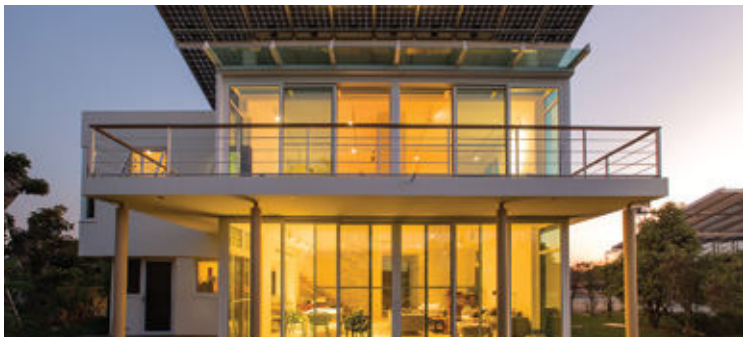
VISION & IDEAS

Knowledge + LEARNING = expertise

The better and greener world starts with a step.

Everyone should contribute to live in a better world. We are now doing our part by leaving the world greener, while gaining and sharing knowledge.

As guests in a country, we are one day leaving it with the lowest ecological footprint possible. For us, sustainable development and living relates to the relationship we have with our environment and how we use the limited resources available.



IDEAS

The Phi Suea House is a sustainable residence project fully powered by photovoltaic panels harvesting the sun's energy.

Its innovative hydrogen energy system is a central solution for community solar power and storage. We believe it is the answer to energy needs of the future, and is the solution that stores energy in the most effective and ecological way.

We have combined strategies to minimize our impact on the land we live on. We designed and built a water collection system to save and reuse as much of the rain and irrigation water as possible. We directly harness heat provided by the sun to heat water with specifically engineered panels. We also integrated home automation for its potential in energy saving and carbon footprint reduction.

By utilizing windflow and growing a permaculture garden, we aim for a holistic approach to sustainable living.

The Phi Suea House project is a modular concept. It is ideally suited for residential or other developments in remote locations; or where complete independence from the grid is desired.

