Reduction of Insolation through Air Plant Green Roof

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Abstract: *This paper presents an experimental study on the reduction of insolation through air plant green roof. By using the plant named Tillandsia Cotton Candyas the solar filter(area of 1 square meter tree panel), the solarimeter was installed above and under the green roof. The positions of solarimeter are 50 cm and 25 cm under the air plant. The measurement started from 8:00 am. To 4:00 pm. The results showed that the intensity of solar radiation is dropped through the air plant green roof. The intensity of solar radiation is in the range of 400- 1,118 W/m^2. The solar radiation at the position of 25 cm under the air plant showed* 45-267 *W/m^2. The solar radiation at the position of 50 cm under the air plant showed 45-267 W/m^2.*

Keywords: *Solar radiation, Green roof, Air Plant*

1. Introduction

Solar radiation is the energy generated from the sun. It radiates out into the ambient air in the form of electromagnetic waves at various wavelengths including both daylight, ultraviolet and infrared radiation.The total radiation energy from the sun is 3.854×10^{26}W [1] by starting from the rays of the sun that shines upon the world.Upon impact with the clouds, water vapor and dust in the atmosphere, about 30% of the total radiation is reflected back and 70% can be forwarded to the earth. The absorbing is on the ground and ground water in water bodies.

The creating of office buildings, and houses are always designed with the using of air conditioning system.It spawned and added up or burdened to the external environment because of the heat is ejected to the outside. Especially, the room under the rooftop of the building that has high temperature.Therefore, increasing green space by growing plants on the roof can drop the temperature. The limitation is the weight of soil on the rooftop of the building and its effect e.g. molding, maintenance, watering, and fertilizer. The using of air plant as green roof will be a good solution because it can survive from dust in the air as fertilizer, moisture in the air, and without soil for planting. The Tillandsia species clone (Tillandsiarecurvifolia Hooker or "Tillandsia Cotton Candy") is a kind of air plant which can be used as green roof. Its thermal performance helps to drop the solar radiation. [2]

Direct solar radiation is the emission of radiation received from the sun in the direction of the energy from the sun to the earth. As it comes to atmosphere such radiation heats the air molecules and the rest would go straight down the ground of the world.

Diffuse solar radiation reaches the atmosphere but affected by clouds, water vapor and dust in the air. The intensity is high at the horizontal direction. Radiation is approximately 10-90% of total solar radiation. In hot and climate of Thailand, there have the sky, clouds, spray at high volume.The solar radiation distribution influences the amount of heat generated by the building.

2. Solar Radiometers

Detection of the optical electromagnetic radiation is primarily performed by conversion of the beam’s energy in electric signals that subsequently can be measured by conventional techniques.

The pyrheliometer is a broadband instrument that measures the direct beam component Gn of solar radiation. Consequently, the instrument should be permanently pointed toward the Sun. [3]

Pyranometers are broadband instruments that measure global solar irradiance incoming from a 2p solid angle on a planar surface. The accepted classification of pyranometers in respect to their quality is defined by the International Standard ISO 9060/1990 that is also adopted by the World Meteorological Organization [4]

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3. The heat transfer through the deck rooftop of the building

Many commercial buildings are designed as a cube with flat deck rooftop. [5] The transmission of heat from the sun that send through the building envelope especially the rooftop is so high. Because of the perpendicular angle of the rooftop of the building and its material as concrete. In Thailand, the building energy code has limited of the roof thermal transfer value (RTTV) which is classified by the building types. The RTTV of office and school must beless than 15 W/m^2. The RTTV for department store or hypermarket, and restaurant must be less than 12 W/m^2. The RTTV of hotel, hospital, and hostel must be less than 10 W/m^2. Even the building energy code did not recognize the green roof as a part of heat transfer reduction ction but in the future, it might be included.

