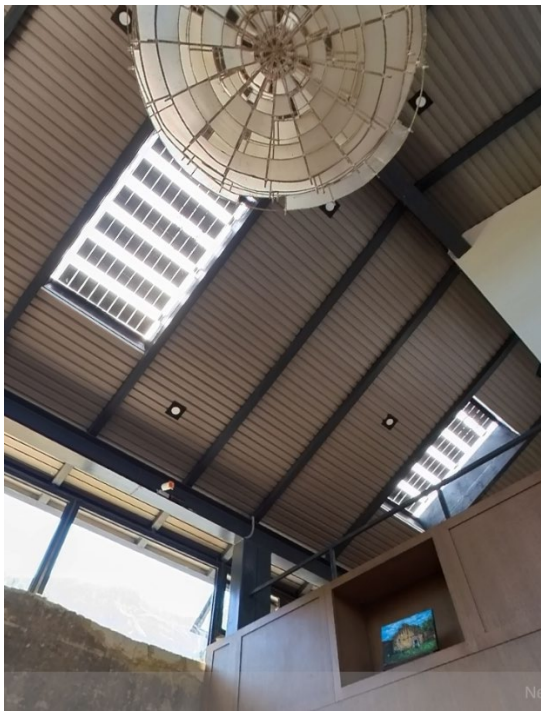
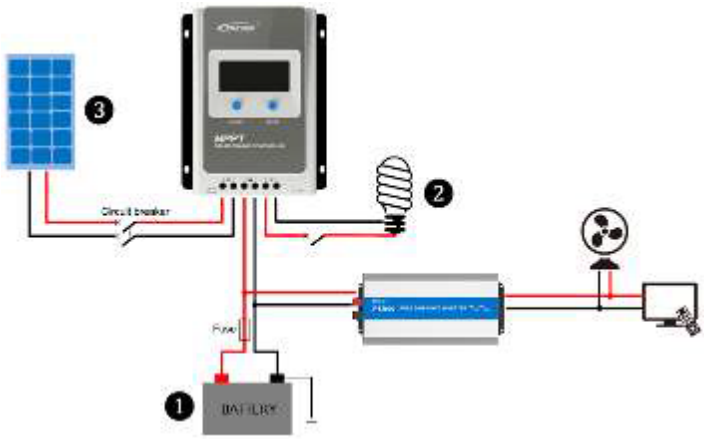
Evaluation of carbon-reducing technologies in Old House

1. Polyvoltaic panels

To preserve the traditional roof form of the Old House, a building-integrated photovoltaic (BIPV) system was adopted instead of conventional rack-mounted PV panels. This system incorporates two large skylights constructed with thin-film PV glass, allowing for natural illumination. The electricity generated by the BIPV system is utilized to power indoor lighting, thereby reducing the building's reliance on the external power grid. The location of Mui Tsz Lam in a hillside valley, characterized by unobstructed sunlight, provides an optimal environment for photovoltaic energy generation. Specifically, the south-facing orientation of the PV glass installation on the roof maximizes solar irradiation capture.





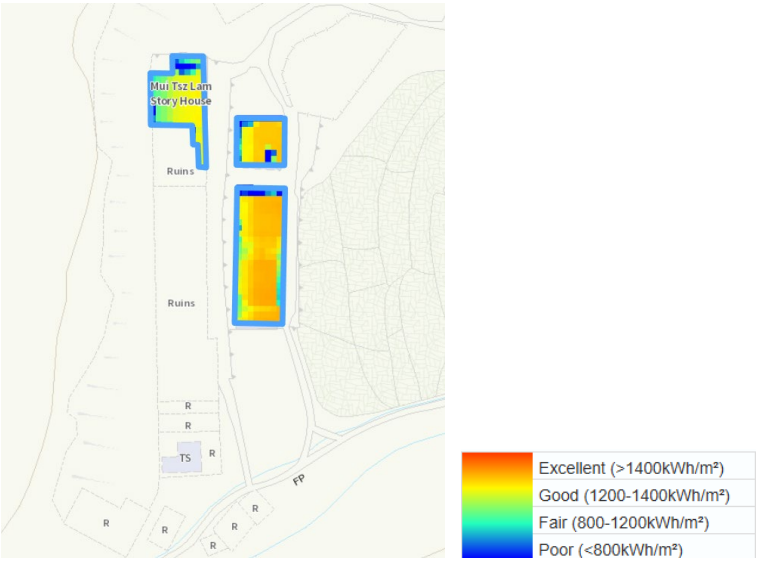
Wiring diagram for photovoltaic system

(1) Battery

(2) Load

(3) PV array

(4) Solar charge controller



Technical data

Effective roof area for PV panel =2.345m^2

Average annual solar irradiation in Mui Tsz Lam = 1246 kWh/m2

(data from EMSD)

