**Sky Letters**

**Letters to the Invisible: Beneath the Surface of Light**

**Concept Narrative**

**“Letters to the Invisible: Beneath the Surface of Light”** (Sky Letters) is a structure that brings people together under one canopy—an ecological apparatus that harvests solar energy and rainwater for the benefit of the community. The design is inspired by many local ecological forms in Fiji. Rain trees and vutu trees have fluffy, brush-like flowers, evolved through convergent adaptation to the tropical climate. These blossoms are quiet communicators with the sky—opening at dusk, releasing scent, and catching moisture and light. Their blossoming echoes our intention for a design that honors ecological dialogue and cultural richness as much as it responds to technical demands.

Designed for the village of Marou, Sky Letters seeks to be resilient in cyclone conditions, embrace the natural environment, and integrate communal space with everyday needs. The ability to withstand storms, the use of local materials, and ease of assembly are central to the concept. Each Sky Letters module is equipped with solar panels, a gutter system, structural pipes, and water collection tanks. Each module measures 10 meters long and 5 meters wide. Across the full system, 352 solar panels of 2 m² generate a total of 267.52 MWh of clean electricity annually and collect 1,196,800 liters of rainwater per year.

The main structure consists of locally sourced hardwood. Trusses of hardwood are securely anchored to the ground. Two electrical and maintenance rooms are placed between the trusses, designed for safety and durability, even under extreme wind conditions. Two sinks provide clean water for drinking and daily uses such as washing fruit and for sanitary needs. Primary and secondary wooden beams span each module. As the modules repeat, they can be elevated on higher water tanks and trusses, producing vibrant spatial effects and enabling diverse programmatic possibilities. The overall form is aerodynamic, designed to withstand cyclones. Elevated foundations protect against storm surges and offer shelter in extreme weather.

The weaving of Sky Letters brings together not only light and rain, but also the people of Marou Village and visitors from near and far. A central walkway ramp points toward the mountain peaks beyond, leading to a communal gathering space. When it is not raining, residents can hang *masi* between the beams. On both sides of the central path, elevated platforms offer space for play and shelter. Light shines through the canopy’s gaps. Standing between the platforms and looking east—toward the village—one may see the rain pipes forming shapes reminiscent of *Drua*, the traditional boats of Fiji, evoking both technical mastery and symbolic power to navigate storms and dream beyond. In moments of breeze and bloom, one feels the strength of community and the quiet force of nature.

**Technical Narrative**

Sky Letters incorporates solar power generation, rainwater harvesting, and modular construction using locally available and cost-effective materials. The design prioritizes accessible technologies with proven efficiency and long lifespans, rather than high-cost or complex systems that may be difficult to maintain or replace in the local context. The total footprint of the project is around 1460 m².

There are two standard module types, flat or fixed tilt at 15 degrees. Each module supports 17 monocrystalline solar panels (2 m² each), mounted directly on the primary beams. Monocrystalline panels were chosen over polycrystalline or thin-film alternatives due to their higher efficiency (typically above 20%), moderate cost, and long lifespan of approximately 30 years. An example of solar panels used in the design measures 1134 mm wide 1762mm long.

The entire system includes 352 solar panels, with a total solar panel area of 704m². Based on an average solar radiation of 1,000 W/m² and 20% efficiency, the system can generate approximately 140.8 kW of power, exceeding the estimated 75 kW peak requirement. This translates to roughly 267.52 MWh of clean electricity per year.

Energy is stored in lithium-ion batteries housed in two dedicated technical rooms. While more expensive than other battery types, lithium-ion batteries offer greater durability, energy density, and lifespan—making them suitable for community-scale infrastructure.

Regarding water harvesting from the solar panels, gutter designs and sloped surfaces direct rain into integrated storage tanks. With an estimated 85% collection efficiency, the system can harvest approximately 1,196,800 liters of rainwater annually for uses such as drinking, washing, and sanitation.

Stainless steel or other corrosion-resistant gutters run along the periphery of each module. Where continuous gutters are not feasible, angled metal deflectors redirect rainwater to the gutter ends. Attached to the gutters are 0.1-meter-diameter rainwater pipes, engineered with structural capacity, that channel water into individual collection tanks.

To supplement the gutter system, two elevated catchment basins with integrated filters are positioned above the technical rooms. All rainwater is pre-filtered and stored in decentralized tanks, which are linked by underground conduits to central storage tanks located beneath the community stage.

The central tanks are made of durable, easily sourced polyethylene —selected for cost-effectiveness, low maintenance, and simple replacement. Each tank holds 5,000 liters and measures approximately 2,150 mm in diameter by 1,750 mm in height. A total of 33 tanks provides a combined storage capacity of 165,000 liters.

 We approached technology creatively by embedding these systems directly into Sky Letters’ structural and spatial systems. Solar panels become part of the canopy's form, while the water collection system reinforces its protective and communal purpose. The infrastructure is both technically and symbolically visible and tied to local climate resilience.

**System Inputs and Outputs**

Annual Solar Energy Harvesting and Rainwater Harvesting:

Assumptions: 2000mm of rainfall and 1900 kWh/m²/year of solar irradiation, Naviti Island.

