DOMUS I & DYMAXION

TWO PROPOSED CONCEPTS FOR LUNAR HABITATS

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Domus I and Dymaxion:
Two Concept Designs for Lunar Habitats

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Abstract

Two concept designs for lunar habitats are explored and developed in this monograph based on human factors/environment-behavior considerations. Attention is given to initial operating configuration design requirements, different technological options, and 12 different habitat concepts. The first developed concept, Domus 1, is a pressurized self-supporting membrane structure (PSSMS) proposed by Chow and Lin, and the second a Dymaxion dome structure based on the work of Buckminster Fuller. The master plan, construction sequencing, technical subsystems, and interior configuration of both of these concepts are presented. Domus I consists of three entrance/EVA modules connected to a rigidized, inflatable torus containing research laboratories and mission control, and a domed interior of an rigidized, inflatable ellipsoid containing crew quarters and crew support facility. Dymaxion consists of three hard-module research laboratories/EVA chambers, a mission control core, and a two-floor habitation inflatable. The relative advantages and limitations of the PSSMS and dymaxion concepts are briefly reviewed.

Other Monographs in the Space Architecture Monograph Series

Space Architecture: Lunar Base Scenarios, by A.J. Schnarsky, E.G. Cordes, T.M. Crabb & M.K. Jacobs (edited by E.G. Cordes, G.T. Moore & S.J. Frahm). ISBN 0-938744-59-3,R88-1, 1988; pp. vi + 80, illus; $10.00.

Genesis Lunar Outpost: Program/Requirements Document for an Early Stage Lunar Outpost, by D.J. Baschiera & 12 others (edited by E.G. Cordes). ISBN 0-938744-61-5, R89-1, 1989; pp. xix + 89, illus; $10.00.

Genesis Lunar Outpost: Criteria and Design, by D.J. Baschiera, J.P. Fieber, T.L. Hansmann, J. Huebner-Moths & G.T. Moore (edited by T.L. Hansmann & G.T. Moore). ISBN 0-938744-69-0, R90-1, 1990; pp. xii + 107, illus; $10.00.

Genesis II: Advanced Lunar Outpost, by J.P. Fieber, J. Huebner-Moths & K.L. Paruleski (edited by G.T. Moore). ISBN 0-938744-74-7, R91-2, 1991; pp. xvi + 72, illus; $10.00.

Pax Permanent Martian Base: Space Architecture for the First Human Habitation on Mars, by J. Huebner-Moths, J.P. Fieber, P.J. Rebholz & K.L. Paruleski (edited by G.T. Moore). ISBN 0-938744-79-8, R92-2, 1992; pp. xi + 67, illus; $10.00.

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Executive Summary

Two concept designs for lunar habitat missions are explored and developed in this monograph. In contrast to other work on lunar habitat designs, the driving force was habitation objectives and habitation performance requirements based on human factors/environment-behavior considerations. Attention was given to site selection and site planning requirements, first lunar outpost requirements, and initial operating configuration design requirements (both quantitative and qualitative). After review of 5 technological options and 12 previously published lunar habitat concept proposals, it was decided to further explore two concepts. The first is a pressurized self-supporting membrane structure (PSSMS) proposed by Philip Chow and T.Y. Lin, and the second a Dymaxion dome structure based on the work of Buckminster Fuller.

The master plan, construction sequencing, building system, technical subsystems, and interior configuration of both of these concepts are presented in this monograph.

Domus I consists of three entrance/EVA modules connected to a rigidized, inflatable torus containing all research laboratories and mission control, and a domed interior of an rigidized, inflatable ellipsoid containing all crew quarters and the crew support facility. *Dymaxion* consists of three hard module research laboratories/EVA chambers, a mission control core, and a two-floor habitation inflatable. The relative advantages and limitations of the PSSMS and dymaxion concepts are briefly reviewed.

Domus I is the result of a feasibility study of the Chow and Lin PSSMS concept on the lunar surface. The results of this design analysis indicate the concept is very feasible from habitability, human factors, and environment-behavior considerations. Technical details have already been published in the aerospace literature. The PSSMS structure is easily able to be made habitable. The torus versus the inner part of the ellipsoid allows easy separation of work from living areas. The two floor possibility in the ellipsoid allow separation of public crew support spaces from private crew quarters. Orientation and circulation are clear. Translation pathways allow for unobstructed movements of components and crew. Dual egress is assured. Variety of space within tight quantitative space limitations is accomplished. Creating two separate environments within one envelope—the torus and the domed center of the ellipsoid—lessens the number of materials interfacing with one another. In sum, the concept seems extremely feasible and deserves most serious exploration by the various lunar program offices at NASA.

The *Dymaxion* principle—not previously published in the aerospace literature, but seeing its first exploration in the current study—also deserves further exploration.

Preface and Acknowledgements

Since 1987, the University of Wisconsin-Milwaukee School of Architecture and Urban Planning has been actively involved in the investigation, research, and design conceptualization of extraterrestrial habitation and laboratory facilities. Through our involvement with the NASA/Universities Space Research Association Advanced Design Program (NASA/USRA ADP), design requirements together with a Martian and six lunar base conceptual proposals have been created. These have been the catalysts for over 60 presentations and lectures, research papers, technical reports, and interviews and articles.

The 1992-1993 ADP is the beginning of a second, 3-year cycle grant received from NASA/USRA. Our continuation as a contributor to the aerospace community offers an opportunity to remain in the mainstream of current and future projects. We continue to build upon past endeavors in the pursuit of education and sophistication in our design proposals.

During the course of the studies, professional consultants from the Johnson Space Center (JSC) were contacted, questioned, and subsequently offered valuable insight and answers. John Connolly of the Planetary Projects Office at JSC served as a primary consultant on construction technology. In addition, as the proposal for the feasibility study was selected, further contact was made with Phillip Chow of T.Y. Lin International. The Meroform Company offered expert advice on spaceframe trusswork. An interim review conducted in the company of retired Wisconsin astronaut, Dan Brandenstein, proved extremely beneficial. His review and suggestions served as a catalyst for major design revisions.

Our thanks is extended to Jeri Brown and Deborah Neubek of NASA Johnson Space Center for the supporting documents detailing the First Lunar Outpost requirements. Section 2.0 in this report are derived from two volumes by Carpenter (1992) unless otherwise noted.

We would like to thank NASA and the Universities Space Research Association for their continued support of our work. Appreciation is extended to the Johnson Space Center. Specifically, we would like to thank the following personnel for critical feedback and suggestions: Dan Brandenstein of IBM/Houston; Deborah J. Neubek, Jeri Brown and John F. Connolly of NASA/Johnson Space Center; Alan Adams of NASA/Marshall Space Flight Center; and Jon Davey, Mark Roth and Daniel Rhone of the University of Wisconsin-Milwaukee School of Architecture and Urban Planning.

Finally we would like to acknowledge the support of the administration and faculty of the School of Architecture and Urban Planning. Professional careers in aerospace have been a result of the ADP and the SARUP encouragement. We would like to extend deep appreciation for the extensive time and creative talent exhibited by the spring Space Architecture Design Studio team, their efforts resulting in the final design products, *Domus I* and *Dymaxion.*

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Professor

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