Estimated PV conversation efficiency = 10%

Average annual electricity generation =292 kWh

2. Rainwater harvest system

Rainwater collected from the gutter undergoes initial filtration via a leaf eater to remove macroscopic debris before entering a sedimentation tank to allow particulate impurities to settle. A backup steam water supply is connected in case there is a shortage of rainwater in dry season. Water is then transferred to a main storage tank, pumped through a water filter for secondary treatment, and stored in a restored water tank, ready for use within the residence. A ball valve is installed inside the water tank to prevent overflow.

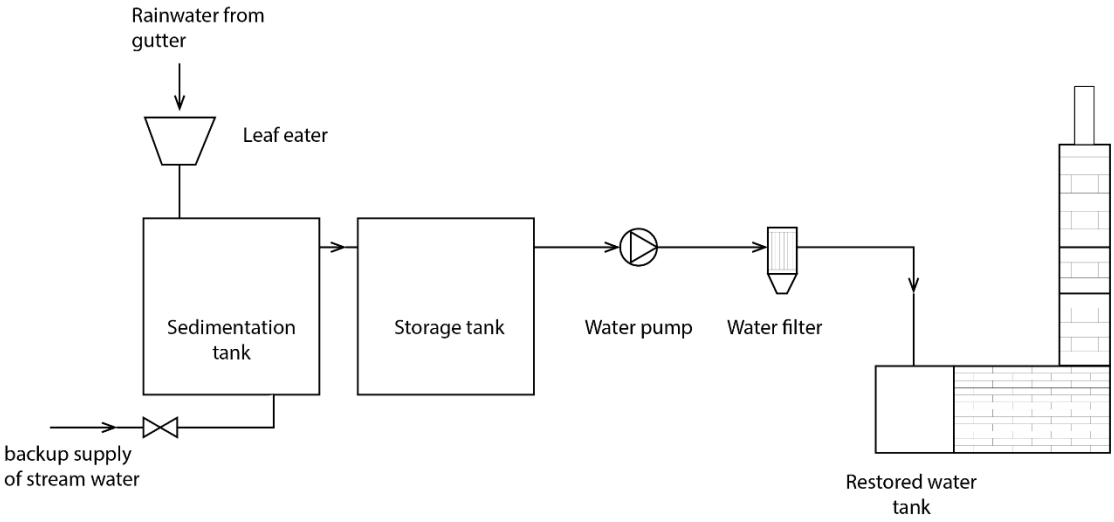
Technical data

Annual rainfall in HK = 2200mm

Effective roof area for rainwater collection =18.8m^2

Maximum annual rainwater collection =41.4m^3

(Note: Due to spatial restraints in Old House, the volume of water tank for rainwater collection is limited to 1.2m^3. Excess rainwater especially during the rainy season will be drained away)



Schematic diagram

Filter and water tanks

Ball value installed to control water flow into the restored water tank

Completion photo

Composting toilet

Completion photo

Since installation of normal toilet with a septic tank requires statutory approval and the application process exceeds the timeframe of the project, the compost toilet offers a feasible alternative to waste treatment in Mui Tsz Lam.

The waterless system also suits the village where no flushing water supply is available. It works by a urine diversion mechanism that separates solid and liquid waste: the solid waste drops directly to the built-in container by gravity, while urine is discharged with other grey water outside the house. A ventilating fan is constantly discharging foul gas to prevent accumulation of bad smell.

Waste handling, cleaning and maintenance

Once the container is full, it is moved to the designated location in the village for decomposition of waste to compost. A layer of soil (20mm thk.) is filled into the container. The decomposition process takes about 12 months. As some Mui Tsz Lam volunteers have been testing with small scale growing practice in the village, The CUHK team is working with them to use the compost as fertilizers.

As the toilet is designed with minimal maintenance need, according to the supplier's instruction, only cleaning of the fan filter is done regularly by the house owner or volunteers.

Technical specifications

Electricity consumption: 1.8kwH per month

(for powering the built-in ventilation fan)

Estimated annual reduction of flush water usage: 3600L

Internal container capacity: 0.027m^3 (around 240 times of use)

Volume of compost converted = 0.027 x 30% (conversation ratio) = 0.0081 m^3

Volume of compost recommended per m^2 of farmland (vegetable garden) per year = 0.0127m^3

Hence, it is estimated that each full container can produce compost serving approximately 0.6m^2 of farmland on a year basis.