The designers also may use the local brick and rocks, extracted from the surrounding environment to be used in building and finishing of walls, and the use of domes and vaults in roofs as an environmental system to decrease the energy consuming and in order to achieve a design which goes with the natural environment and the traditional architecture, as shown in the "Movinpeik El-Kosere Resort " Fig. (17) & fig. (18).

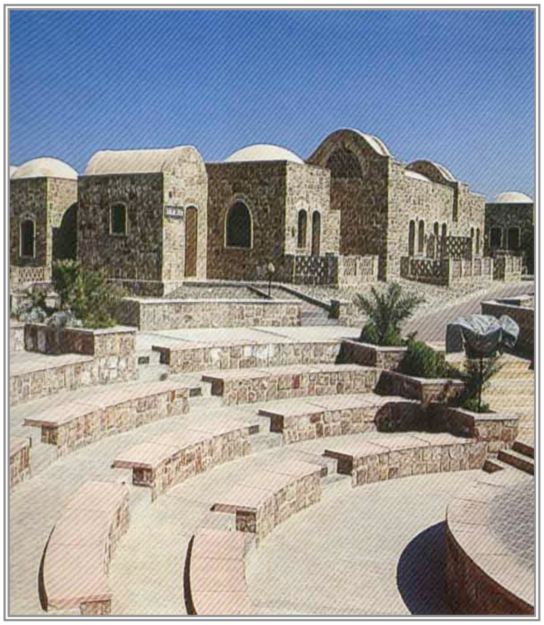

Figure 17
Movinpeik El-Kosere Resort

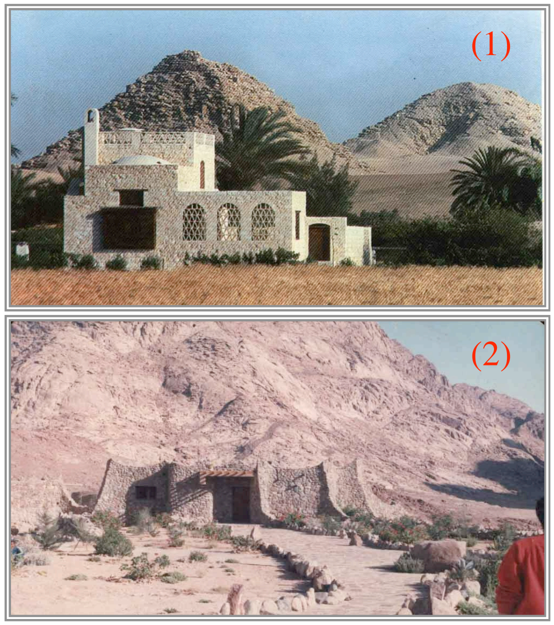

Figure 18
(1) Villa in desert Abu Seer
(2) St Catherine's Resort

There is no doubt that, the more the designer uses the environmental elements in his planning and design or the use of materials and elements which matches with the local environment in a way that goes with the nature recycling and the ecological order and the use of the renewable energy sources and the decrease of the harmful out-puts which go to the sinks causing its pollution, as mentioned before, the more this designer will be able to reach his aim and achieve the protection of environment as much as possible. In order to decrease the damage and increase the positive value of such projects, leading to an economic touristic development with environmental respect and value and this is what we aim to achieve.

Results and recommendations:

(1) The parameters and restrictions to protect the environmental system for coastal areas must be complete with no exceptions what ever the importance of the project built in it.

(2) The reconsideration or the environmental rules which control the development in the coastal regions, since the study which was prepared and

approved in September 1998 and up till now had proved that there are many weak points which cause trouble, and that this agenda must be followed by a sub-agenda to face the problems which leads to the destruction of environment.

(3) The need to extend the natural protective areas and its surrounding regions.

(4) The natural sea shore coastal line must be preserved as it is with no interference, using the satellites pictures periodically to preview any change either natural or man-made.

(5) It is important to keep the nature of the land topography in the sites where touristic projects are built especially those with natural grooves resulting from the heavy rain- putting plans and programs to face the risk of torrents before it happens.

