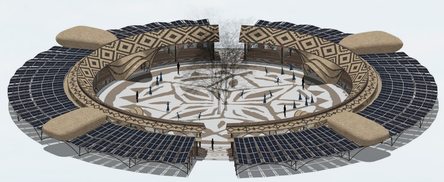
2

Scenario 1 - Typical Sunny Day

The arc-shaped arrangement of the photovoltaic array helps achieve daily electricity production homogeneity. It can slide along a circular track, allowing adjustment to the optimal local orientation and tilt angle for power generation.

Scenario 2 - Cyclone Shelter

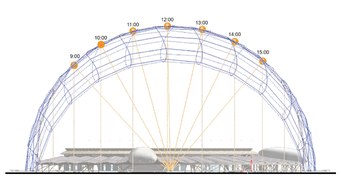
During cyclone alarm, the units of the PV arrays can be folded and stored in two wind resistant shells with the streamlined body shapes, effectively preventing them from being damaged by heavy falling objects such as coconuts or be overturned by cyclones.



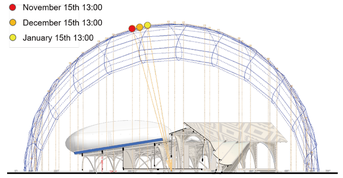
Scenario 3 - Expandable Module

Each module is stand-alone and expandable according to the power demand increase. The modular design simplifies the system expansion, cuts cost, and provide a future-proof power solution.

Optimized Photovoltaic Array Design



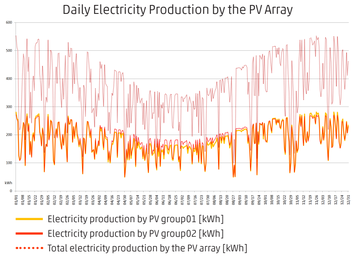
Enhancing Daily Electricity Production Homogeneity



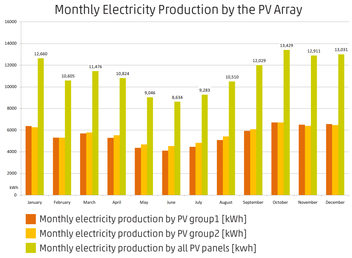
More Electricity Production for Cooling in Summer

Electricity Production By The PV Array

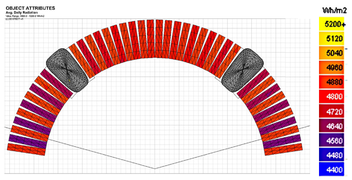
Daily Electricity Production by the PV Array



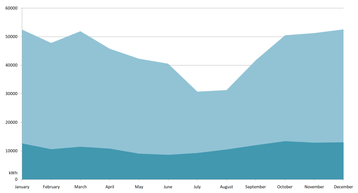
Monthly Electricity Production by the PV Array



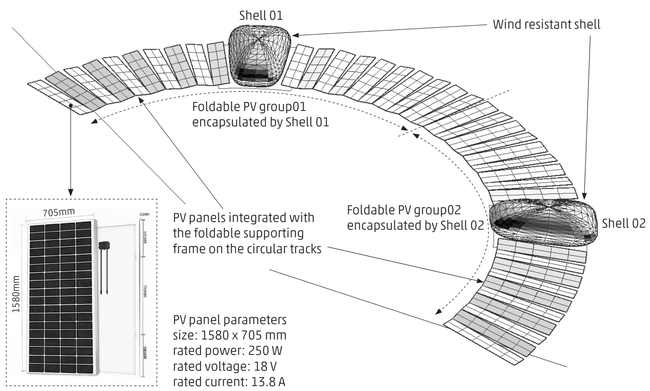
Average Daily Solar Radiation Distribution On The PV Panels



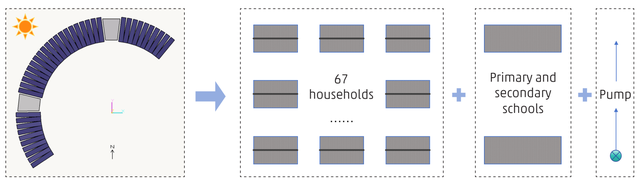
Monthly Electricity Production By Pv Vs The Electricity Demand Of The Village



Energy Simulation Model Of The PV Array



Annual PV Electricity Production and Total Energy Demand Of The Village



Inverter efficiency: 0.98
Battery storage capacity: 200kWh

Annual Photovoltaic Electricity Production:

134438 kWh

Approximately 25% of the Village's Electrical Energy Demand

Lighting power per house: 180W
Equipment power per house: 2595W
Including: 1 refrigerator, 1 air conditioner, 1 microwave oven, 1 electrical cooker , 1 ceiling fan and miscellenous electronic devices

Lighting power: 480W
Equipment power: 1000W

Pump power: 60W

Annual Total Energy Demand of the Village under the Design Condition:

536200 kWh

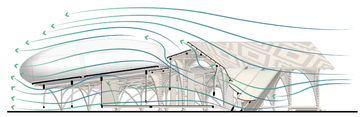
Residence: 532625 kWh; School: 3117 kWh; Landscape Pump: 458 kWh

Natural Ventilation and Cyclone Hazard Mitigation

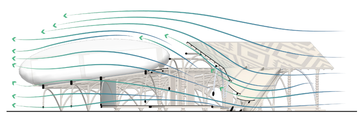
Natural ventilation and wind-resistant strategies are incorporated into the design. The colonnade roofs and foldable photovoltaic arrays are segmented to create airflow channels, facilitating cross ventilation.

