

Case Study Title: Kigali Adobe House

As-built building photograph (Please insert only one representative picture in a landscape format, 300 dpi, JPEG)



Project Name	Single Home
Location	Kigali, Nyarugenge District, Rwanda
Climate Zone	Am (Tropical monsoon)
Latitude/Longitude	1.9° S, 30.0° E
Building Type	Domestic
Floor Area [sqm]	70m2

Building Height [m]	3m
Number of Storeys	GF
Completion Year	2022
Project Team	MASS Design Group (Design & Build)

*mock-up experiments and other research-based experiments could be included as case study, aside from actual building construction projects if similar information could be provided.

1. Project Description

Project Overview
A one off home demonstrating Adobe Block (Rukarakara) Standards and passive cooling strategies.

2. Climate & Site Context

Basic Climate Conditions		
Temperature	Annual Average	20.4°C
	Annual Range	20°C (January) - 24°C (September) (average)
Relative Humidity	Annual Average	73%
	Annual Range	50% (August) - 98% (March)

Annual Degree-Days (ASHRAE Standard 169-2020)	HDD 10°C: 0 CDD 18°C: 1010
Climate Analysis	
<p>Kigali has a tropical warm and humid climate with average daytime highs between 23°C and 31°C and average nighttime lows between 11°C and 27°C. However, Warmer temperatures (up to 34°C) have been experienced in Kigali over the past few years especially from June to August.</p> <p>Monthly precipitation levels vary between 12mm to 1440mm. The relative humidity ranges between approximately 30% to 90%.</p> <p>Kigali is 2° south of the equator. The sun passes overhead and provides high horizontal solar radiation (approximately) of 1993 kWh/m²/year.</p> <p>The Predominant wind is from the South and North West direction with an average wind speed of 2m/s during the day and 1 m/s at night</p>	
Site Analysis	
Please describe project site conditions that inform your building design (e.g., topography, building density, landscaping, etc.) [Max 150 words]	

Passive Cooling Strategies (please tick implemented passive cooling strategies)
<ul style="list-style-type: none"> <input checked="" type="checkbox"/> Building Orientation & Form (site orientation, building shape, etc.) <input checked="" type="checkbox"/> Envelope Design (insulation, air-tightness, shading, window system, thermal mass, etc.) <input checked="" type="checkbox"/> Natural Ventilation (cross ventilation, stack ventilation, night ventilation, etc.) <input type="checkbox"/> Evaporative Cooling (direct/indirect evaporative cooling, etc.) <input type="checkbox"/> Ground Cooling (geothermal, ground-coupled systems, basement/underground space, etc.) <input type="checkbox"/> Radiative Cooling (cool roof, night sky radiation, radiant barriers, reflective surfaces, etc.) <input checked="" type="checkbox"/> Nature-based Solutions (green roof/wall, tree shading, etc.) <input checked="" type="checkbox"/> Others (human behavior, clothing, semi-passive (fans, etc.))
Description (please describe one strategy per box – you can add more boxes below if needed)
Thick adobe block walls provide thermal mass and buffer peak temperatures during the day whilst keeping the house warm at night time.
Roof build up includes a ventilated cavity, insulation and radiant barrier. The exterior roof is a light coloured finish with solar reflectance index (SRI) > 0.7.

Vent blocks above windows for secure background and nighttime ventilation. Operable windows for single sided ventilation.

3. Passive Cooling Design Details

4. Active Components

Active (Hybrid) Cooling Strategies

(please describe one strategy per box – you can add more boxes below if needed)

Ceiling fans in the majority of occupied spaces.

Mechanical ventilation supplied to thermal labyrinth (passive cooling or air)

5. Performance Data

Cooling Energy Use

Please describe the measured or observed reduction of cooling energy due to the introduction of passive cooling measures against baseline. (e.g. annual/peak month cooling energy, peak demand, hours of mechanical cooling, etc.) [Max 200 words]

Indoor Thermal Comfort

Please describe the measured or observed improvement in indoor thermal comfort (e.g., PMV, PPD, adaptive comfort compliance, or occupants' interview, etc.) [Max 200 words]

6. Financial Data

Cost Benefits

Please describe the financial benefits due to the introduction of passive cooling measures against baseline (e.g., positive return on investment [incremental cost versus saving operational cost], payback periods, IRR, etc.) [Max 200 words]

*Please try to extract passive cooling cost and savings; however, if it is difficult, please annotate the premise. (e.g., the calculation includes the cost for both passive heating and cooling, etc.)

7. Passive Cooling Operation

Maintenance Requirement

Please describe the maintenance requirement to sustain the passive cooling performance [Max 150 words]

8. Lesson Learnt / Recommendations

Technical Challenges, Solutions and Achievement

Please describe the challenges and solutions of passive cooling strategies in the design/construction/operation phase [Max 150].

Financial Challenges, Solutions and Achievement

Please describe the challenges and solutions of passive cooling strategies from the financial perspective (e.g., what are the factors of incremental costs (e.g., imported materials, lack of labor skills, additional analysis cost, etc.), and how could these be mitigated (e.g., tax rebate, preferential loans, subsidies, business incentives, etc.) [Max 150].

Other Challenges, Solutions and Achievement

Please describe the challenges and solutions other than the two above (e.g., capacity of design professionals, material availability, cultural resistance, users' low awareness, etc.) [Max 150].

9. Free Description

Free Description

Please describe the information that could be useful to readers (e.g. replicability of case studies, tips on design and material specifications, cost information, etc.) [Max 300].

10. Annex

Supporting documentations

11. Citation

Citation**12. Contact**

Contact Person	
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