(6) The more we use the water element, which is the main element in the water front character, in a natural way with its flow and combining with the land natural structure, the more will be the architectural and form value of the built project, taking into consideration not to destroy the sinks underground and the use and benefit from the desalinated water, since the use of the treated water, either with desalination or biological treatment is so promising to be the source of fulfilling the great demand of fresh water for these areas.

(7) The original natural environment of the area, even if it laks the green cover, still has its own beauty and its special desert environment with its limited kind of plants and rocks and natural colors, which is something most of the tourists are interested in, since they may not have environment in their own countries.

(8) The more, the designer benefit from the natural structure of the site using its local materials and energy sources, the more he will be able to save the natural environment with its homogenous effect and influence between the built projects and its surroundings, which in turn provide an additional esthetic, cultural and economic values to the project and the site itself.

(9) Our aim is to achieve the harmony with the natural environmental orders when designing touristic projects in the coastal area to protect the natural environment of the water fronts while developing these areas.

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Solar Thermal Electric Panel (STEP): Performance Analysis

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ABSTRACT

With increased energy costs, driven by a higher demand and dwindling supplies, the search for alternative and renewable energies to compensate or even replace the current energy production technology is very necessary. A properly sized and installed solar energy collection system can be a practical alternative for acquiring all or some of your energy needs.

The main goal of this research was to conduct an experimental analysis of an integrated photovoltaic and thermal system. The design and development was initialized by a group of students and advisors from both the University of Missouri-Rolla and Crowder College with the intent to use the hybrid system as part of the solar houses in the upcoming solar decathlons. Previous research studies on hybrid roof systems have shown increased performance however the differences in the systems studied vary in their setups and use of materials. In the case of this study a series of copper tubes were integrated into a metal seam roof with an amorphous silicon panel encased in low iron glass. This experiment encompassed almost 160 square feet of hybrid Solar Thermal Electric Panel (STEP) system panels and performance data acquired was used for input to computer simulation software to optimize the system for application to the UMR/RTI solar house that is entered into the 2005 DoE's Solar Decathlon.

Based on experimental tests overall efficiency of the STEP system is 50% while a separate thermal and electric system is estimated to be 26% for the same roof area. An assumption for the thermal systems is that they are of similar makeup and their efficiency is based on an ambient input temperature. The glazed versus unglazed analysis yielded a glazed panel reducing the PV collection by 23% and increasing the thermal collection by 200%. In conclusion this paper will discuss additional performance based analysis on the STEP system thermal and electric outcomes.

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INTRODUCTION

With increased energy costs, driven by a higher demand and dwindling supplies, the search for alternative and renewable energies to compensate or even replace the current energy production technology is very necessary. A properly sized and installed solar energy collection system can be a practical alternative for acquiring all or some of your energy needs.

The combination of photovoltaic and solar thermal (PVT) system has been proven to provide greater efficiency then their stand-alone counterparts. Previous studies on hybrid assemblies have found favorable results supporting the combination of both systems (Zondag, 2002). Drawing the heat of the back of the photovoltaic panel can increase the panels output as well as the panels lifetime output. While the concept is not new research continues on developing more effective ways that will ultimately result in better performance at a lower cost.
This experiment encompassed almost 150 square feet of the hybrid STEP system panels and performance data acquired will be used for input to computer simulation software to optimize the system for application to the UMR/RTI solar house that is entered into the 2005 DoE's Solar Decathlon. The obvious benefit of implementing a STEP type system to the planet would be the reduction in energy consumption and reducing the impact on the environment resulting with the improvement in human living conditions.

Explorations of conditions such as temperature gain due to stagnation of the thermal system and how the system performs with and without glazing as it relates to this systems design will be discussed further in this paper.

EXPERIMENTAL SETUP

The solar thermal electric panel (STEP) system is a standing seam copper roof with three channels for copper piping. The PV panel, a Uni-Solar PVL series panel, is self-adhesive and is applied to the base of the standing seam roof over the copper pipes that were inserted into the channels of the standing seam copper roof pan. There are extra bends at the top of the pan to facilitate the glazing of the collector. The glazing is needed to trap the suns radiation thus amplifying the heat, via the greenhouse effect, inside the collector. Figure 1 shows the cutaway view of the STEP collector.