MASTER
LANDSCAPE PLAN

Title: Phi Suea House Master Landscape Plan

Scale: 5 10 50 100

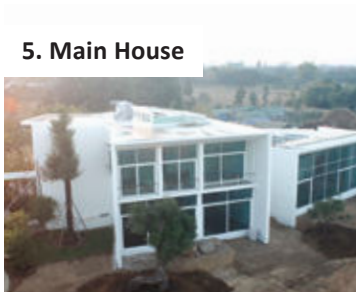
SITE OVERVIEW


1. Entrance


2. Roadview


3. Energy System / Sopohs


4. Guest House A & B


5. Main House


6. Workshop


7. Permaculture Garden


8. Nursery


9. Sala


10. Baan Din

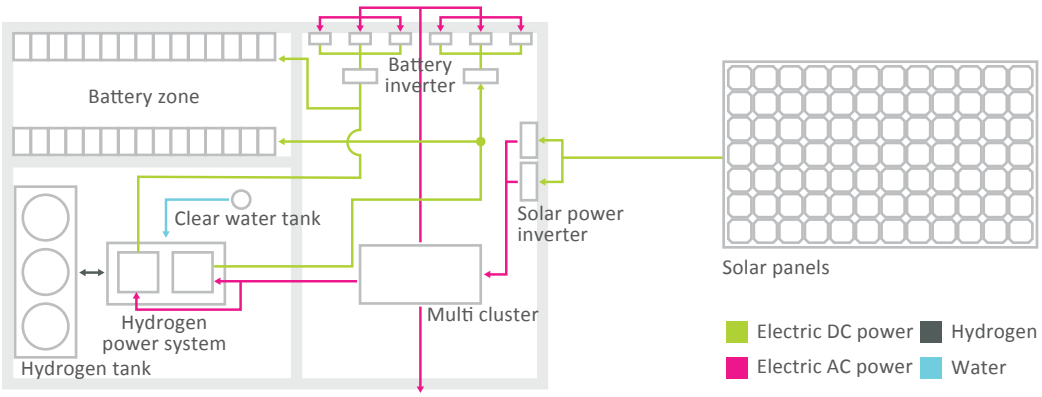

11. Main Kitchen


12. Swimming Pool & Beach Volleyboll Court

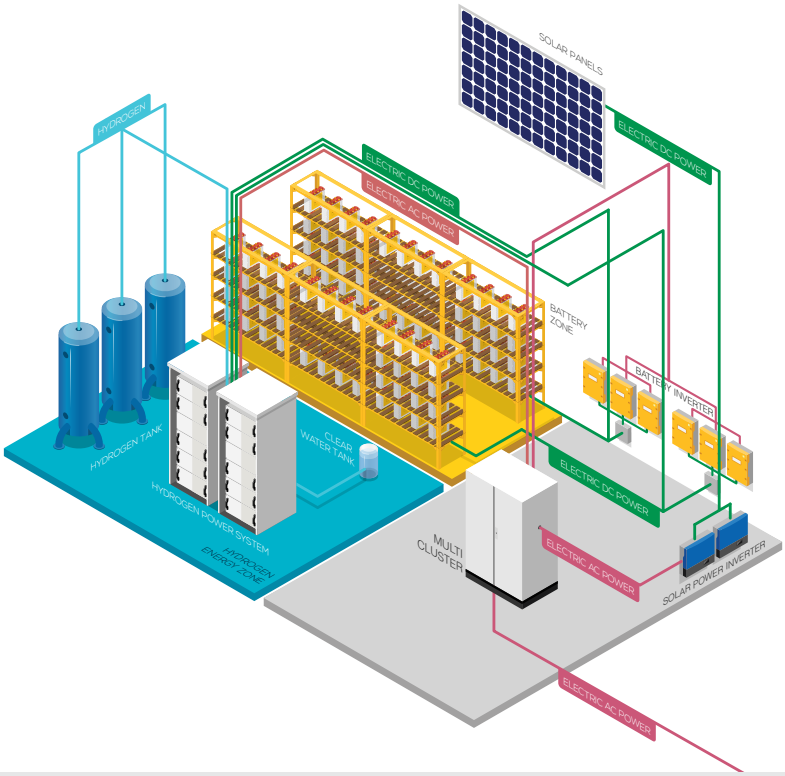
ENERGY SYSTEM

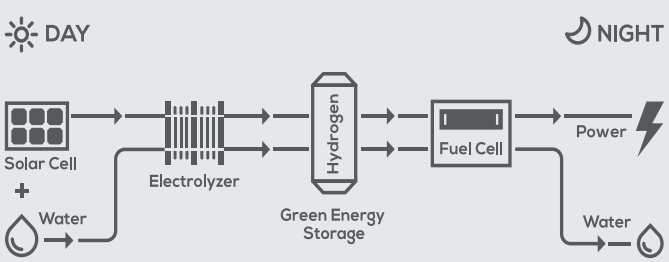
Solar Powered Hydrogen Storage System

PV POWER / HYDROGEN ENERGY STORAGE / BATTERY



PV installed:	86kW
Average daily power production:	326.8kWh
Phi Suea House energy demand:	6000kWh monthly
Battery:	2x 2000Ah, 48V lead-acid battery banks
Hydrogen gas production rate:	max. 2000 litres/hour
Hydrogen storage capacity:	90,000 litres of H2 at 30 bar, equivalent to 130 kWh in the fuel cell





Day Time

- The electricity that solar panels generate is direct current (DC power).
- Electrolyser generates Hydrogen and Oxygen from water.
- We storage Hydrogen in a tank but Oxygen gas goes in the air.

Night Time

- A solar inverter converts the electricity (DC power) from Hydrogen into alternating current (AC power) that can be used for your TV, computer, etc in your house.

