

### Ascending Array

### Miracle for Africa Foundation Central Library, Lilongwe, Malawi



**Main author**

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**Project data**

Project group: Architecture, building and civil engineering  
 Client: Miracle for Africa Foundation  
 Project background: Private commission  
 Planned start: March 2018

**Summary and appraisal of the project by the jury**

The new central library for the campus of the Miracle for Africa Foundation in Lilongwe provides spaces for books, archives, reading rooms, classrooms, offices, and an open forum. The architectural aim is to maximize the use of natural light, while powering the building with solar energy. An ascending array of roof elements – each with a gentle curve, like wind moving across a field – gives orientation to all interior spaces. Small glass-encased rooms containing humidity-sensitive materials and activities are situated within a larger, passively cooled open plan. A locally-crafted bamboo screen enclosure acts as a permeable dust-filtering facade and allows natural cross ventilation to cool the building both during the day and at night.

The jury commended the sophisticated, undulating design that synthesizes effective shading, natural ventilation, solar energy, and greywater recycling into one seductive and highly resolved form. It was further noted that ambitious architecture is so unusual in the region that – as a distinctive landmark with a noble program – the project could provide an aspirational environment. Despite the exceptional design, a clear depiction of the siting of the building – as, for example, a site plan – was unfortunately lacking, making it impossible to assess the library's relation to its context. Nonetheless, the jury applauded the project's overall design posture, taking sustainability beyond what it conventionally appears to be.

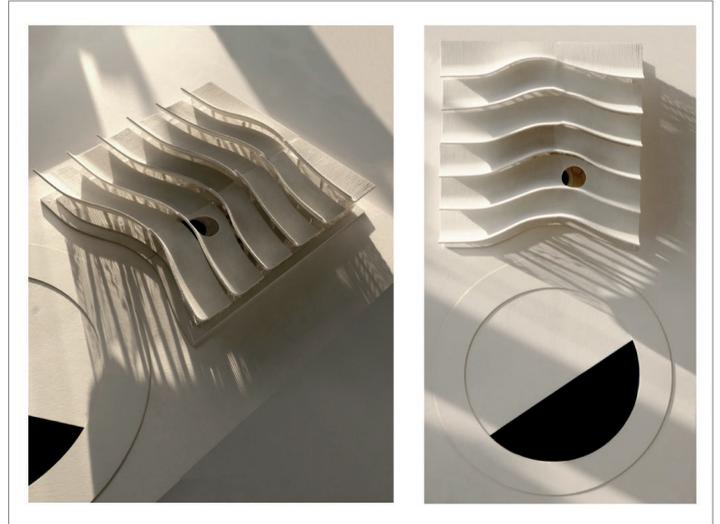


Image 1: Axonometric view with screens casting shadows in interior. The ascending array of roof elements curve as a field in the breeze. The curved elements are designed to block peak sunlight and allow clerestories to the interior for maximal and optimal interior diffused light. A circle cut through the roof collects rainwater into an interior pond for library visitors to gather around.

**Statements on the sustainability of the project by the author**

**Sustainably designed and programmed for human comfort**

The building's program is sensitively arranged with glass box rooms controlling smaller environments within a larger open plan, passively conserving energy and maintaining thermal comfort in the space. A permeable dust filtering façade for the building allows natural cross ventilation through the building during the day and an exposed thermal mass to naturally cool off at night. During the dominant rainy season peak temperatures are above 35°C while nights are below 22°C. Naturally ventilated office boxes made of glass and open reading rooms located near the periphery and under mezzanine clerestories are lit by the highest quality daylight. Humidity controlled archive boxes, also made of glass are strategically located at the center under the mezzanine for maximum UV and thermal protection.

**High performance, low impact**

There are two main construction materials used for the library: local wood & bamboo are used to create a permeable façade, while ductal or UHCP concrete is used for the roof / columnar structure. The UHCP results in a very low carbon footprint while providing tremendous material savings in iron and aggregates, up to 70%. Exposed material finishes further reduce

maintenance costs. The lean slab is carefully designed to be thin enough to reduce material consumption and waste, while sufficiently thick enough (6cm) to provide a regulating thermal mass, providing large spans. Waterless toilets and greywater management strategies in combination with rain water harvesting and storage ensure no drop of water goes to waste, but is instead utilized for landscape irrigation and cleaning.

**Building as an ecological engine for the campus and Malawi**

The characteristically curved roof is covered with flexible solar PV sheets, a pioneering solution to Malawi's crippling energy crisis. The roof produces 627 MWh/a of electricity, 340% more than its calculated consumption of 142 MWh/a. All excess energy is distributed to the rest of the campus. Thermal capillary mats behind the PV harvest solar energy for free water-based night heating, while also boosting the efficiency of the PV panels. The ratio of the façade's perforation was calculated to utilize the dominant East South East winds and maximize cross ventilation throughout all reading and office spaces. Roof-formed mezzanine clerestories allow diffused daylight from the South, ensuring high quality reading and office spaces with a spatial daylight autonomy between 70-99%.



Image 2: Elevation view of screen and roofline at night: A locally sourced bamboo and wood permeable dust filtering screen allows for cross ventilation and passive thermal control of the space, while filtering and emitting a glowing light gained from the roof PV's at night. The section shows the ascending curve in the roof which shields the interior from peak heat while creating clerestories for optimal diffused natural light within.



Image 3: View of south facade showing opening entry for public forum space.

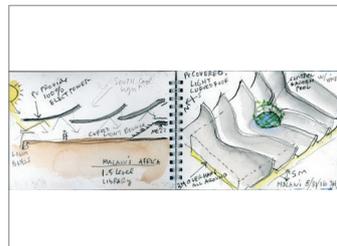


Image 4: Concept sketch detailing the protective overhangs, maximized solar collection, and interior light.

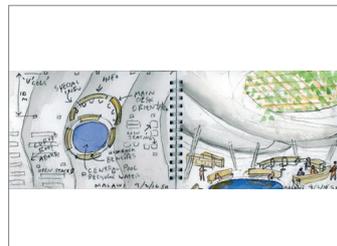


Image 5: Concept sketch of interior rainwater collection pool for gathering and main desk at entrance.



Image 6: Ground floor and mezzanine floor plans.

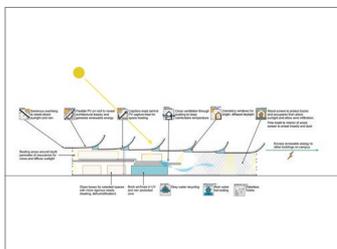


Image 7: Sectional diagram highlighting key sustainable elements.



Image 8: Detail view of perforated bamboo screen and rainwater collection interior pool.



Image 9: View of Library from Lake.

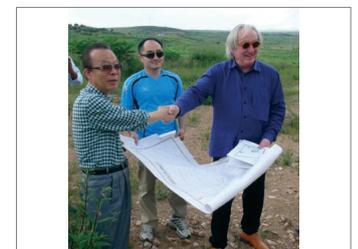


Image 10: Steven Holl on site with client, Mr Y K Chung, after final approvals.