Example name: Building Integrated Collector for Solar Heating and Radiant Cooling

Template completed by:
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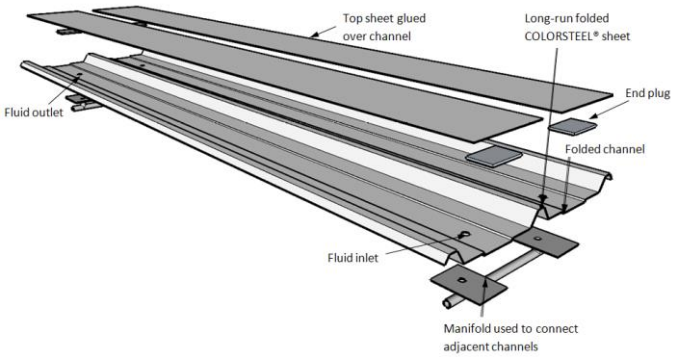


For installations

BISTS Location: Auckland, New Zealand 36.5N, 174.5EW
Climate: Cfb
Building type: Domestic
Level of BISTS integration
Rush level 2 / Reijenga level 2

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

Type of BISTS:

~~Active/Passive~~/Hybrid

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

Building element:

- O Facade
- ⊖ Roof
- O Other

Parameter	Symbol	Value	Unit
Emittance of plate	ε_p	0.95	
Number of tubes	n	12	
System flow rate	m	340	l/h
Collector Length	L	2	m
Collector Breadth	b	3.15	m
Collector Area	A	6.3	m^2
Thermal Trans/Abs	$\tau\alpha$	0.875	
Absorber thickness	t	0.5	mm
Tube Hydraulic Diameter	d_h	8.5	mm
Tube Spacing	W	0.22	m
Ratio of Tube width to spacing	d/W	0.09	
Insulation Conductivity	k	0.045	W/mK
Back Insulation Thickness	L_b	0.1	m
Absorber Conductivity	k_{abs}	50	W/mK
Mounting Angle	β	10	degrees

BISTS characteristics:

The Building Integrated Collector for Solar Heating and Radiant Cooling system was developed to be directly integrated into a troughed sheet metal roof. During the day the unglazed collector can be operated as a standard solar absorber to heat water in a storage tank. However, it is possible to take advantage of radiant cooling of unglazed solar collectors by operating them at night. Under night conditions when there is no solar radiation and the sky temperature is low, the collector can radiate heat to the sky and cool a cold storage tank to provide cooling in the building the following day.

Stage of Development:		**Responsible:**
O	Idea/Patent	
O	Prototype	Auckland University of Technology, Auckland, New Zealand
O	Demonstration	……..
O	Integral building element	……..
O	Commercially available	……..

BISTS description and context

The Building Integrated Collector for Solar Heating and Radiant Cooling system was developed to be directly integrated into a troughed sheet metal roof. During the manufacturing process in addition to the normal troughed shape, channels are added to the trough for the thermal cooling medium to travel through. An absorber sheet, analogous to the fin of a finned tube absorber, is bonded into the trough. The channels formed in the trough are thus enclosed by this sheet; forming a riser tube having an inlet and outlet at opposite ends of the trough to which heat can be transferred. Fluid is pumped through a manifold (header tube), through these "riser" tubes and out through a manifold (header tube) before being fed to a heat exchanger that removes the heat from the fluid. The top absorber sheets were glued to the roof section, and the channels sealed, with a high temperature silicone adhesive sealant thereby forming a standalone watertight collector with a roof profile.

System viability

In New Zealand and Australia long run metal roofing is widely used for domestic, commercial and industrial applications. Moreover, its low cost, high durability, aesthetics and relatively good thermal conductivity make the material well suited to use as the basis for a large area solar heating system.

During periods of high solar radiation in a sheltered location (low wind speeds) it was possible to heat water to an appropriately high level for domestic water use. Furthermore, it was found that when operated in the absence of solar radiation, the collector was able to achieve cooling in the order of 50W/m^2 with temperatures of approximately 10ºC being observed in the storage tank.

Modelling and simulation tools developed/used

To determine the theoretical performance of the building integrated solar collector a one-dimensional steady state thermal model for an unglazed solar collector was utilised.

BISTS Performance data

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

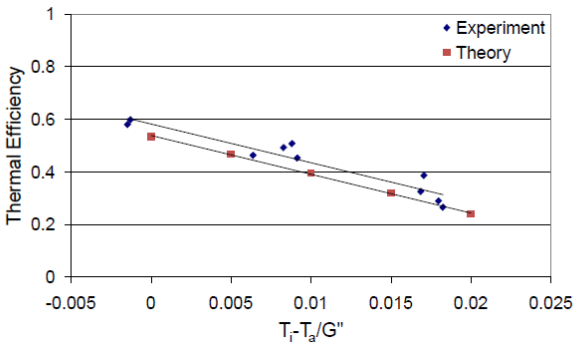
Performance parameters

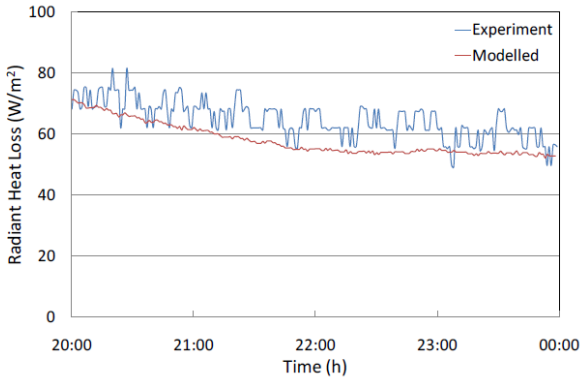
For integrated systems:
key performance indicators -

For separate collectors:
performance rating coefficients -

AS/NZS 2535.1 (1999)

Other:





Additional information:

Sources and references:

T.N. Anderson, M. Duke, J.K. Carson. Performance of a Building Integrated Collector for Solar Heating and Radiant Cooling. Solar2011, the 49th AuSES Annual Conference, 30th November -2nd December 2011