FULL SYSTEM UTILIZATION

Energy Calculations

ENERGY BUILDING	GUEST HOUSE A	GUEST HOUSE B	Main House	6 kW solar pump for pond waterfall	9 kW solar pump for swimming pool and well pump
330 w	**315 w**	**315 w**	**250 w**	**250 w**	**250 w**
75 solar panels	64 solar panels	64 solar panels	84 solar panels are made in Chiang Mai!	24 solar panels	36 solar panels

Average overall yield is equivalent to 3.8 hrs of full irradiation per day

(75 x 330W) + (64x 315 W) + (64 x 315 W) + (84 x 250W) + (24 x 250W) + (36 x 250W) = 101.1 kW

101.1kW x 3.8hr = 384.2 kWh / day
384.2 kWh x 365 days = 140,233 kWh/year

We produce an average of **140,233** kWh/year

We save
96.75
metric tonnes of CO2 emissions
(assuming 0.69 kg CO2 / kWh)

It would take
321,033
sqm of forest per year to remove that amount of CO2 from the atmosphere

= Area of **8** CentralFestival Chiangmai

= **41,000 sqm**

A car would have to drive
370,523 km.
to emit the same amount of CO2

=

With this much energy you could drive around Thailand

69.5 times

= **5,326 km**

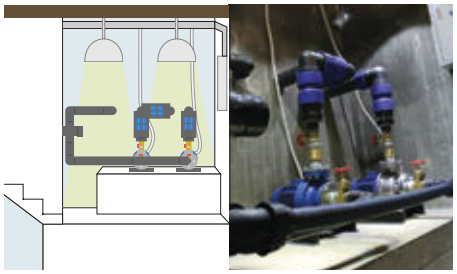
CO2 is a naturally occurring chemical compound consisting of two oxygen atoms bonded to one carbon atom. Humans produce additional carbon dioxide by burning fossil fuels for energy. CO2 absorbs and reflects the earth's heat and increases the planet's surface temperature when emitted in excess. This effect is called global warming. Global warming can only be reversed by reducing the amount of carbon dioxide emissions.

NATURAL FISH POND

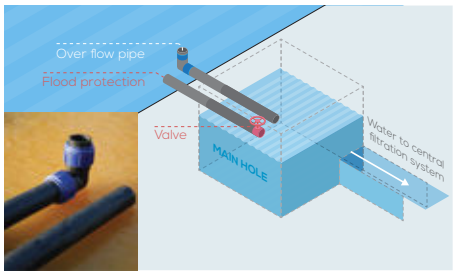
1. Large Waterfall
The large waterfall is the water's primary source of oxygen. Water is circulated by two pumps.

2. Small Waterfall
The small waterfall is the inlet of both ponds' water circulation.

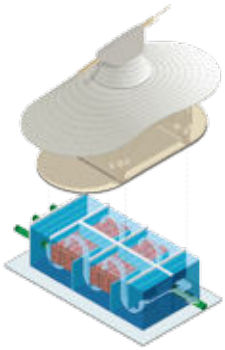
3. Pump Room
Two pumps below water-level pump water from the pond to the small waterfall.



4. Correction Overflow/ Level Control
Overflow/Level Control: The overflow pipe prevents the natural fish pond from overflowing, by draining water when the water level goes above the pond's threshold. Before periods of heavy rain, the valve to the level control pipe is opened to lower the water level, and to drain water from the pond to the conveyance system.



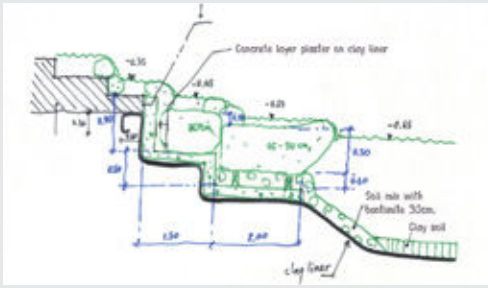
5. Filtering System
Gravity pushes water from the fish pond through chambers of the filtering system. It moves through sediment and natural coral filters before flowing into the pump room.



6. Solar Pump
A 3-phase DC pump is connected directly to a 6kW solar array via a controller. This setup allows for maximum water pumping efficiency, as there are no inverter or storage conversion losses. At full power, the pump can move over 100 m3 of pond water through the filter and into the waterfall every hour.

