravity, (1/6 of Earth surface gravity).
- Danger of meteorite impacts, (micrometeorites do not burn in the atmosphere).
- Energy supply: Solar energy during the day for power generation and heating, (energy production through solar cells). Energy reserves are utilized during the night, also auxiliary nuclear power may be required for continuous, uninterrupted power supply.



Fig.5. View of the Apollo 15 Lunar module



Fig.5. View of a possible spherical structure of a planetary surface habitat module

## Implementation on Mars:

Mars has half the diameter of Earth, thus its surface is one fourth and its mass is approximately one eighth of the Earth's surface and mass.

- The surface gravity is one third of the Earth's surface gravity
- Very low pressure atmosphere 0.75 mbar.
- The composition of the atmosphere is mostly CO<sub>2</sub>, with very small amounts of nitrogen, argon and water vapor
- Surface temperature range between min - 70°C and max +20°C.
- In the atmosphere significant winds are large dust storms may be present.
- The day and night cycle is very similar to the Earth's day and night cycle.

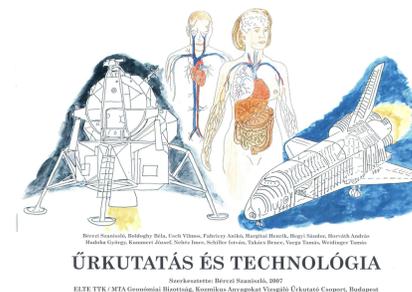


Fig.4. Front page of the handbook of SPACE SCIENCE and TECHNOLOGY

## Acknowledgements:

Eötvös József High School of Tata the student circle for Space Research and Robotics would like to express thanks for the help of Dr. Szaniszló Bérczi of the Eötvös Loránd University, who has supported the student circle during the years since its founding. He also helped our circle by making the Space Science and Technology handbook [5] available, both in print and in his presentation in the fall of 2012.