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# THE INNA

by My Dao Le Hong  
Architect | Vietnam

## 1ST PLACE WINNER

Inspired by the people and culture of Mali



African vernacular architecture is impressively rich with ingenious techniques that early dwellers used to protect themselves from the diverse weather conditions. Great examples of well-thought vernacular architecture are found in hot and arid climate zone regions where earthen architecture prove to be the great response. In Mali, a country known for its use of earthen architecture, bungalow homes called the Inna are found and are an endless source of inspiration for the development in African homes today. In this project, traditional techniques are rediscovered and applied to a modern prototype of the Inna.

The Inna is a typical bungalow which tries to bring low cost, sustainability and very high living quality for the next generation of African housing. It also allows flexibility in order to accommodate the different needs of the house owner. Learning from vernacular strategies, along with integrating modern technology, the goal of the Inna is not to limit its use for only responding to the Mali climate, but to become an adaptable prototype in many different regions of Africa.

### **FUNCTION ORGANIZATION**

African lifestyle is diverse all over the continent, through many countries, regions and ethnic groups; however, common characteristics can still be found within its architecture. Figure 1, 2 and 3 show aerial views of traditional homesteads in different regions. The homesteads are all combined of many smaller houses, and each house is used for one function and is located in its appropriate functional zone. This clear separation allows for each house to have its own size, shape and construction type. Then, in one homestead, the visual appearance and construction type of the main house, insaka, ganaries, or pigeon coops are different.

As part of Africa's social, economical and cultural changing, the modern lifestyle requires the house to be more compact, private and efficient, causing some functions to be removed or changed. For example, the modern kitchen and dining room are important gathering areas and instead of being kept in the backyard of the homestead, they have been positioned in the front. The modern lifestyle also requires a more separated bedroom to keep privacy for family members. However, the vernacular African lifestyle is still maintained in modern living by allowing for enough space to accommodate large family gatherings and events. The kitchen has always had an attached kitchen yard or scullery for food preparation and trash. Hence, to find the right answer for modern African house layout, the functional zones need to be transformed and reallocated according with modern requirements, while still promoting social interaction inside the house. That is where the Inna starts to form.

### **MASSING AND COURTYARD**

Due to the warm African climate, people use outdoor spaces for many reasons. These spaces can be designed for focus or functional use. In vernacular dwellings, plenty of seating and different outdoor space is important; the design always tries to incorporate as much nature as possible.

The outdoor space is still kept even when the population growth and the land use requirement is much higher. An example of an Yoruba traditional house type in Nigeria would show that the room layout is more compact and aligned, but a generous courtyard is still provided for various activities. One great example of a courtyard is Roman Domus. Even though this example does not originate from Africa, this courtyard is worth to learn. They use the yard and pitched roof as the rain water collection, known as the impluvium.

Learned from the past, the Inna form by simple principle: the interlocking of courtyard and functional areas. This organization allow flexibility in changing and adapting with different needs of owners but still keep the main concept and space quality. These courtyards, discussed in depth later on, play a major role in the climatic control of the house.

**INSPIRATION**

Earthen architecture is at best celebrating African architecture. Earthen architecture differs from country to country, with different types and forms such as rammed earth, mud brick and mud wall. It was often linked to poor housing and self-building phenomena and wasn't considered worth being studied in depth. However, over centuries, earth material proved to be durable and sustainable as it well respond to the context. Mali possess one of the most amazing earth structures: Djenne Mosque.

Another inspiring earthen architecture is New Gourn Village, Egypt by Hassan Fathy. All details of vault openings are neat and sophisticated. The light is filtered though careful openings, creating sacred light environment. This masterpiece is a great source to learn from.

The most attractive feature of earthen architecture is the opening. When the outside environment is harsh, the opening should be very careful in position and size to achieve visual and thermal comfort. All of the design details are to respond to the context, as shown by the amazing aesthetic taste of Fathy. Earthen architecture is the endless inspiration both aesthetically and technically for modern architecture.

**CLIMATIC CONDITION**

Mali, the country of inspiration, has a climate so diverse, it represents climatic conditions across the entire African continent. The country's climate ranges from tropical in the south to arid in the north. Most of the country receives negligible rainfall; droughts are frequent. Late June to early December is the rainy season. Mali faces numerous environmental challenges including desertification, deforestation, soil erosion, and inadequate supplies of potable water.

