Island: A Writers' Retreat

David Vardy, Luhang Shi, Haitian Xie, and Xinxin Gao

Abstract The project is imagined as a small temporary bamboo building inside which one may write. The title "Island" refers to the separation of the interior space from the outside of a hot and humid Beijing. This separation is threefold—the physical separation created by a surrounding water-garden whereby the access is made by crossing a bamboo platform; the visual separation of a veil of bamboo textile covering entirely the structure and diffusing light; and a thermal separation achieved by a passive natural ventilation cooling system inspired in part by the barjeel wind-towers of the middle east. A central column of bamboo poles forms a wind-tower. The poles are threaded through a heavy concrete water-filled earth-supported tub at the base. This tub and its steel base plate form a ballast foundation supporting the bamboo super-structure, and act as a water, wind, and earth cooled thermal sink, and as a desk from which to write. The design aims to exhibit the pliability of bamboo; as a construction material; the building being made from bamboo pole, bamboo lath, bamboo-ply, bamboo decking, and bamboo textile. At night, with internal light reflecting in the surrounding water pool, the building is intended to resemble a Chinese paper lantern.

Keywords Bamboo building · Wind-tower · Bamboo structure · Passive ventilation system · Bamboo textile building

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1 Concept Design

The project follows an impetus to create a bamboo 'writers' retreat'—somewhere protected and shaded, cooled and still, natural; an inspiring space of concentration and semi-privacy, from which to sit and write.

The inner space is surrounded by a 'reflection-pool', planted with water-lilies and containing floating solar lights. A bamboo platform deck crosses the water to provide access, as well as providing a surface upon which to place a chair or plant pots. Entrance is made by pulling apart a white bamboo textile that envelopes the structure, a curtain of sorts. Inside, there is a cork stool, and a cool-to-the-touch concrete writing desk that holds a volume of water, the surface of which reflects the natural light entering from above.

Bamboo pole framing is formed into a central swirling column and chimney—a wind-catcher (1), orientated to face the general direction of air-flow on a given site. The wind-catcher has a wide opening at the top fitted with a bespoke shaped bamboo funnel, catching and driving the cooler higher wind downward into the space. This fresh air supply is further cooled by the effect of its acceleration, and by passing over a night-time-cooled thermal energy store of concrete and water, at the columns base. The chimney has a central vertical partition that hovers over the waters face, allowing its opposite chamber to operate as a stack extract chimney, drawing out stale warm air, and driving a ventilation circulation through the space.

This naturally ventilated internal environment is conceived as a sanctuary on a hot and humid Beijing day. For an occupant, the effect of the thermal energy store radiating cool; and of the ventilation system passing an accelerated air-flow across the skin; and of the cool-to-the-touch concrete writing desk; each contribute to an improved thermal comfort.

In plan the structure forms a series of swirls and loops, enveloped by a 'veil' of breathable bamboo textile material, acting as a light filter, and resulting in an interior of diffuse daylight. As an adaptation, similar to a tent, fabric sections can be rolled-up and pinned, creating an open pavilion instead of a naturally cooled enclosed one. Configurations of open or closed sections are controlled by the fabric panel design which is aligned to the framing elements, allowing the pavilion to respond to alternative locations and variations in temperature and light throughout the day, and able to open to views or visual connections of other kinds. In this respect the building is adaptive, able to respond to weather and situation, and importantly, able to be adjusted and transformed with speed and ease by a building user (Fig. 1).

Bamboo is among the most versatile construction materials of today, especially with modern innovations and technological processes, and yet perhaps this is not so well appreciated, particularly the potential of bamboo for textiles. The project explores a way to combine a multiplicity of bamboo material products, some traditional construction, and some modern innovations—bamboo-pole, bamboo-lath, bamboo-ply, bamboo-decking, and bamboo-textile—the effect is intended as didactic and unifying. The overall use of bamboo as a material able to achieve sustainable

Fig. 1 Conceptual render

construction is further complimented by an idea of efficiency and a reduction of material use through designed consolidation and multiplicity, meaning elements perform more than one role. For example, the central column is intended to work variously as a wind-catcher, a natural ventilation chimney, a roof light, and a structure.

2 Design Development

The buildings structural frame is made of naturally straight bamboo poles, and also flexed bamboo poles, where slight bending is required of the buildings shape (Fig. 2). This way curvature is achieved almost fully through a simple use of natural bamboo. The one exception to this is the continuous ring beam at the roof eaves. This beam is of a curvature that cannot be achieved by naturally growing bamboo poles, and so a special beam is formed as a bundle of bamboo laths (or splits), glued together and pinned, and forming a prefabricated beam. This beam occurs also as a very visible fold in the fabric that covers the building, and marks the transition from wall to roof, and so a precise curvature rather than a faceted line is important to achieve visually. This prefabricated beam being a curve rather than a faceted line achieves this.

