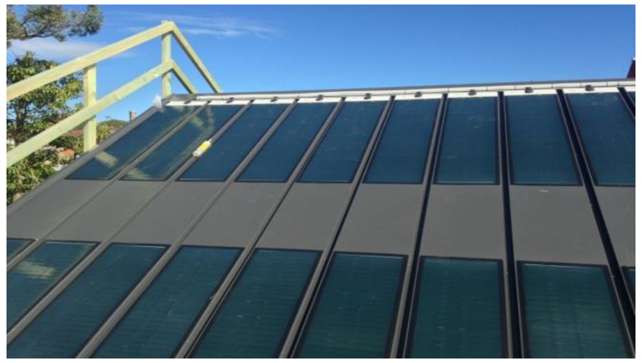
RP1001

AIR HANDLING SOLUTION, INTEGRATION APPROACHES AND BUILDING DESIGN CONSIDERATION FOR A PARTICULAR PHOTOVOLTAIC THERMAL AIR ROOFING

Research Question

1. What are the energy outputs of the BlueScope Steel BIPV/T air system connected to a house in Sydney?
2. Considering the proportional and on/off control strategies for the BIPV/T system, which strategy produces higher thermal and net electrical contributions?
3. What are the best suited residential building typologies for the above BIPV/T air system?

Fig. 1: BlueScope Steel BIPV/T Air System on a House in Sydney



Methodology

In order to answer the first question, monitoring equipment was installed to measure the energy outputs of the installed BIPV/T air system (Fig.1). The performance of the system was monitored during the summer and winter.

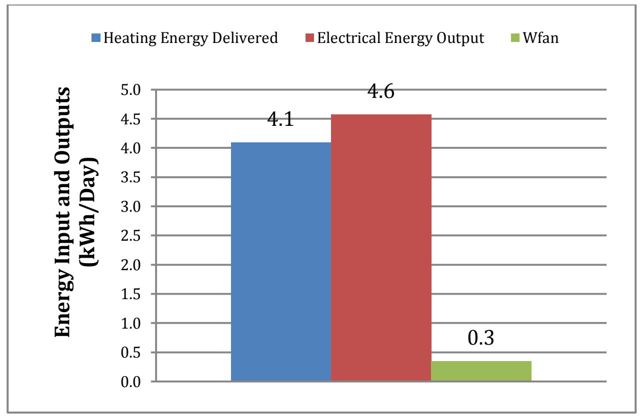
To answer the second question, this particular BIPV/T system was modelled in TRNSYS and the results were compared with the experimental data to validate the model. Then various control strategies were modelled and simulated for the BIPV/T system.

In addition, different types of residential buildings were modelled. Combining building models with the BIPV/T model, provided answers for the third question.

Results

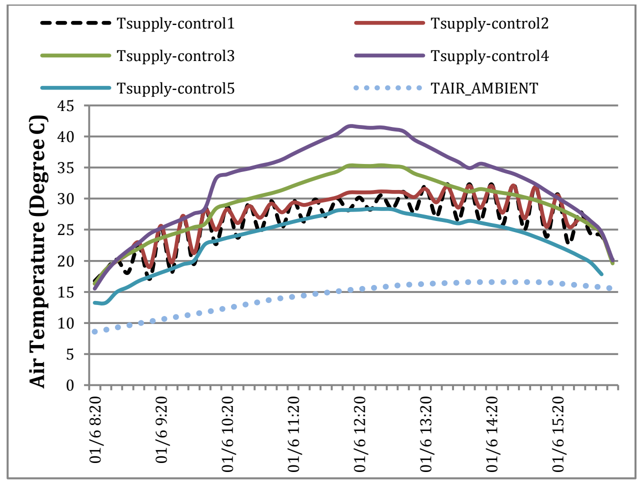
Fig. 2 shows the measured heating energy delivered from the BlueScope Steel BIPV/T air system to the house for a sunny day in June 2015. Additionally the electrical energy output and the fan energy consumption of this system are also shown.

Fig. 2: System outputs on a sunny day in June 2015



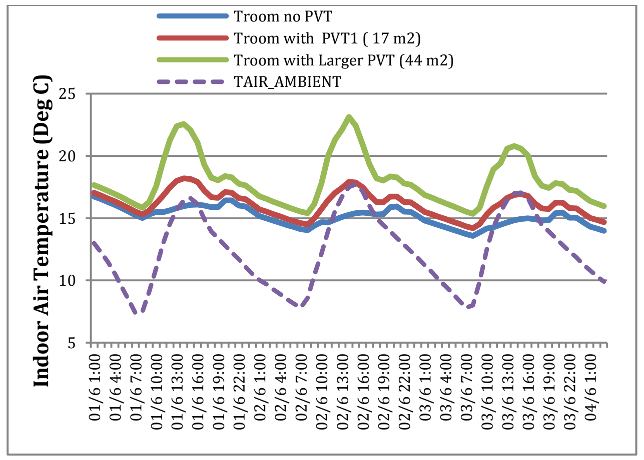
From Fig. 2, the average daily heating COP of this system is around 13.6 which is higher than the minimum COP value of 3.22 required for a heating system in a residential building in Australia. Combining the validated TRNSYS model of the BIPV/T air system and a building model, various proportional (Control 1 to 4) and on/off (Control 5) control strategies were modelled and investigated. Fig. 3 demonstrates the outlet air temperatures of the BIPV/T system using different strategies for the fan operation of the system. It was found that the proportional control of the fan is more effective than the on/off control strategy.

Fig. 3: Outlet temperature variation based on using different control strategies



The integration of this BIPV/T model into various residential buildings was investigated using TRNSYS software. It was determined that the best suitable house for the integration of this system is a well-insulated building with heavy mass constructions and double glazed widows, shaded externally in temperate climates. Figure 4 shows the indoor air temperature of a potential house with/without BIPV/T systems in Sydney.

Fig. 4: Room Temperatures with BIPV/T systems



Conclusions

In conclusion, the outputs of the particular BIPV/T air system were measured in summer and winter. Also, the integration of this system with various control algorithms to different residential building types was investigated for major Australian cities

Anticipated impacts

The results will be useful for researchers, government departments, and companies utilizing BlueScope Steel BPV/T air system design and integration to buildings. This system is capable of generating electricity, heating and cooling (night radiative cooling) for a potential house and impacts on the electricity and gas consumptions.

Further information

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