The arid regions are dominated by tents and houses with flat roofs or terraces with relatively thick walls. These areas measure against the great drought of wind, solar radiation, solar reflection, sandstorms, dust, insects and parasites. In the tropical region, the traditional sloping roofs are more frequent. The houses in this region requires natural ways to combat heat (with a relative humidity of at least 50%), solar radiation, precipitation, insects and parasites. The Inna attempts to respond to the Mali climate and from that be able to adapt with different climatic patterns of Africa.

*Thermal mass:* Thermal mass strategy in Africa is mostly found as thick earth wall, which can stabilize indoor temperature, slowly absorb heat from harsh sunlight and release the heat during night time.

*Stack ventilation:* Stack ventilation is passive ventilation that uses air pressure differences due to height to pull air through the building. Hence, high opening is easily found in hot and arid climate.

*Cross ventilation:* Cross ventilation occurs where there are pressure differences between one side of a building and the other.

*Evaporative cooling:* Cooling through evaporation is an effective way to low down the temperature. Figure 18 shows the air captured is cooled by a small fountain before entering living space.

*Hot and cool courtyard:* Simple but effective strategies are positioning the courtyard with two characteristics. One is the cool courtyard: shaded, with greenery or a pool. The other is the hot courtyard: unshaded, no greenery or pool. Temperature difference between the courtyards will generate air flow from the cool courtyard to the hot courtyard. Then, the space between the two courtyards will have good ventilation.

*Wind tower:* Wind towers catch the passing winds and channel them down to the ground and living spaces. They provide effective ventilation to refresh the air and remove unwanted smells from cooking. When there is no breeze, these towers still serve as a means to good ventilation.

## **PERSPECTIVE**

After evolving from vernacular architecture as well as learning passive strategies from the past, the Inna was developed with simple and efficient massing by rammed earth. All openings were positioned carefully and the facade is inherit from Earthen architecture, in Mali, with an extruding wooden bar.

## **THE PLAN**

The Inna has a roofed / livable space area that totals 120m<sup>2</sup>. The preferred orientation is for the bedroom and living room to be northward . However, the Inna still can respond well with different orientations if the master plan requires change. The entrance hallway leads to the open plan lounge and dining room. The dining room is the central gathering area.

Next to the dining room is the open patio. This patio is used on a cool day or in the evening. In some family gatherings and feasts, the dining room can fully open toward the patio and become a big gathering area. On hot days, the patio acts as the “hot courtyard” to generate air flow from the “cool courtyard” (impluvium). The dining room in between the courtyards will benefit from cool ventilation. Also, cooking smells can be swept away. The kitchen leads to a kitchen yard, where people can prepare food and clean.

In the middle of the house is the impluvium courtyard. This courtyard capture rainwater and recycle water for domestic use. The courtyard also provides moisture for evaporative cooling. The central position of the courtyard benefits living spaces of the house.

The living room has a full internal door facade and , on cool day, the door can fully open to connect with the impluvium. The master bedroom has one private toilet and shower. From this bedroom, people can see full view of the impluvium. The small bedroom also can benefit from the impluvium and an extra small bedroom is provided, either use for guest or staff.

## **SECTIONS**

A double layered metal roof is used to prevent direct heat. The use of a metal roof will be explained in more detail in following sections.

## **THE INNA RESPONDS TO DIFFERENT CLIMATE**

### *Responding to arid climate*

In this climatic condition, the house is mostly closed to protect from harsh outdoor environment. The rammed earth wall acts as a thermal mass to protect the house from extreme heat. The stack ventilation is only used for ventilation. In this case, all the exterior low windows should be closed; the upper high and small openings are carefully open. The indoor space takes fresh and cool air from inside the courtyard and releases the hot air though high openings.

The open patio and the outside garden act as a “hot courtyard” and the impluvium acts as a “cool courtyard“. This will automatically create the frequent air flow from indoor to outdoor without any help from wind. If the impluvium pool has water, evaporative cooling will happen and will be even more effective to cool down the space. Spaces are able to close for local zoning in relation to time of operation to better control the thermal factors.

*Responding to tropical climate*

In this condition, the humidity of the air is even higher so combating with the heat is still the main job of the house. The rammed earth wall act as thermal mass to protect the house from the heat. Here, cross ventilation can be used to cool down the area. The hot courtyard and cool courtyard principle still works in this circumstance. The space needs to be able to open, allowing cross ventilation from space to space. The tall dining roof acts as a wind catcher during windy days.

**ROOF**

The chosen material is white metal roofs. Although producing metal is energy-intensive, it is long-lasting, cheap, lightweight and easily recyclable.. Metal roofs can last up to 50 years which means less waste in the long run. Metal offers exceptional durability and fire-resistance, and they're ideal for those who want to collect rainwater from their roofs to water gardens (or for household uses). With the metal, there will also be no worries about chemicals that might leach from a conventional asphalt roof.