The central column structure is designed as a single-leaf hyperboloid and is constructed using a traditional technique of weaving flexed naturally straight bamboo poles around each other (2). The poles are regularly pinned, and with each pole twice-fixed at the base using proprietary metal brackets. These poles do not touch the ground, and so are kept free of ground moisture. They are also weaved through pre-cast holes formed in the water-weighted concrete tub that acts as a structural ballast, with loads transferred to the ground via a steel spreader-plate attached to

Fig. 2 Structure

the tub. This steel spreader-plate is lipped so as to form and contain the water pool outside, with a precise straight and level edge. The use of a concrete and water weighted ballast and pad as a foundation contributes to the buildings' sustainability, eliminating the need for a traditional invasive and disturbing concrete foundation and under-building. As long as the ground surface is suitably compacted, and the ground is of suitable bearing, the building could be considered a temporary and moveable structure, able to travel between locations with relative ease by way of a process of disassembly and reassembly.

The continuous ring beam at the roof eaves is supported by straight bamboo poles, triangulated and forming a canted wall. The roof is formed as sections of triangulated straight bamboo poles, spanning from ring beam to column and with mid-span support, made rigid by a covering of bamboo lath, pinned and glued to the bamboo poles, and with gaps for light to pass, forming a spiral pattern around the central column, and facilitating water run-off.

The junction between the bamboo poles of the wall and the bamboo lath eaves ring beam, is made by proprietary metal pins and brackets that handle lateral compression and shear resistance forces, and these joints are largely secret fixed with metal work concealed inside of the poles (alternatively there are more traditional options for such joints). The bamboo poles of the wall are fixed into a continuous curved steel angle running the length of the base of the wall and welded to the steel spreader-plate water pool former, which is further weighted by water, river pebbles and rocks, and together with the water-weighted concrete tub structural ballast, this forms a stable and ground-supported structure able to resist lateral forces and uplift (Fig. 3).

The water-weighted concrete tub structural ballast is formed from pre-cast concrete, and as well as being a heat-sink, it also forms a bespoke shaped desk

Fig. 3 Section and elevations

for writing. Cool to the touch, it holds a vat of water that acts along with the concrete itself, as a thermal energy store, cooled at night, and as a drainage system should it rain and water enter the central chimney. As a further use of bamboo, the concrete pre-casting process utilizes a formwork made of bamboo decking boards, such that the concrete is imprinted with the surface pattern and aesthetic of bamboo once struck. These same bamboo decking boards are then reused to form the flooring. This recycling idea and utilization of an element for multiple purposes; such as the tub being a desk, a foundation, and a heat-sink; is a core repeating principal and strategy that contributes to the sustainability of the construction (Fig. 4).

The outer surface of the building is a 'veil', made from state-of-the-art bamboo textile—engineered for impermeability to water droplets, breathable, and with low air-permeability. It allows for the passage of diffuse daylight and is a warm matt off-white color, treated for resistance to mold. This woven fabric can optionally be rolled up to create an open pavilion instead of a naturally cooled enclosed one.

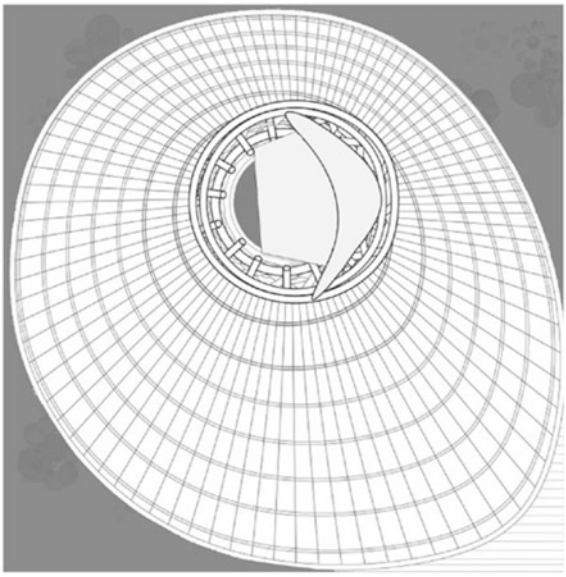

Fig. 4 Floor Plan, Luhang Shi, Xi'an Jiaotong-Liverpool University Design Research Centre (DRC)

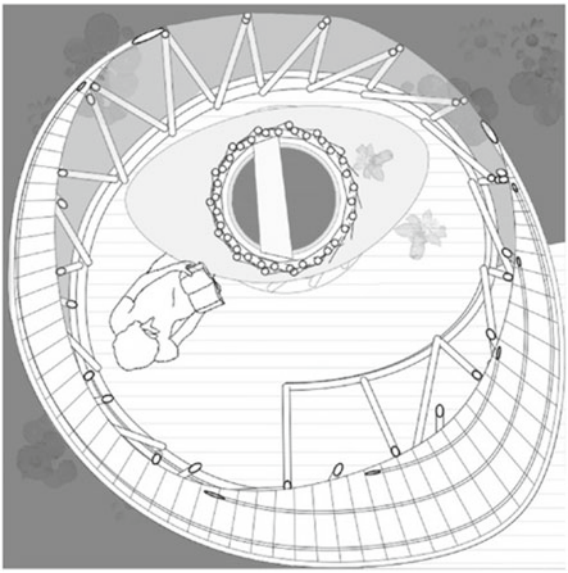

Fig. 5 Floor Plan, Luhang Shi, Xi'an Jiaotong-Liverpool University Design Research Centre (DRC)