CLAY LINER
The natural fish pond is reinforced with a clay liner. A clay liner is a safe and convenient material:

- Long lasting
- Easy installation
- Self healing capacity
- High flexibility



MOCK UP 1 : 1 PROCESS

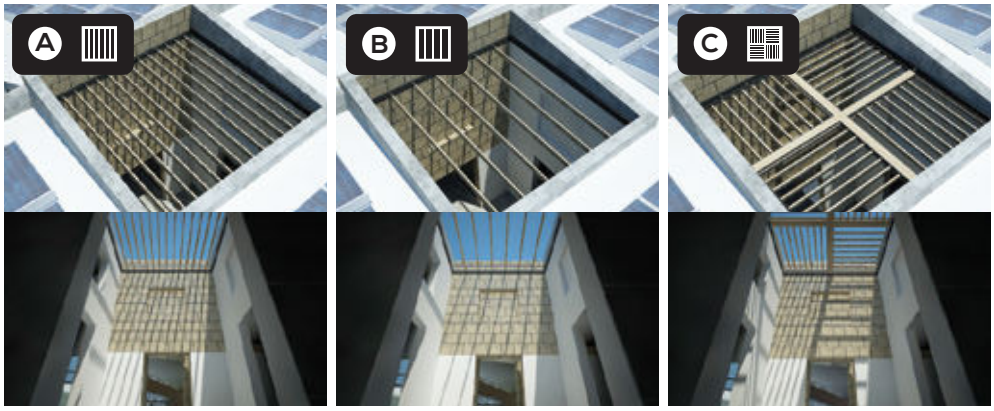
From Design To Reality

An interactive construction process allows each house to be tailored to the user's individual needs.

A simulation shows how the shadows and light in the main hall will look during different times and seasons.

A mock up 1:1 of parts of the building - some up to 9 meters high, was built to check their use and dimensions.

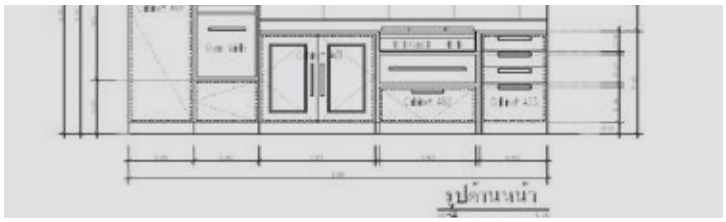
The orientation of the walls and windows were assessed to verify some views of the Main hall and of the temple from the House.



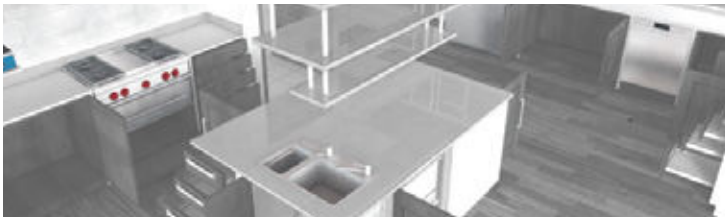
Designing Usability

1. Sketch Idea First ideas were based on rough sketches.

2. Drawing The original sketch was placed into Autocad to produce a drawing to scale.



3. 3d Model SketchUp was used to produce a detailed 3D image.



4. Built Mock Up 1 : 1 Sizing Model The original sketch was placed into Autocad to produce a drawing to scale.

5. Built Mock Up 1 : 1 Working Model

A trial working kitchen allows for real interaction with the appliances over a period of several months.

This will determine if the height and dimensions of working counters need to be adjusted.