A roof painted white can actually reduce energy use by about 20 percent in hot, sunny weather, according to the Lawrence Berkeley National Laboratory Heat Island Group in Berkeley, Calif. The white roof reflects the solar radiation and absorbs less heat than a roof in another color. The roof is doubled with a layer of air in the middle, presenting heat transmission very well. Even when the metal roof becomes very hot on a sunny day, the heat transfer to the indoor environment is still limited. The pitched roof to inside prevents solar reflection from the roof to the neighbor house.

**TECHNICAL APPLICATION**

Horizontal flow reed bed treatment can be used to filter rainwater in the impluvium. Reed is available in Africa and is a great natural water filtration. It is environmentally friendly, using only a natural, sustainable ecological processes. Gravity driven systems don't require any energy input. Maintenance requirements are low, but as with most systems, cannot be ignored. Operational and maintenance costs are low and can be carried out by anyone with a modicum of gardening skills and common sense.

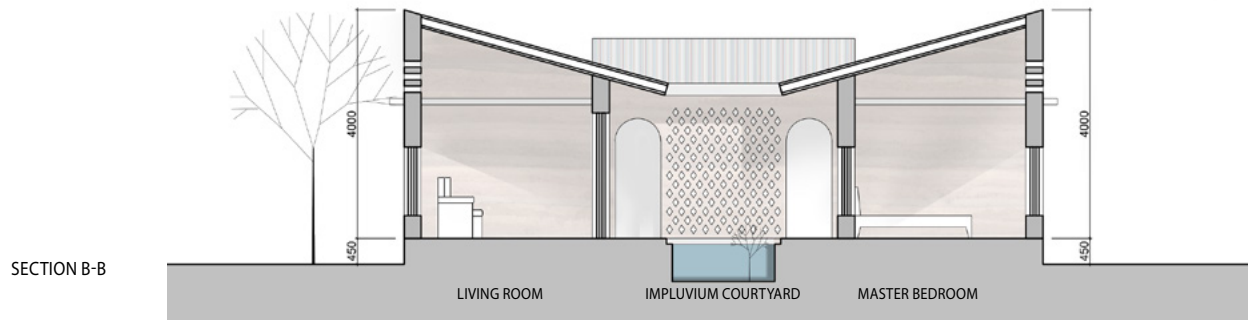
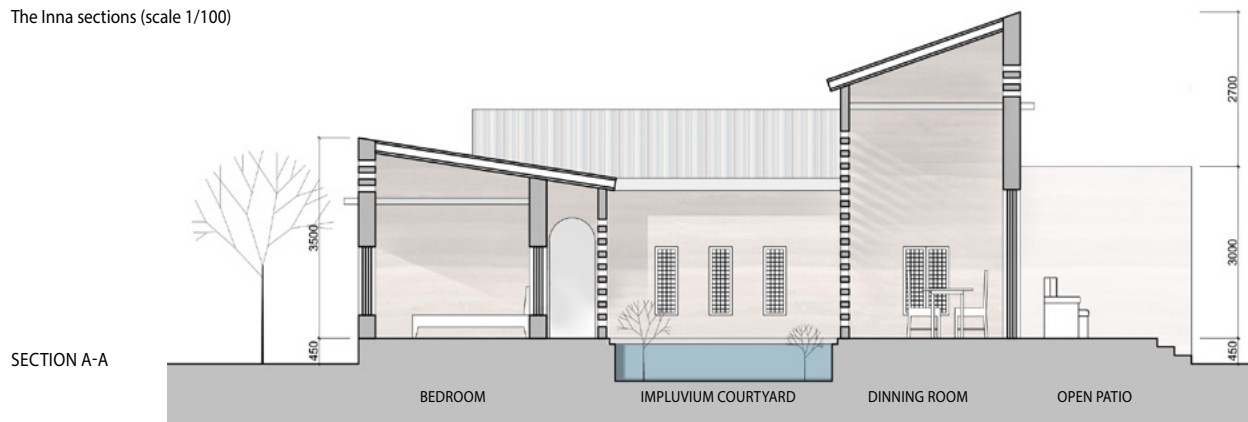
The filtered water then leads to a storage for domestic use. Depending on the efficiency of the system, the water can be cleaned enough to cook or just used for shower, sink, gardening and toilet flush.

**CONCLUSION**

As a conclusion, vernacular architecture gives endless lessons about passive climatic controls. Even though the bungalow is set in an extreme climatic zone, some techniques could be successfully implemented for high quality living environment. Additional studies of vernacular dwellings could surrender ideas of aesthetically pleasing structures that are very efficient in terms of energy use.