Various configurations of open or closed sections can be created following the seams of the fabric panels and their locations, allowing the building to respond to alternative locations, and to variations in temperature and light throughout the day. This adaptability is also a core aspect of the sustainability of the design (Fig. 5).

Writing can be considered a deeply reflective activity. The water garden is formed by a shallow steel liner, with green-grey river pebbles and planted with water lilies and other water plants. Crossing this water is how someone reaches the interior. The platform can be considered as a threshold, marking a journey from one place to another, from the outside to the inside.

The versatility of bamboo as a construction material is employed throughout the construction (3)—there are five uses of bamboo, each exposed and visible to read. These are—firstly yellow bamboo pole, both straight and in the form of a prefabricated bundled lath beam, forming the super-structure; secondly the shower-proof woven fabric bamboo textile that covers the superstructure; thirdly a bespoke double-curved thin laminated bamboo-ply hood positioned at the top of the ventilation chimney to funnel the air downward, something like a roof cowl; fourthly bamboo lath strips used as a sheathing layer at the ceiling above the poles; and fifthly, thermally treated bamboo decking boards, used firstly as formwork to mould the concrete tub, and then recycled as decking for the floor and entrance platform bridge.

3 Experience

Bamboo, as a fast-growing renewable material resource, has the potential to contribute significantly to achieving sustainable construction (4). With this project we endeavored to build not only a bamboo framed structure, but also to use bamboo as flooring, as roofing, and as an envelope material. We designed a sustainable performance in use, through the creation of a natural cooling system that reduces a need for active system energy-consuming cooling, and in so doing we were interested to exploit both the low-tech and the high-tech potentials of bamboo as a material to create a wind-tower, and to create a synthesis and exhibition of these multiple uses of bamboo as part of our small building design.

The architectural idea is concerned with how the control of space, light, temperature, and furniture, can combine to create a space and environment from which an occupant may be inspired in the production of their creative work—in this case writing. Our experience through this project helped us to understand some of the tradition of bamboo form-making, weaving and jointing with bamboo poles, and also how contemporary engineered bamboo can be used to create high-strength bespoke prefabricated double-curved pieces such as the ventilation hood, and surface systems such as textiles. We learned that we could structure and render a building almost fully in bamboo surfaces of one kind or another.

We valued the experience, and learned from the other competition finalists, and from the knowledge and ambitions that now support modern bamboo construction as a field. In our view, the future of bamboo construction can be both a revival or rediscovery of past traditions, and at the same time, the development and innovation of modern high-tech bamboo products and processes, especially as a path to sustainable renewable construction. We hope to have exhibited through our approach and design solution, an example of a small, sustainable, natural, low and high-tech bamboo construction.

4 Rendering

Two renderings are provided as below shown in Fig. 6. The renderings convey an atmosphere of gentle diffused light entering through the surrounding textile and through the skylight of the ventilation chimney, and the reflection of this light by the water surface held by the central writing desk. Other than the concrete (which is formed from a bamboo mould), all surface materials are bamboo, in various forms. The internal space is intended to feel something like being under the canopy of a large old tree; to be a place of serene concentration, somewhere shaded and sheltered, a cooled space from which someone may be inspired to think and to write.

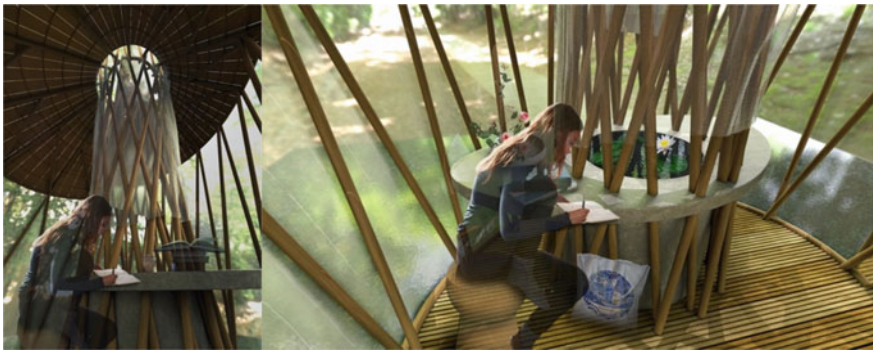

Fig. 6 Render of the interior space

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