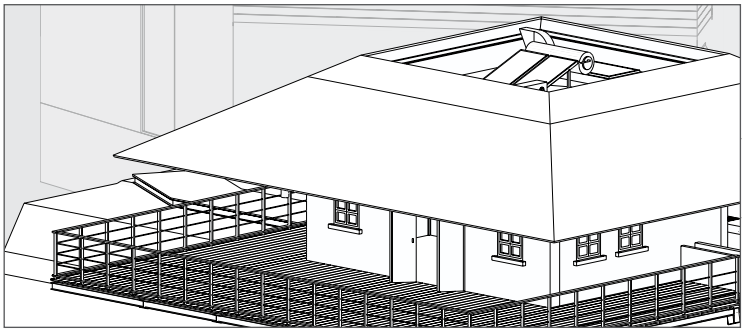
UTILIZING WIND FLOW

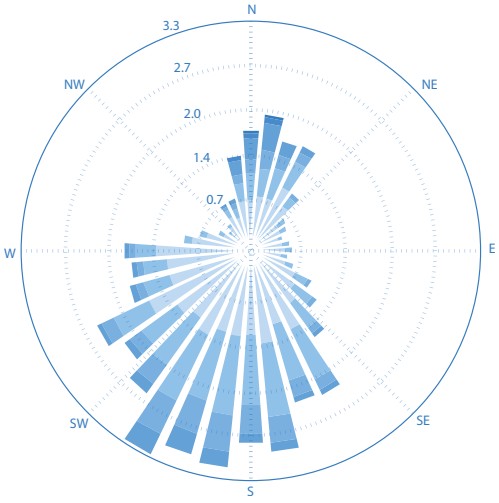
Wind Flow in Northern Thailand

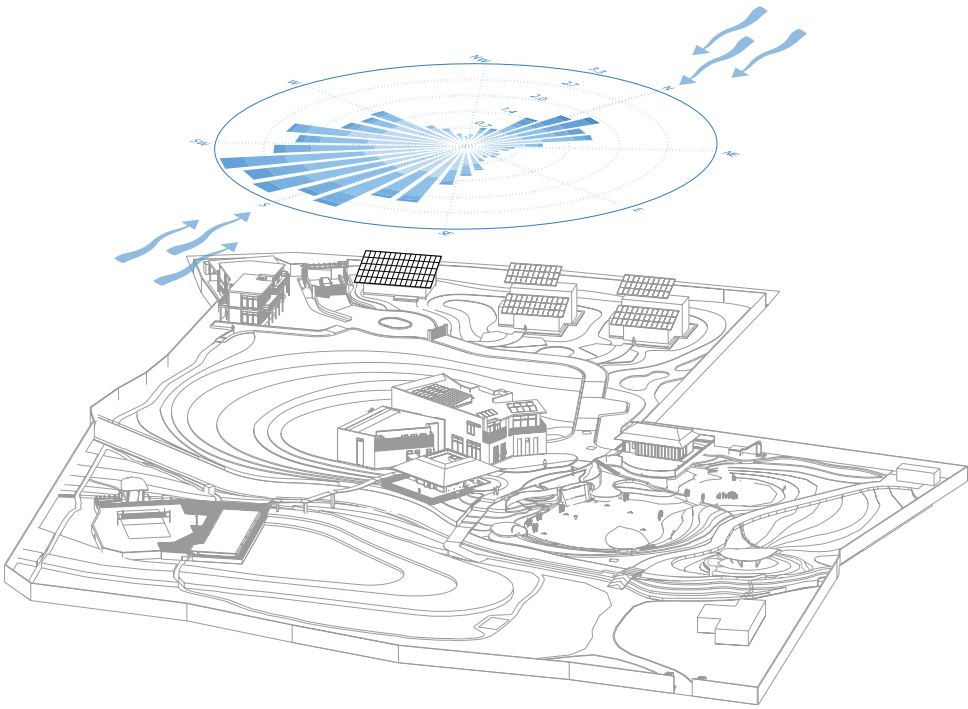
Northern Thailand experiences two monsoons, or seasons of heavy winds. The winter monsoon originates from the mountains, spreads to the Northeast, and generates cold, dry winds.

Compared to the summer, the winds in the winter are stronger, but brisk.

The summer monsoon comes from the Indian ocean, flows to the Southwest, and produces warm and moist conditions. Its winds are less powerful, but last for six months.



