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LARGE-SCALE INFLATABLE HABITATS FOR MARTIAN SETTLEMENTS

Abstract

We present an innovative approach to deep space habitation through the development of large-scale inflatable membrane domes designed for Martian colonies. The concept leverages lightweight, membrane-based structures to create expansive, urban-like environments—capable of hosting communities of up to 10,000 people over areas as large as 10km—at a fraction of the cost and construction time of traditional pressurized modules. By optimizing dome geometries (e.g., toroidal and semi-toroidal configurations) to minimize atmospheric volume and structural loads, the design integrates a central hyperboloid framework with a water reservoir and deep-anchored supports to ensure both stability and radiation protection. This configuration not only facilitates natural lighting and aesthetic architectural diversity but also supports modular, scalable growth; starting with transportable units (e.g., a 60-meter radius dome) that can be interconnected into larger settlements, ultimately transforming vast Martian landscapes into habitable territories. Key aspects include controlled atmospheric management (maintaining 0.3-0.5atm with elevated oxygen levels), autonomous construction techniques using robotic tunneling, and adaptable zoning that mirrors Earth-like urban dynamics while incorporating advanced terraforming and life-support technologies. This multifaceted strategy offers a transformative paradigm for cost-effective, sustainable off-world colonies and serves as a blueprint for the next generation of deep space habitats.