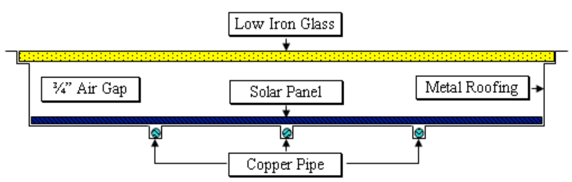

Figure 1: STEP System - Cutaway View

The roof section tested consists of six STEP panels. The overall dimensions of the collection area are 16.67 feet tall by 8.91 feet wide for an area of 148.61 square feet. The angle measured from the ground is 61 degrees. This angle is optimal for winter solstice for the latitude in Rolla, Missouri, where the testing took place. The results presented here are for the collector angle of 61 degrees in late March. Figure 2 shows a picture of the test roof.

Figure 2: Test Roof

Using a 40 gallon solar hot water tank with food-grade antifreeze with a rust inhibitor combined with distilled water. The fluid is pumped using a 1.5 horsepower pump from the bottom right corner and flows out the top left corner. The equal geometric flow pattern lends itself to uniform flow and ensures that their will be a solid column of water in the thermal collection piping.

A type-T thermocouple was used to measure the inlet and outlet temperature. When the fluid has passed through the collector area it passes through the outlet thermocouple before entering the hot water tank via the top hot water supply pipe as indicated in Figure 3.

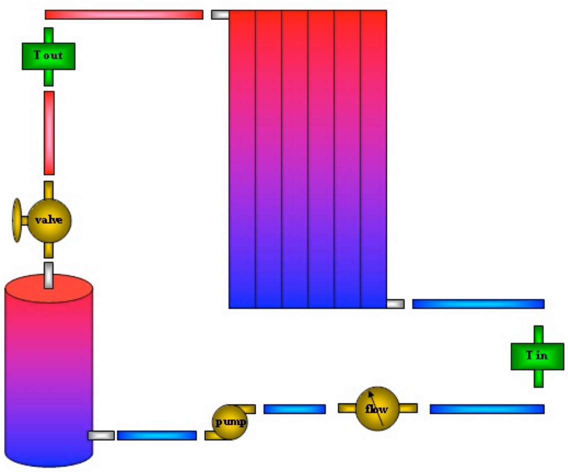

Figure 3: Fluid Flow System

The photovoltaic (PV) panel voltage was measured across the capacitor bank while panel amperage was obtained by measuring the voltage drop across a low resistance resistor, 0.03 Ohm, in series to the flow of electricity. Knowing the amperage and voltage the maximum power can be obtained.

A silicon PV based pyranometer was used to obtain the available radiation numbers used in this report. The pyranometer was mounted on the roof surface to see the same angle as the STEP panels, 61°.

The data was collected in ten second intervals. The data logger collects all of the temperature and voltage data from the components mentioned previously. The ambient temperature was taken via a digital temperature gage. A diagram of the measurement system can be seen in Figure 4.

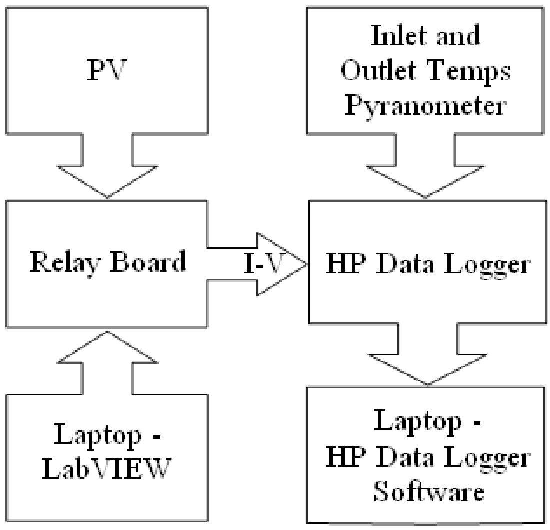

Figure 4: The Measurement System

The PV power output was obtained by finding the maximum power point on the I-V curve. This technique was used because finding a consistent load and the cost of inverting equipment would have been more expensive and would add more unknowns into the experiment. Forty-eight data points are taken at each capacitor bank charging cycle to obtain the maximum power the PV is outputting. Figure 5 shows the I-V curve over a ten second charging interval. Figure 6 shows the voltage and amperage plotted versus time.