When gales are forecasted, the photovoltaic array is folded into the wind resistant shell, and vulnerable colonnade components are temporarily disassembled and stored in the storm-proof storage room to prevent damage.

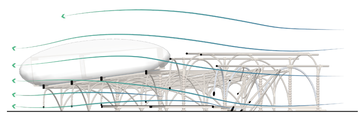
During cyclone warnings, the entire colonnade roofs and partition structures are disassembled and stored, leaving only the steel framework. This ensures effective resistance against cyclone impacts.



Colonnade Wind : Breeze



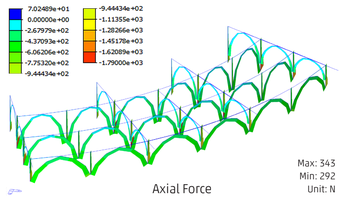
Colonnade Wind : Gale



Colonnade Wind : Cyclone

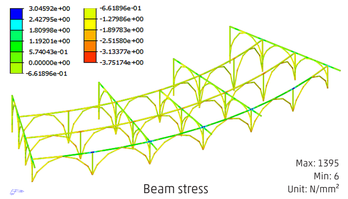
Colonnade Structural Calculations

Structural analysis was performed using the structural finite element analysis software. The main beams and columns adopt the circular steel tubes with section D102×5mm, while the curved frames use the D83×5mm circular steel tubes. During cyclones, the folded panels are subjected to a surface load of 1.5kN/m^2. Self-weight and wind loads on the panels were equivalently applied as linear loads on the sliding rail beam elements in the simulation. Structural calculations confirm that the substructure meets the strength and stiffness requirements under both unfolded and folded conditions.



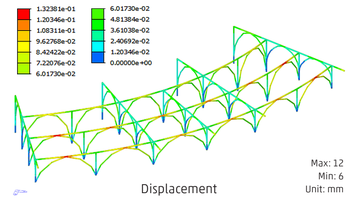
Axial Force

Max: 343
Min: 292
Unit: N



Beam stress

Max: 1395
Min: 6
Unit: N/mm^2

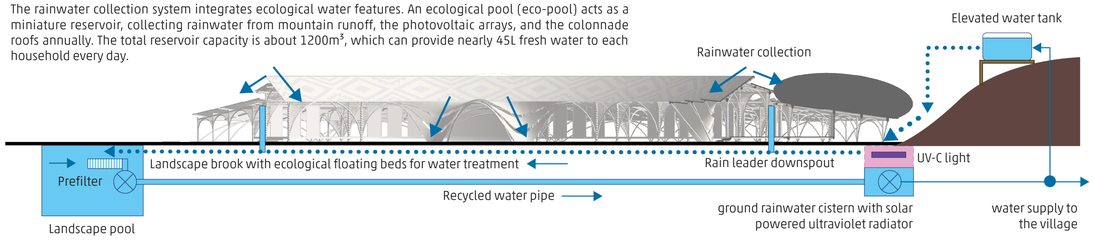


Displacement

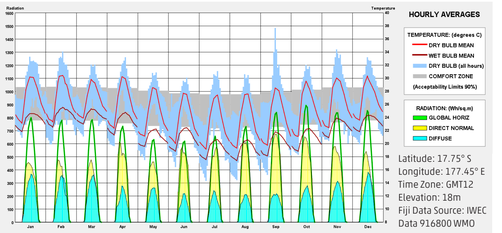
Max: 12
Min: 6
Unit: mm

Rain Water Collection and Treatment

The rainwater collection system integrates ecological water features. An ecological pool (eco-pool) acts as a miniature reservoir, collecting rainwater from mountain runoff, the photovoltaic arrays, and the colonnade roofs annually. The total reservoir capacity is about 1200m^3, which can provide nearly 45L fresh water to each household every day.

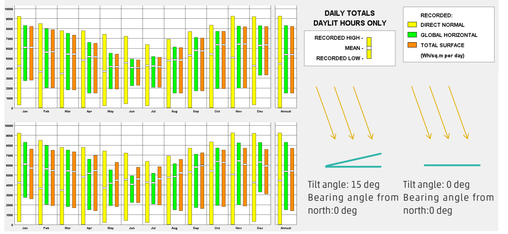


Hourly Average Temperature and Solar Radiation



Latitude: 17.75° S
Longitude: 177.45° E
Time Zone: GMT12
Elevation: 18m
Fiji Data Source: IWEC Data 916800 WMO

Average Solar Radiation Intensity At Tilted Surfaces



Tilt angle: 15 deg
Bearing angle from north:0 deg

Tilt angle: 0 deg
Bearing angle from north:0 deg

Average Cloud Sky Coverage