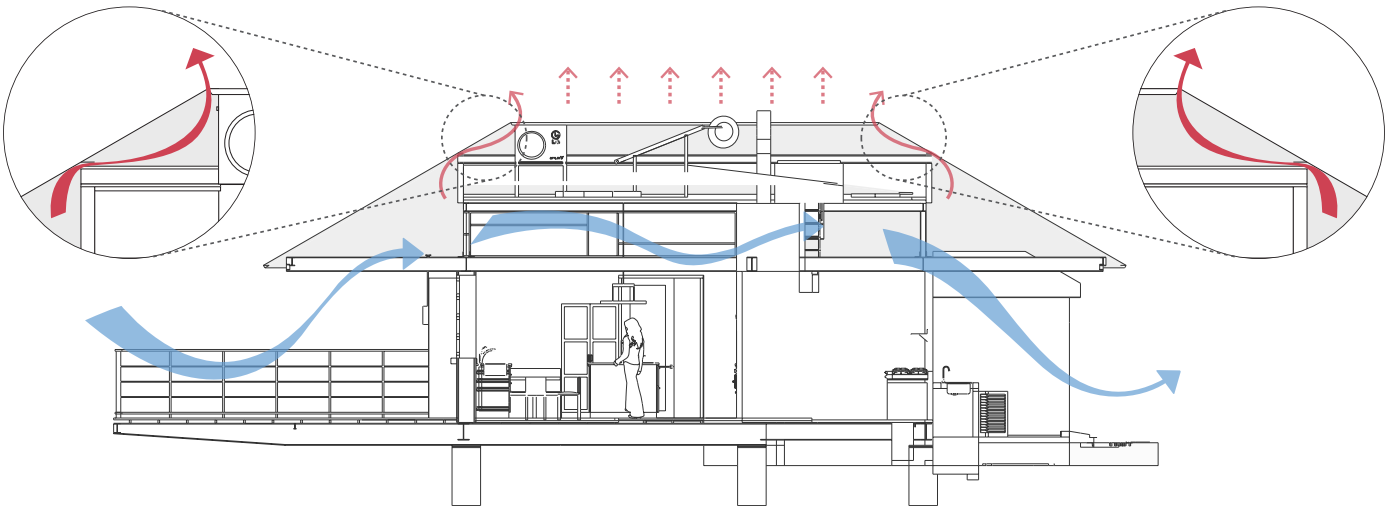




Wind Speed (mph)

2-5	7-10	15-20
5-7	10-15	20+

CHIANG MAI
Windrose Plot [All Year]
Period of Record: 22 Aug 2011 - 10 Mar 2014
Obs Count: 46594 Calm: 44.4% Avg Speed: 3.2 mph
Retrieved from www.windfinder.com/windstatistics/chiang_mai



Air Vent Design

An open air vent in the kitchen maximizes the building's air circulation. It allows for both additional vertical air circulation and natural light in the building. Hot air in the veranda is released through a ridge vent at ceiling level.

WATER

Collection & Treatment

1. Pebble Gutter

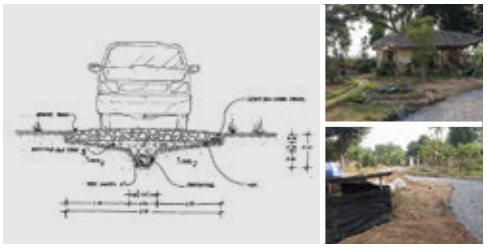
Location: Guest House A, Guest House B
Purpose: To collect water from the roof and transport it to the conveyance system.

2. Lawn Draining System

Location: Under the lawn
Purpose: The draining system collects the excess water from rain and irrigation and drains it into the conveyance system.

3. Garden Trail

Location: Underneath garden trail
Purpose: To drain water from the permaculture garden and garden trail into the conveyance system.



4. Conveyance System

Location: SIte center
Purpose: The backbone of the conveyance system is a large concrete pipe that transports water from around the site to the central filtration system.

5. Drainage Gutter

Location: Front area
Purpose: To collect water from around the site and drain it into the conveyance system.

6. Central Filtration System

Location: Beneath the swimming pool and beach volleyball court
Purpose: To collect, treat and store water for later use.

