LUNAR EXPLORATION FACTORS FOR CONSIDERATION G. Zhou[1] and A. A. Mardon[2], [1]University of California, Los Angeles (School of Engineering and Applied Science, Los Angeles, California, USA, gordzhou@ucla.edu) [2]Antarctic Institute of Canada (Suite 103, 11919-82 Street NW, Edmonton, Alberta, Canada, aamardon@yahoo.ca).

Introduction: Terrestrial Construction Techniques face numerous challenges posed by the different lunar geography and can not be used. One daunting problem is the production of suitable construction materials. Materials must offer similar strength, durability and other engineering properties to support human habitation as on earth. It is not feasible to transport large amount of construction material from earth to the moon due to large transport costs. Like many space exploration missions, cost is a determining factor. Transportation alone imposes a cost of $10,000 per kilogram for the entire mission making it simply not profitable or attractive to potential investors. [1] A potential near-instantaneous solution would be to develop an asteroid mining economy developing of a human-commercial market. It is suggested that this scenario will create the economical and technological opportunities not available today. The National Aeronautics and Space Administration (NASA)'s Space Exploration Initiative (SEI) promoted industrial involvement in the research and exploitation of lunar resources in the early 1900's. Although this initiative failed in the end, it prompted NASA to consider engaging industry for financial investments. Future lunar missions must prioritize private investments in this sector in order to meet preliminary program cost. Therefore due to the lack of funding, one feasible solution to reducing mission costs is to use native material such as lunar regolith to produce useful construction material.

It is proposed that a process to devise and extract volatiles from lunar regolith can be used to create construction material on the moon. Currently, space travelling require missions to carry life necessities such as air, food, water and habitable volume and shielding needed to sustain crew trips from Earth to interplanetary destinations. [2] In theory, the focus from any lunar mineral mission will focus on regolith excavation and transportation, water and oxygen production and fuel/energy production. All of these necessities along with construction and site preparation will be taken from the lunar regolith. [3] In-Situ Resource Utilization (ISRU) offers long term sustainability for large human colonization.

The majority of the mineral found on the moon is composed of silicates. Composition of lunar basalts is approximately 50% pyroxenes, 25% plagioclase and 10% olivine by volume. [4] With the chemical composition in mind, the designer must take into account the loads for structure. In basis structural mechanics, a designer must take into account the dead load which is primarily from the weight of the construction material caused by gravity. Internal pressurization and the amount of shielding must also be taken into account as this may increase the dead load. Live loads caused by moving or vibrating objects such as ventilation machinery must be also included in the calculation of overall design. A Factor of Safety (like for terrestrial designs) must be included for accidental impact loads from potential micrometeorites, possible seismic activity, extreme solar maximums and the like. This value needs to be estimated through experimentation. As we can not test the experiments on the moon, scientists and engineers can only conduct these tests under similar environment which will have a larger factor of error.

Conclusion: Robotic surveys of the lunar surface would be the precursor to the development of in situ resources. Advanced technology directed towards space mineral exploitation, excavation and effective transportation is necessary.

References:

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