4. Air Plant

This research selected the plant to be used for the green roof in hot and humid climate. The criteria for the selection of genetic are air plants and light weight. The species used to reduce solar áshould be drought-resistant, damp resistant, weather resistant, solar radiation acceptant, free maintenance, leaves all year round, and easy to find in the market. The Tillandsia species clone (Tillandsiarecurvifolia Hooker "Tillandsia Cotton Candy" or called T. Cotton Candy in this paper) is suitableto be used in this study.Itsleaves surface area is covered by trichome which can absorb the moisture and nutrients in the air. [6], [7]

5. Methodology

The research was conducted at the Faculty of Environmental Management, Prince of Songkla University, Hatyai Campus, Thailand. The area of green roof is 1 square meter of tree will be placed with 10 rows of 10 trees. The Solarimeter is places on the top and bottom of the green roof. By the distance between the T. Cotton Candy and the Solarimeter the testing divided into 2 groups i.e. about 50 cm and 25 cm. The test starts from 8:00 a.m. to 4:00 p.m., because it is the time that solar radiation emit to the rooftop. The solar radiation was recorded every 15 minutes within 24 hours.

6. Result and Discussion

According to the study, the total solar radiation transmitted through the green roof showed that the range is 400- 1,118 $W/m^2$and the filtered solar radiation from the sun at a distance of 50 cm under the T. Cotton Candy (Figure 1) is in the range 97-579 W/m^2 (Figure 2).

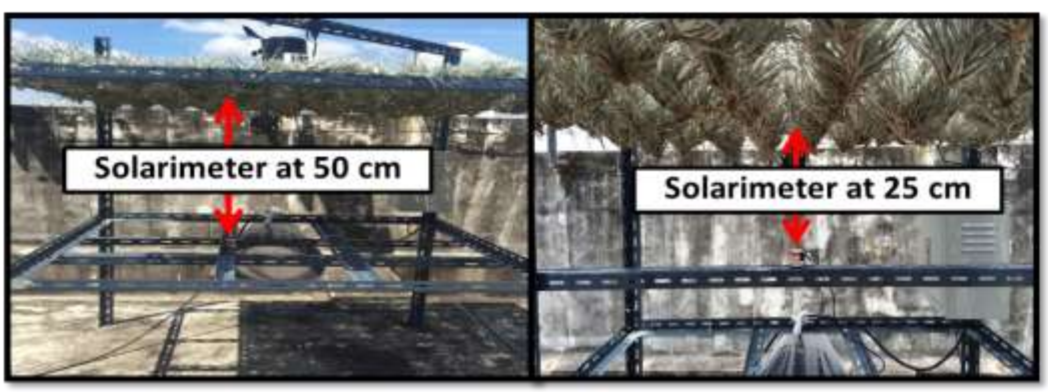

Fig. 1: The position of Solarimeter at the distance of 50 cm and 25 cm under the T. Cotton Candy.

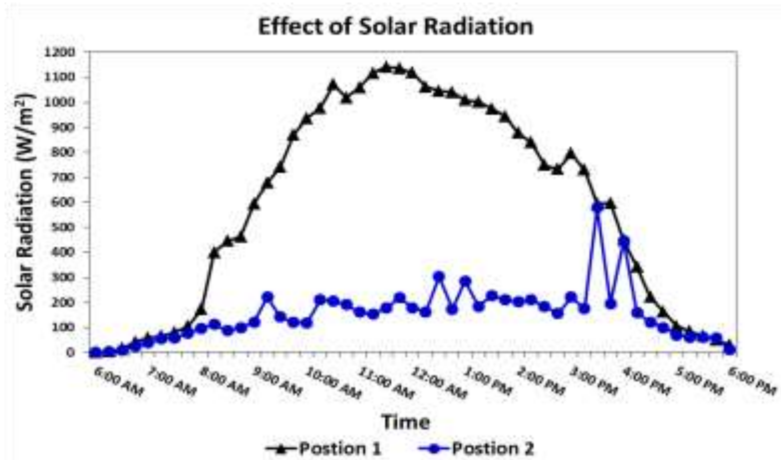

Fig. 2: The intensity of solar radiation emittedand the filtered radiation measured at50 cm

