Example name: Solar Concrete collector

Template completed by:
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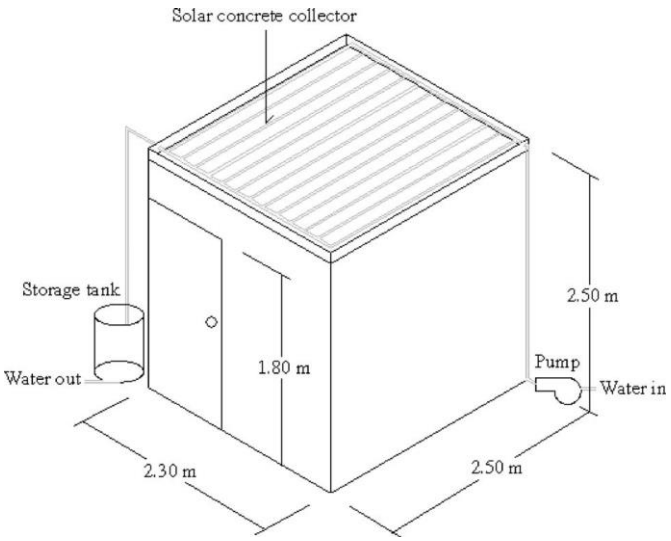


For installations

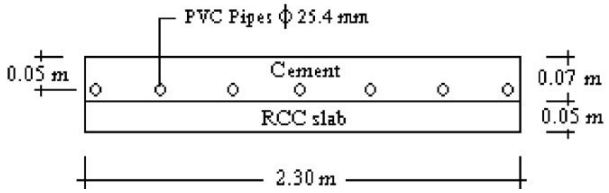
BISTS Location: Bangkok, Thailand 13.4N, 29.4W
Climate Type: Aw
Building Use: Domestic
Level of BISTS integration
Rush level 1 / Reijenga level 1

- ~~O~~ New Build
- O Refurbishment
- O Other: ……

Type of BISTS:

Active~~/Passive/Hybrid~~

Function(s):
- O Air heating
- ~~O~~ Water heating
- O Combi-system
- O Cooling/ventilation/shading
- O PV/T
- O linked to another system (e.g., heat pump)
- O Other: ……



Building element:

- O Facade
- ~~O~~ Roof
- O Other

BISTS characteristics:

The roof-integrated solar concrete collector is a dual pupose system to reduce unwanted solar heat gain into a dwelling whilst providing domestic hot water. The solar concrete collector is made of PVC pipes embedded in deck slab or concrete roof. The unglazed collector prototype was 2.5m long and 2.3m wide.

Stage of Development:		**Responsible:**
O	Idea/Patent	
⊖	Prototype	DhurakijPundit University, Prachachuen, Laksi, Bangkok 10210, Thailand
O	Demonstration	……..
O	Integral building element	……..
O	Commercially available	……..

BISTS description and context

The concrete solar collector was installed as a full roofing element and consisted of ten PVC tubes placed on the reinforced cement concrete (R.C.C.) slab. The spacing of each PVC tube was 10cm and the pipes topped with cement. The thicknesses of R.C.C. slab and topping cement was 0.05 and 0.07 m, respectively. A water pump was used to deliver the water from the cement concrete solar collector to water storage tank. The total volume of water in the storage tank was 0.1m^3.

System viability

Two test rigs consisting of rooms 2.3m in width, 2.5m in length and 2.5m high were built to evaluate the unit performance, compare against a control and validate a computational model. The first room roof was just a reinforced cement concrete (R.C.C.) slab whereas the second room was equipped with a concrete solar collector. The experimental results showed that the cement concrete solar collector can produce up to 40 l of hot water per day at water temperatures ranging from 40 to 50°C.

The indoor temperature of the concrete solar collector roof room was typically 1°C to 2°C lower than the R.C.C. slab roof room, resulting in a 6.14% AC electrical saving. The savings of electrical energy for heated water was 615.6kWh per year.

Table 1
Economic evaluation of the cement concrete solar roof.

Indoor set-point temperature (°C)	Electrical energy consumption (kWh/day) [10]	Saving of air conditioner (Baht/year)	Saving of water heater (Baht/year)	Total saving (Baht/year)	Payback period (years)
22	9.04	449.6	1846.8	2296.4	2.40
23	8.48	421.7	1846.8	2268.5	2.44
24	7.93	394.4	1846.8	2241.2	2.47
25	7.37	366.5	1846.8	2213.3	2.50
26	6.82	339.2	1846.8	2186.0	2.54
27	6.26	311.3	1846.8	2158.1	2.57
28	5.71	284.0	1846.8	2134.8	2.61

1 US$ ≈ 30.5 Baht.

Modelling and simulation tools developed/used

A mathematical model based on the conservation equations of energy was developed to predict the performance of the cement concrete solar collector. There is reasonable agreement from the comparison between measured data and predicted results.

BISTS Performance data

Based on:
O Estimation
⊖ Detailed simulation
⊖ Measurement/testing
O Long-term monitoring

Performance parameters

For integrated systems:
key performance indicators -

For separate collectors:
performance rating coefficients -

Other:

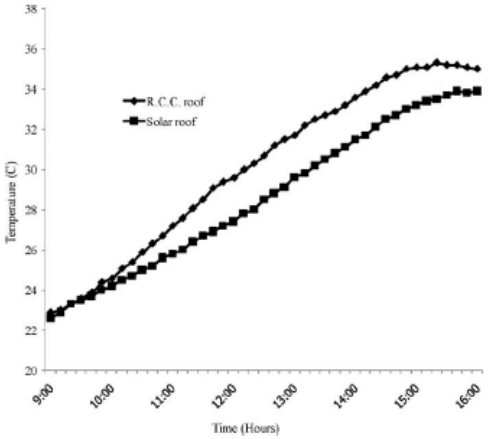


Fig. 9. Comparison between average room temperature for both rooms.

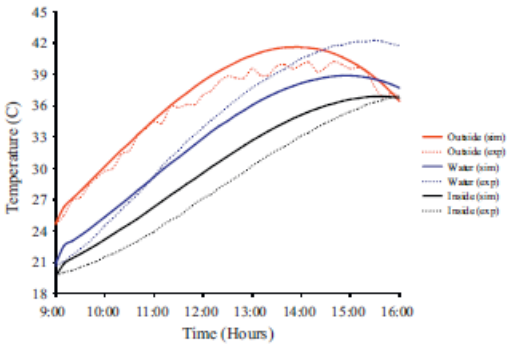


Fig. 10. Comparison between measured and simulated water, outside surface and inside surface of the cement concrete solar roof.

Additional information:

Sources and references:

R Sarachitti, C Chotetanormb, C Lertsatitthanakornb, M Rungsiyopasc.Thermal performance analysis and economic evaluation of roof-integrated solar concrete collector. Energy and Buildings 43 (2011) 1403–1408