LUNAR DESIGN INFORMATION

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In the development of a design program, the studio spent a period of time investigating the peculiarities of the lunar environment. The understanding of the problems and advantages afforded us by this foreign environment continued to evolve throughout the semester. Therefore, in order to completely understand the conceptual thinking behind the projects to be presented and their design evolutions, the reader must have a basic understanding of the lunar climatic conditions.

The studio approached the nuances of the site in a architectural manner. Engineering was used when it directly affected architectural expression. The students felt their role was to investigate overall design solutions rather than specific engineering problems. The information investigated by the students and presented below in a summary form may seem simplistic and generalized to someone familiar with the lunar environment, yet these engineering principles served as some of the most critical design forces for the projects.

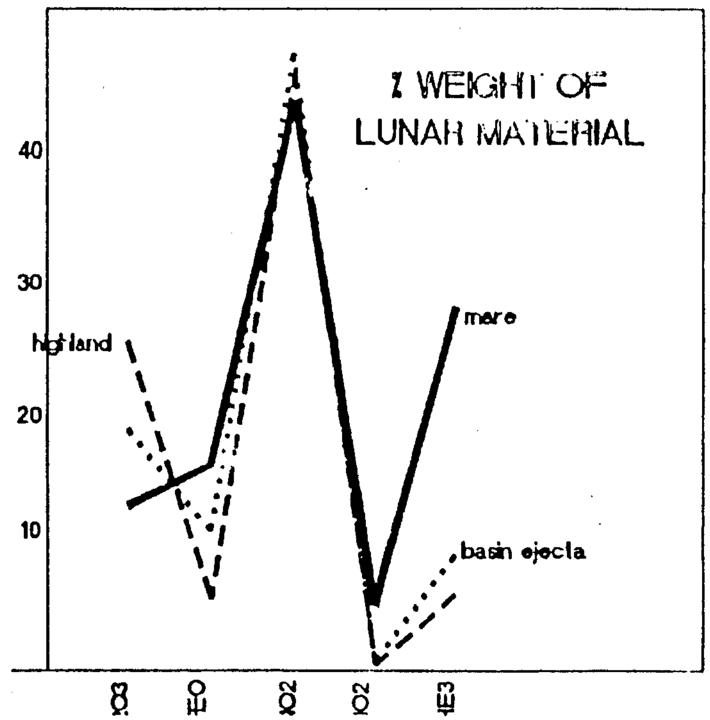
WHY?

The reasons for the eventual establishment of a lunar base are both varied and sometimes conflicting. In the most innate sense, we must go because it is there. The moon is the first stop in exploring and colonizing the space frontier. In more pragmatic reasoning, a lunar base would serve as an important nearby testing ground for technologies and methods needed for deeper solar system and hopefully galactic explorations.

The lunar base would also serve as a key ingredient in a near-space refueling station. The huge gravitational pull of the earth's atmosphere is one of the greatest limiting factors of present space exploration. By using the gravitational advantages of a low-lunar-orbiting space dock and lunar processed oxygen, the moon may provide the most economical solution to a space refueling port for missions exploring further reaches of the solar system.

While many believe that oxygen is the sole most important minable lunar resource, others feel that the lunar soil, or regolith, may hold other exploitable materials worth the investment. Examinations of lunar samples has shown they contain large amounts of potentially valuable metals. Concentrations of scarce or nonexistent earth substances like helium-3 which can serve as an energy source may also prove valuable for a resource depleted earth.

Finally, a lunar settlement will provide a key scientific outpost for further examination of deep space using large telescopes, the refinement of new substances and the study of plant and animal adaption and growth.



PRESSURE

The lack of any lunar atmosphere causes a number of interesting design problems. Besides the obvious issues involved in a closed architectural system like environmental control and the elimination of atmospheric leakage, larger issues such as pressure arise.

The design implications of an environment in which the lunar habitat exerts an outward pressure of over 2074 lbs\ft2 are quite strong. Pressures of this magnitude suggest habitats shaped to resist tension forces most economically. A perfect sphere is the most tension resisting shape. Therefore, designs which make use of tension resisting ideology would seem to be the most efficient and successful.