Note position 1 the intensity of solar radiation is emitted to the rooftop of the building
Position 2 the filtered solar radiation from T. Cotton Candy at a distance of 50 cm

In addition, the ability to filter the solar radiation of T. Cotton Candy at a distance of 25 cm is in the range 45-267 W/m^2 (Figure 3)

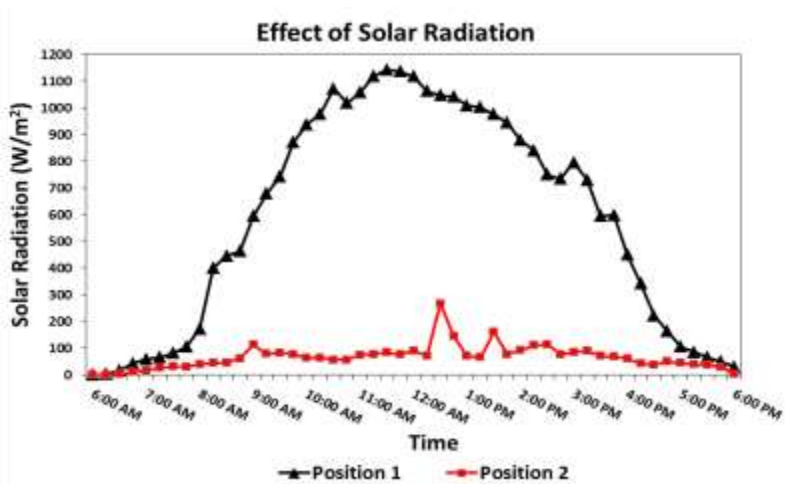

Fig. 3: The intensity of solar radiation emittedand the filtered radiation measured at25cm

Note position 1 the intensity of solar radiation is emitted to the rooftop of the building
Position 2 the filtered solar radiation from T. Cotton Candy at a distance of 25cm

7. Conclusion

The experiments in two areas at a distance of 25 cm and 50 cm had been compared (Figure 4). At the distance of 50 cm under the T. Cotton Candy, the intensity is stronger than at the 25 cm because of the radiation during morning and afternoon can diagonally radiate to the solarimeter. The gap between the panel of the T. cotton Candy and the roof should be around 25 cm.

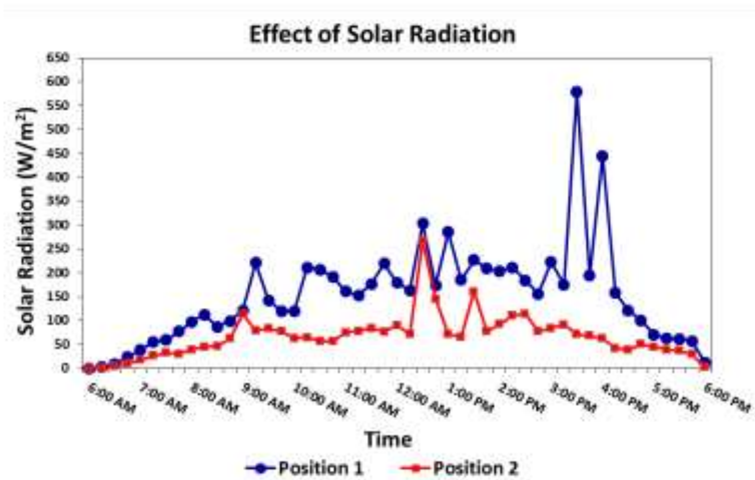

Fig. 4: Comparison of the filtered solar radiation at a distance of 50 cm and 25 cm.

<u>Note</u> Position 1 the filtered solar radiation under the T. Cotton Candy at a distance of 50 cm
Position 2 the filtered solar radiation under the T. Cotton Candy at a distance of 25 cm

8. References

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