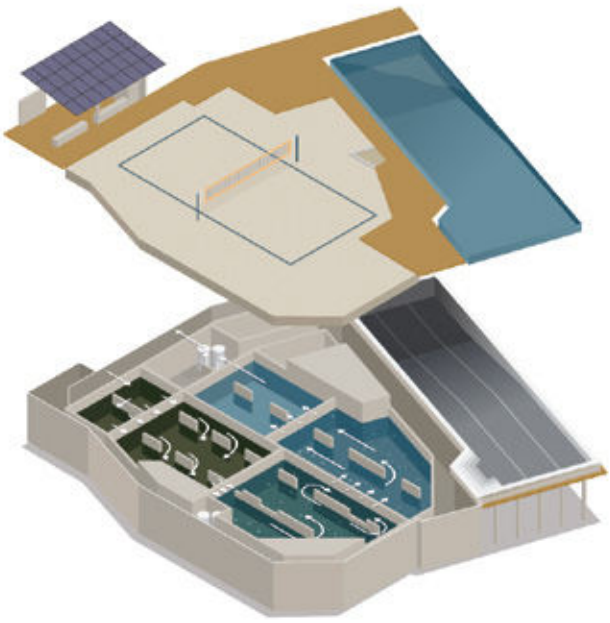
1. The water collected from around the site drains into the conveyance system and reaches the filtration system. A filter in the first chamber separates large debris and leaves from the water.

2. Water in the first tank undergoes mud precipitation.

3. The water cleaning process continues as oxygen is pumped from the bottom of the tank to aerate the water.

4. The water moves to the second tank to undergo an additional roundof aeration.

5. The purified water is collected and ready to be used for irrigation.



TECHNOLOGY HIGHLIGHTS

1. Hydrogen Energy System

Solar Powered Hydrogen Storage System

We have implemented a unique hybrid hydrogen and battery energy storage system to store excess power produced by solar panels during the day for later use.

2. KNX Automation

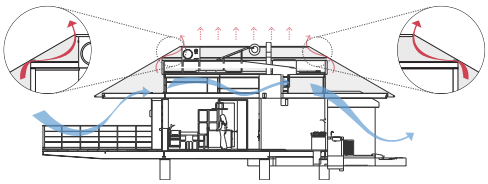
The trend towards building automation systems or smart homes is unstoppable due to the potential for energy saving and increased convenience. KNX is an open international building control standard that allows barrier-free integration and interoperability of products by any manufacturer.

3. Rainwater Collection System

To minimize our impact on the land we live on, we have designed and built a water collection system to save and reuse as much of the rain and irrigation water as possible. An extensive surface drain system collects water and leads it into larger conduits, from where it continues to flow only by gravity into our 1000m3 water reservoir. The water is then aerated and filtered before being reused around the site.

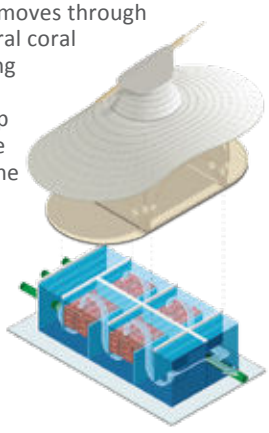
4. Windflow

Using basic physics – allowing hot air to flow freely up and out – we can keep rooms cool and notice a significant improvement in comfort. This design step incurs little cost but can yield great improvements and lower the energy demand for ventilation and cooling significantly.



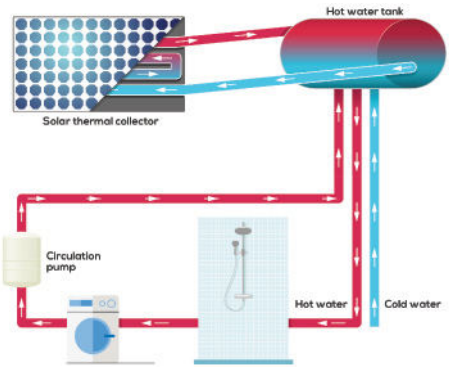
5. Fish Pond

The 600m3 fish pond has been designed and constructed following a fully organic approach.
A solar-pump pumps water into the waterfall at the upper pond. The water runs through the rocky waterway into the lower pond. From here, gravity pushes water into a filter under the Bamboo Sala and then through the chambers of the filtering system. The water moves through sediment and natural coral filters before flowing back through long pipes into the pump room leading to the small waterfall at the upper pond.