RADIATION

The lack of a lunar environment to act as a shielding device, presents additional problems for a successful design. Lunar bases must provide their own protection from intense solar radiation and occasional flares as well as harmful cosmic, gamma and X-rays. Without proper protection, the health of the base's inhabitants would be severely affected. Estimates show that protection equal to three meters of compacted lunar soil would be sufficient. The base should also provide protection from meteorite impacts. While not of the most vital of concerns, it is estimated that over 100 meteorites, weighing above 10 kg, strike the moon's surface each year.

TEMPERATURE

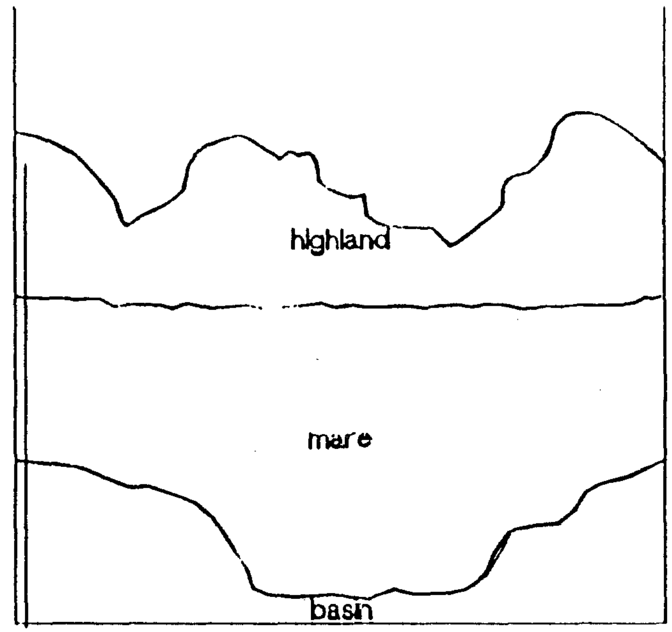
Without atmospheric regulation, lunar temperature fluctuations are great. The average daytime temperature is 134 C (270 F) and the average nighttime temperature reaches -170 C (-270 F). A more constant temperature range however, can be found just a few meters below the moon's surface where direct solar radiation does not have any effect. The severe temperature fluctuations necessitate designs which respond to thermal, insulating factors. One additional factor is that these daily temperature fluctuations occur over a period lasting 28 earth days.

The 14 earth day nights make it somewhat impractical to rely on solar radiation as a major energy source. The lack of an atmosphere also makes it difficult remove excess heat or cold from the closed base environment. Complex radiator and heat generating schemes will be needed to maintain the lunar colony at a temperature suitable for human habitation.

Related to the problems concerning temperature control, are those dealing with a closed life support system. Venting of toxic gases is very difficult. Maintaining a sanitory habitat as well as one that is properly supplied with life essentials such as food, water and air, is another difficult design problem.

GRAVITY

The gravitational field of the moon is approximately 1/6 that of earth. The lessened gravity allows for a number of interesting architectural applications. Construction methods and materials that were unsatisfactory on earth may prove applicable on the moon. The design of interior systems may also change in response to the lower gravity. Since a human would weigh only 25-30 pounds on the moon, seating and work stations might also be redesigned. In an attempt to reduce the amount of materials sent to the moon from earth. Interior systems such as stairs and storage areas may be redesigned or eliminated.



REGOLITH

Regolith is generic term applied to all lunar surface soil types. The oxygen, metals and other elements found in the regolith will prove useful to a lunar colony. The regolith is similar to very fine grained sand and contains a large amount of silica. This substance can be used to produce lunar glass for such things as solar energy arrays. Regolith, in a compacted state would also serve as abundant radiation shield. The layer of regolith dust extends as much as 10 meters below the lunar surface.

The lunar landscape is further divided into three major categories, the mare, highlands and basin ejecta. The highlands represent the majority of the lunar terrain (83%) and are composed of the heavily cratered, hilly, rolling terrain with the common mineral feldspar being very abundant. The remaining 17% of the moon is composed of large basins up to 150 km across containing numerous smaller craters. The large plains in the basin areas are called mare regions. Mare comes from the Latin root for "oceans" and the oxygen and mineral rich regolith in these areas provide the most promising site for future lunar bases.