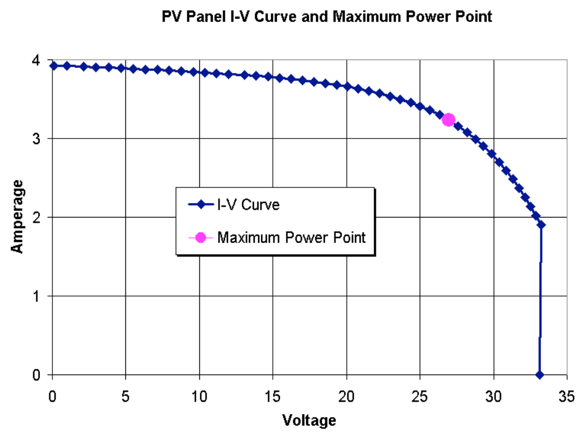

Figure 5: The I-V Curve

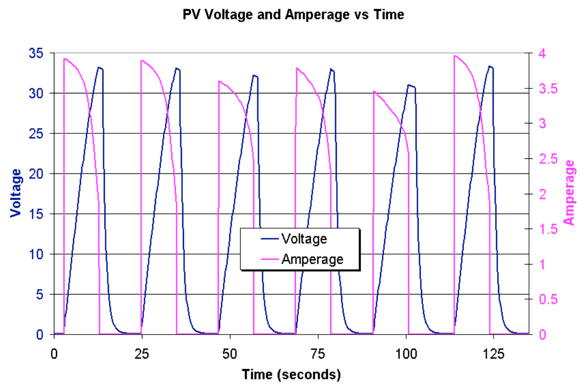

Figure 6: A Sample Set of PV Data

RESULTS

Over the four hour testing period, two hours before solar noon and two hours past solar noon, the PV array collected about 2.4 kilowatt-hours (kWh). Figure 7 shows the energy gain during its sampling interval compared to the available radiation striking the collector surface.

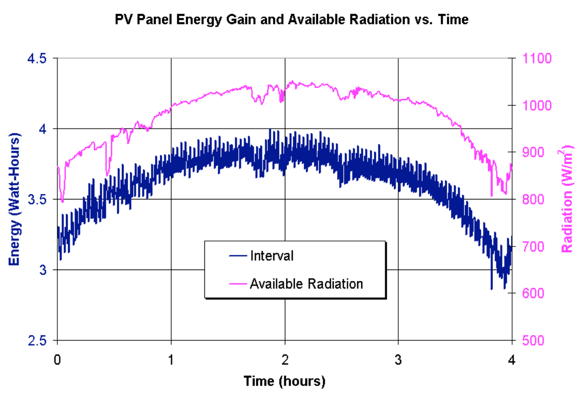

Figure 7: Energy Gain Interval

As expected there is a direct correlation to energy gain and available radiation. Figure 8 shows the same energy gain interval curve with a comparison to the cumulative energy gain throughout the four hour sampling period. As stated before, at hour four the accumulation is 2.4 kWh.

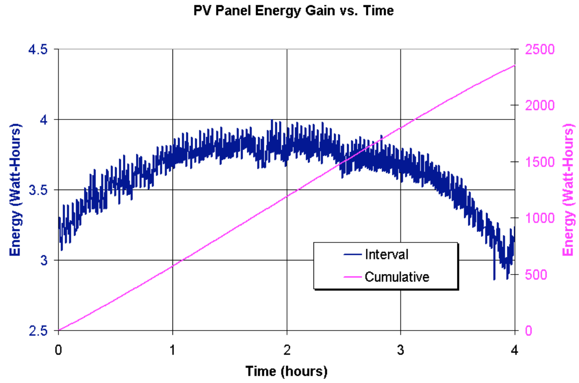

Figure 8: Interval and Accumulation

The efficiency of the solar panels in the STEP system averaged around five percent. Figure 9 is a good representation of PV panel performance on an average sunny day; the daily temperature of all seven test days averaged to 70°F. The two areas being the area only the solar panels encompass and the area of the whole collector as it sits on the roof. Figure 10 is the plot of the PV performance data with the glass removed from the collector.