6. Solar Water Heating System

Solar water heating systems are used to warm up water for bathrooms and kitchens. The hot water system works by circulating water in a tank through solar thermal collectors. As the water contained in the panel heats up, its density decreases causing it to be pushed upwards by cooler water from the bottom of the tank. A well-insulated solar water heating system can hold a very high temperature exceeding 80 degrees Celsius for several days.



PROJECT TIMELINE

2013

NOV — Guest Houses foundation laid

NOV — Deep foundation drill-piling starts

2014

JAN — Shallow foundation footing starts

FEB — Permaculture & fish pond starts

FEB — Shallow foundation concrete footing poured

MAR — Basement construction

APR — Energy House starts

APR — Floor construction hollow core slab laid

AUG — Kitchen Building metal structure framing

SEP — Guest Houses solar panels installed

OCT — Guest Houses windows installed

DEC — Drainage system construction

2015

Main House 1st & 2nd floor column & shear wall building

FEB — Swimming Pool piling 380 piles of concrete used

FEB — Main House concrete roof poured

APR — Swimming Pool base poured

MAY

OCT — Main House floor leveling

NOV — Main House primer painting

DEC — Swimming Pool finished

DEC — Main House doors & windows installed

2016

JAN — Main House floor finishing

Full Utilization
January 29th 2016

BUILDING ELEMENTS

1. Autoclaved aerated concrete blocks (Qcon)

The lightweight, precast, foam concrete blocks are very versatile building blocks providing structure, great insulation, and fire- and mold-resistance. It is an easy-to-use material which can be accurately cut and quickly assembled. It is an environmentally friendly choice for construction, with reduced environmental waste and greenhouse gas emissions compared to traditional concrete.

2. HDPE Pipe

This type of piping has multiple advantages to the traditional blue PVC pipes most commonly used in Thailand. It has much better performance in variable conditions and can be welded instead of glued. It is the ideal long-term solution, minimizing maintenance load in the future.

3. Insulated double glass Low E coat

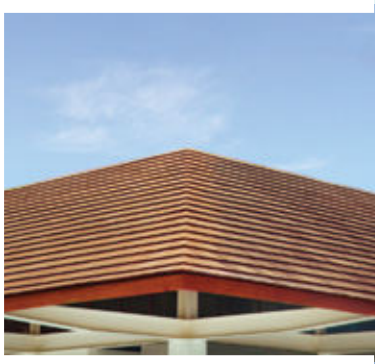
We use double glass with layers of varying thickness and an additional low E coating to increase the insulation value. To keep heat out of buildings, large windows face north or are shaded from direct sunlight whenever possible.

4. Handcraft wood working with special detail

We do not take shortcuts – the wood working team pays special attention to every small detail and goes the extra mile to ensure this most natural and valuable material stands out among modern technology and building techniques.

5. Maintenance Basement

There is a 1.65m high maintenance basement under the entire main house construction. This infrastructure is used for the maintenance of electrical, water and network connections to the surrounding areas. All piping or wiring in the house can be accessed and controlled easily. The space is flood protected and sealed to prevent infestations.



6. Solar Cell

We integrated solar panels to generate all the electricity used on our site. We used semi-transparent panels to allow sunshine to create stunning light around the houses. We used standard panels to shade the building and help keep indoor temperatures low.

QUALITY MANAGEMENT

This stage ensures products and service comply with requirements. This method facilitates the measurement of the quality characteristics of a unit, compares them with the established standards, and analyses the differences between the desired and obtained results in order to correct any differences.

- **Site Preparation**
- **Scaffolding**
- **Concrete sustainability and Curing**
- **Material Treating Process**
- **Buried system inside concrete**