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| --- | --- | --- |
| Metric  | Calculation | Value |
| Panel area  | 352 panels × 2m² | 704m² |
| Rainwater Harvesting (85% efficiency) | 704m² × 2.00m x 0.85 | 1,408m³ = 1,196,800L/year |
| Electricity Generation (20% efficiency) | 704m²×1,900kWh/m²/year x 0.20 | 267.52 MWh/year  |

Solar - Peak Capacity:

|  |  |  |
| --- | --- | --- |
| Metric  | Calculation | Value |
| Each Panel  | 2m² × 1,000W/m² ×20%  | 400W |
| Total  | 400W × 352 panels = 140,800W | 140.8kW (peak) |

The system can generate 140.8 kW, well over the target of 75kW requirement for peak capacity estimation.

Solar – Daily Radiation:

We also did radiation analysis using EnergyPlus Weather file, which takes the weather data Lautouka, Fiji as we did not find data directly available for the Village of Marou. The analysis indicated an average solar radiation of 2.62 kWh/m²/day on the summer solstice, December 22.

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| --- | --- | --- |
| Metric  | Calculation | Value |
| Panel/day  | 2.62kWh/m²/day × 2m² | 5.24kWh/panel/day |
| Total Incident radiation | 5.24kWh/panel/day × 352 panels | 1,843.5kWh/day  |
| Assuming 20% efficiency: | 1,843.5kWh/day × 0.20 | 368.7kWh/day |

If the targeted system is 75 kW and runs at full capacity for ~5 hours/day (typical full-sun hours in Fiji), then it should generate: 75kW × 5hours= 375kWh/day

Our system at 368.7 kWh/day is running very close to the 375 kWh/day target.

Rainwater harvesting and storage:

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| --- | --- | --- |
| Metric  | Calculation | Value |
| Panel area  | 352 panels × 2m² | 704m² |
| Moderate-heavy rainy day of 30mm of rain, 100% efficiency | 704m² × 0.03m | 21.12m³ = 21,120L |
| Tank capacity  | 165,000L÷21,120 | 7.8 or 7-8 full rainy days |

The water storage could store several consecutive rainy days from the solar array.

**Prototyping and Pilot implementation Statement**

The modular nature of the design allows for a scalable approach, starting with a small-scale prototype to test key elements of the system. The structural components—such as wooden beams, rain pipes, and gutters—are specifically designed for ease of assembly and transport. With each module limited to 10 meters in length and 5 meters in width, these elements can be efficiently loaded onto typical small barges, which are 4 meters wide and 14-20 meters long. This modular approach minimizes logistics challenges by allowing for fewer trips, an important consideration for labor-intensive sites.

In the prototype phase, we will focus on testing two or three structural bays of the modules, with particular attention given to the rainwater harvesting system, including the design and functionality of the rain pipes and water storage tanks. A critical objective during this phase is to ensure the system’s resilience to extreme weather, particularly category-five cyclones. This will involve rigorous testing of materials, structural connections, and the overall stability of the system under high wind and storm conditions. We also plan to simulate rainwater collection volumes and the performance of filtration systems to evaluate the system's efficiency in real-world conditions.

Given that a significant portion of the structure is wood based, it is essential to engage the local community for feedback on construction techniques and material choices. The wooden components, which form a significant portion of the structure, must be able to withstand humidity, rainfall, and the occasional exposure to saltwater. We will collaborate with local builders to identify the most suitable hardwoods, verify local availability, and explore sustainable sourcing options. This engagement will ensure that the design is contextually and environmentally appropriate, while also fostering community ownership and involvement in the project.

From the outset, the design prioritizes ease of assembly, with materials sourced from local suppliers. This will further streamline the prototyping process and ensure the feasibility of scaling to full implementation.

**Operations and Maintenance Statement**

Although Sky Letters carries a formally expressive structure, its core components—solar panels, gutters, structural rain pipes, and water tanks—are intentionally chosen for their accessibility, durability, and resemblance to standard mini-grid systems. To ensure long-term operability, a critical early step will be to identify reliable suppliers and consultants capable of delivering robust materials that can also be remanufactured or replaced locally in the future. Solar panels, rainwater gutters, and piping systems should be selected with an expected lifespan of at least 30 years and installed with secure, storm-resilient mounting methods.

We aim to equip the local community with practical training on routine upkeep and storm recovery. This includes knowledge on how to remount or replace solar panels after extreme weather events, check piping joints and gutter alignments, inspect water tanks for leaks, and monitor the condition of the electrical and maintenance rooms. After major weather incidents such as cyclones, each module will require a general inspection, which can be conducted by trained local teams. In this way, Sky Letters becomes not only a resilient ecological structure, but one that empowers the community to care for and sustain it over time.

**Environmental Impact Assessment**

The environmental impact of Sky Letters is minimized through a combination of material choices, modular design strategies, and sensitivity to site conditions. The primary structural system—composed of hardwood trusses and beams—is sourced locally in Fiji, reducing both transportation emissions and environmental disruption associated with imported construction materials. Steel elements are limited to only essential joints and anchorages that enhance cyclone resilience, while concrete is used sparingly, restricted to foundational points where structural stability demands it. Above-ground polyethylene water tanks are selected in place of concrete alternatives, as they are lightweight, easier to install and replace, and have a lower embodied carbon footprint over time.

The solar energy system is designed with flexibility and repairability in mind. Each panel is independent—if one fails, it can be easily replaced without affecting the function of the entire module. The modular nature of the structure not only supports ease of transportation and assembly, but also allows for future disassembly, reuse, or relocation, thus reducing long-term material waste. Throughout the project, an emphasis is placed on ecological integration and lifecycle responsibility—balancing performance, resilience, and sustainability while minimizing negative impacts on the local environment.