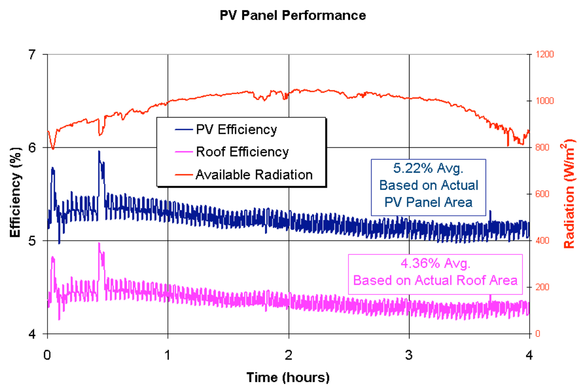

Figure 9: Glazed PV Behavior

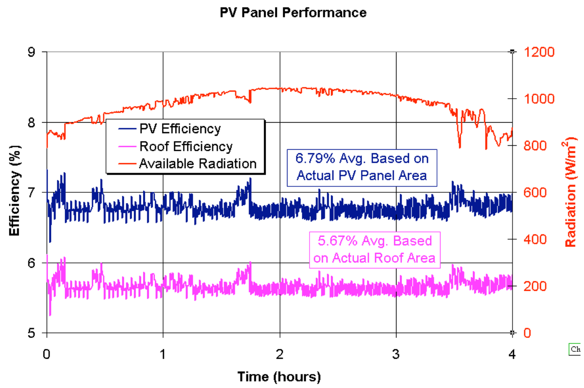

Figure 10: Unglazed PV Behavior

The efficiency of the photovoltaic panels decreases by 23% going from 6.79% to 5.22% a difference of 1.57% due to glazing. This was noted in previous research study at the Energy Research Lab in the Netherlands resulting in the same conclusion (Zondag, 2001). Similar research found the efficiency of the PV array declined with increase in temperature of the module. In an attempt to model this effect through the experimental setup the fluid pump was not run. The glazing is on the collector so the greenhouse effect is still in play. With no fluid flow the PV panels would see a higher temperature. Figure 11 shows the performance of the PV panels with the effects of stagnation. When comparing figures 11 and 9 the effects of stagnation the output by 0.15% due to temperature gain. This, however, does not take into account the effects of extended durations of stagnation.

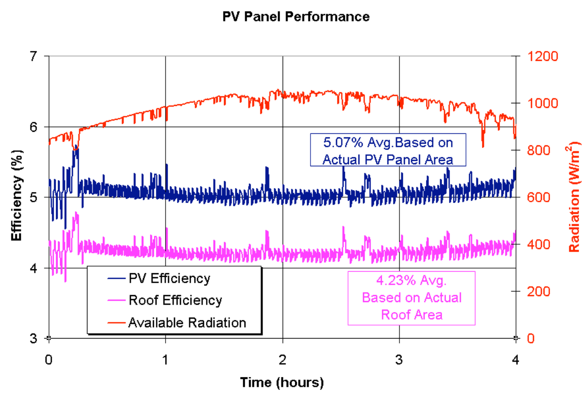

Figure 11: PV Performance with Stagnation

DISCUSSION AND CONCLUSIONS

The overall efficiency of the STEP system is 50% while a separate thermal and separate electric system is estimated to be 26% for the same roof area. The glazed versus unglazed analysis yielded a glazed panel reducing the PV collection by 23% and increasing the thermal collection by 200%.

It has been shown in previous work (Staebler, 1980) that an a-Si panel can benefit from being subjected a pattern of heating a cooling of the panels. This annealing process can retain a higher efficiency through lowering the degradation of the a-Si panels. Also, cooling a solar panel whether glazed or not, by extracting heat away from it will increase the electrical energy gain of the system (Duffie, 1991).

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