RELIABILITY AND LUNAR BASE CONCEPTS. Jackelynne Silva jackysil@eden.rutgers.edu; Haym Benaroya benaroya@rci.rutgers.edu; Department of Mechanical & Aerospace Engineering, Center for Structures in Extreme Environments, Rutgers University, 98 Brett Road, Piscataway, NJ 08854

Introduction: Why do we want to go to space? Specifically, why go the Moon and have a settlement there? The following are the most driven reasons: Lunar science and astronomy, as a stimulus to space technology and as a test bed for the technologies required to place humans on Mars and beyond, the utilization of lunar resources, establishment of a US presence, stimulate the interest of young Americans in science and engineering, and as the beginning of a long-range program to ensure the survival of the species.

Human safety and the minimization of risk to an "acceptable" level is usually the top consideration in any project. It is clear that to go to the Moon represents a challenge, mostly because it is a new environment and the many unknowns provide the design engineers many uncertainties. In order to minimize possible risks, structural redundancy must be used, and when everything else fails, an easy escape for inhabitants must be ready. However, what is considered to be "acceptable" for a lunar construction and under what conditions? We will encounter some problems; but, can we afford to fail?

Reliability is a specialized term for the analysis and design of systems where certain aspects of the environment and system have associated uncertainties [1]. This idea lets us see how important it is to know small details at the time of doing any construction, which can be ignored in less risky environments; such small details can become the Achilles heel that can put lives and facilities at great risk. Uncertainties imply the need to use statistical and probabilistic tools in the analysis and design process.

Using the concepts from earthquake engineering, for example, we can study how to approach lunar base design studies. Of course, probabilistic approaches are only as precise as the assumptions and data allow. However, in earthquake modeling, a probabilistic analysis can tell us approximately the time, area, and at what magnitude the event may happen, and based on these estimates our designs are optimized. We can, hopefully, minimize the danger.

Of course, even the uncertainties inherent in earthquake engineering pale by comparison to reliability of structures for the Moon. This is a little-known area, but there is enough information to begin to consider, study and investigate the reliability of such structures.

We want to address points that will verify that a certain construction is dependable and offers "trust" for people in charge of the construction, investors, astronauts, inhabitants, tourists, and the public in general living on the Moon and Earth.

What are we talking about? What is reliability? How can we minimize risks? For a better understanding, a scheme is proposed for the main points that should be taken into account when we talk about reliability.

We need to have a design process. A diagram that shows what needs to be considered will be explained. Prototyping, conceptualization and evaluation are the steps to follow. We will explain in detail how concurrency is used here and the relation between reliability and the total life cycle.

A design philosophy is proposed within the scheme of reliability concepts, which demand higher factors of safety compared to those taken on Earth [1]. This design establishes relationships between, and shows the importance of having a good understanding of, redundancy, parallelism, and logistics.

The primary contributions of this work is to consider the reliability of a structure proposed by Ruess et al. [2]. Related to this is the examination of how various classes of structures are amenable to a reliability analysis, and whether one has an overall advantage.

References: [1] Benaroya, H. (1994) Structural Safety 15, 67-84 [2] Ruess, F., J. Schanzlin J., Benaroya, H. (2004) Structural Analysis of a Lunar Habitat, in press, J. Aerospace Engineering