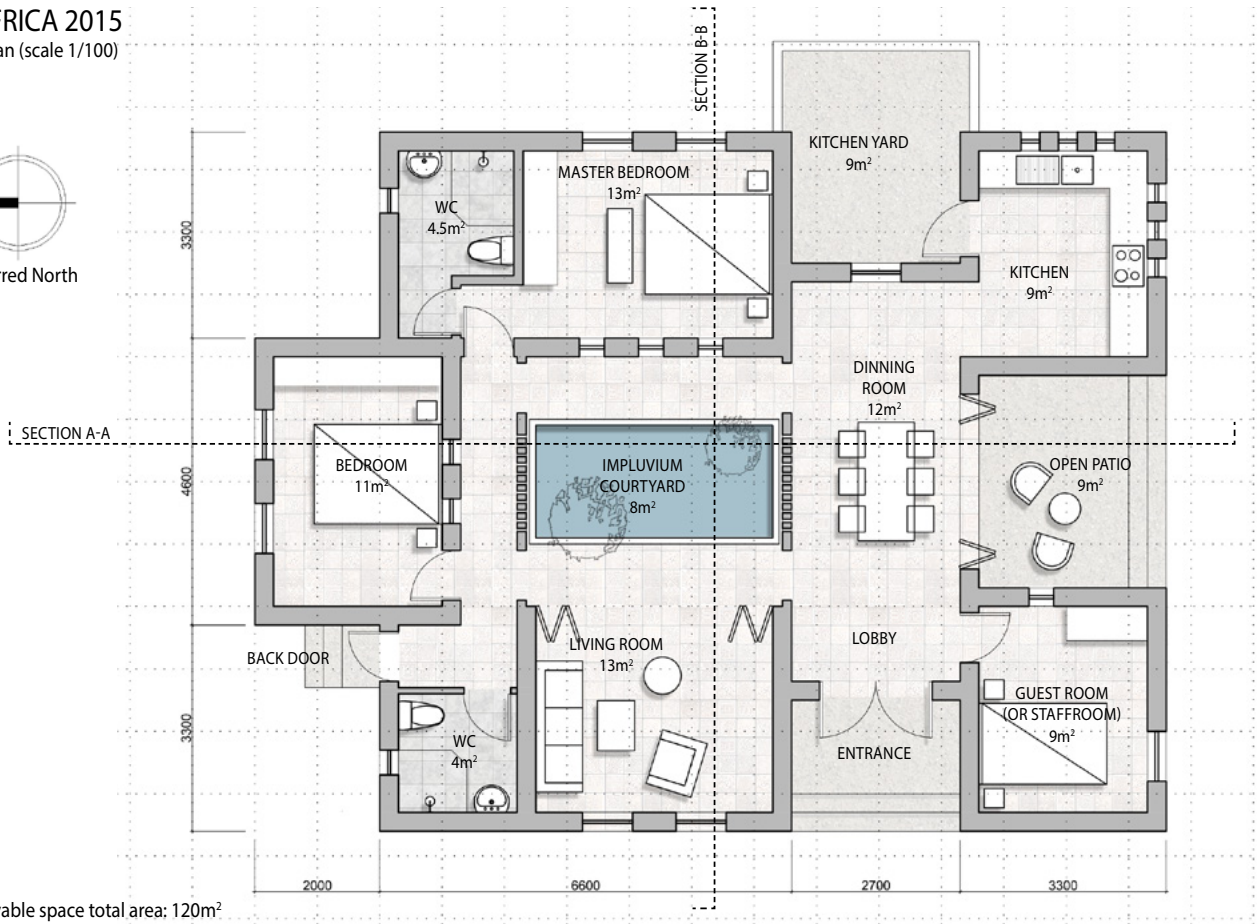
Compared with the low construction cost required, the Inna can provide dwellers with a very high living standard. The using cost is also minimized, as the house requires limited need of air condition and artificial lighting. The Inna is easy to build in a short amount of time because of its simple shape and form. It also allows flexibility to change in function and room size according to the different needs of the inhabitants. The Inna uses pattern and motif from Mali architecture in the design. However, it is believed that using vernacular strategies is the best way to celebrate African architecture.

CPDI AFRICA 2015  
The Inna sections (scale 1/100)





**CPDI AFRICA 2015**  
The Inna plan (scale 1/100)



Grid: 1m<sup>2</sup>  
Roofed / Livable space total area: 120m<sup>2</sup>