Optimum Orientation of Solar Panels in Baghdad city

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Abstract

In this paper went to prove which correct facing and reach to the optimum orientation of solar panel, from this research we know the best facing installation of Baghdad city by using five facing in installation solar panel (east , south-east , south ,south-west and west)the results for the optimum power for solar panel are obtaining relatively differ for each face and we are found that the face of south are best for fixed panel.

Key words: - installation solar panel, solar power, orientation solar panel, fixed solar panel facing solar panel.

Introduction

The sunlight travels in a straight line from the sun to the earth. When it enters the earth's atmosphere part of the light is scattered and part of it reaches the surface in a straight line. Another part of the light is absorbed by the atmosphere. This scattered sunlight is what we call
diffuse radiation or diffuse light. The sunlight that reaches the surface without being scattered or absorbed is of course direct radiation. Direct radiation is the most intense as everyone knows from sunbathing or working outdoors. Only a small fraction of all sunlight actually reaches the surface of the earth [1,2,3].

A solar panel produces energy even when there is no direct sunlight. So even with cloudy skies a solar energy system will produce hot water. The best conditions, however, are bright sunlight and the solar panel facing towards the sun. To benefit most of the direct sunlight a solar panel has to be oriented as best as possible towards the sun. For places on the Northern Hemisphere this is south, for countries on the Southern Hemisphere this is north.

In practice, the solar panels should therefore be positioned at an angle to the horizontal plane (tilted). Near the equator the solar panel should be placed slightly tilted (almost horizontal) to allow rain to wash away the dust.

A small deviation of these orientations has not a significant influence on the energy production because during the day the sun moves along the sky from east to west figure (1) [1,3,4,5]

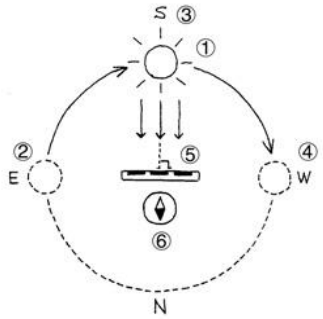

Fig (1) shows the sun moving

Solar cells have been receiving a great deal of attention in recent years as one source of renewable, environmentally-friendly energy. One problem with solar cells, however, is the fact that the amount of power that can be generated is unstable, because the quantity of sunlight hitting the solar cell panel surface is affected by weather and other factors. In order to maximize power generation efficiency, it is necessary to design a system that is able to change the orientation of the solar cell panel to suit changes in the angle of the sun due to the rotation and revolution of the Earth, and seasonal changes. In spite of the above, most solar cell panels are pointed in a fixed direction figure (2), because it costs too much to be continually changing their orientation [3, 4, 5, 6].

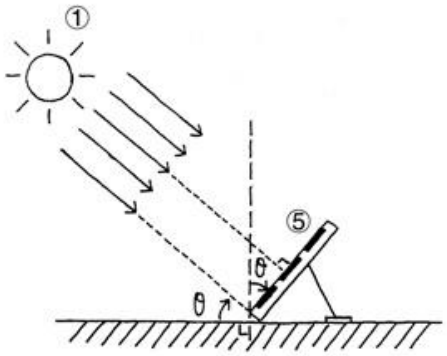

Fig (2) shows fixed solar panel

When installing photovoltaic modules, be aware that they generate maximum power when facing the sun directly. The fixed position which approximates this ideal over the course of the year, thus maximizing annual energy production, is facing due South (in the Northern Hemisphere) or due North (in the Southern Hemisphere) at the angle listed in the table in the next column. Note that these orientations are true

The mounting configuration of a PV module depends on whether it is mono facial of bifacial or on its application. Conventional modules are normally mounted facing the equator with the tilt equal to the latitude angle. However, for some applications a different mounting configuration may be optimum [2, 6, 7, 8].

At some installations, it may be cost-effective to adjust the tilt seasonally. At most latitudes, performance can be improved during the summer by using an angle flatter than the chart's recommendation; conversely, a steeper angle can improve winter performance. In designing the optimal tilt angle and orientation of a fixed solar panel for maximizing its energy collection is to acquire the maximum solar radiation availability at the required location, a number of studies have been conducted by

various researchers to determine the optimum location for solar radiation collection using different empirical models. However, solar radiation varies with geographic latitude, season, and time of a day due to the various sun positions under the unpredictable weather conditions. Systematic long-term data measurements are regarded as the most effective and accurate method of setting up the solar radiation database. In many parts of the world, the basic solar data for the surfaces of interest are not always readily obtainable. It is also impracticable to measure the solar radiation for every tilt angle to deduce the peak value. Traditionally, solar radiation on an inclined surface is model led using horizontal data.

If modules are not cleaned regularly, it is recommended that they not be mounted at an angle flatter than 15". Flatter angles cannot take ful1 advantage of the cleaning action of rainfall [2,3,6,7,8]

To capture the maximum amount of solar radiation over a year, the solar array should be tilted at an angle approximately equal to a site's latitude, and facing within 15° of due south. To optimize winter performance, the solar array can be tilted 15° more than the latitude angle, and to optimize summer performance, 15° less than the latitude angle. At any given instant, the array will output maximum available power when pointed directly at the sun

To compare the energy output of your array to the optimum value, you will need to know the site's latitude, and the actual tilt angle of your array-which may be the slope of your roof if your array is flush-mounted. If your solar array tilt is within 15° of the latitude angle, you can expect a reduction of 5% or less in your system's annual energy production. If your solar array tilt is greater than 15° off the latitude angle, the reduction in your system's annual energy production may fall by as much as 15% from its peak available value. During winter months at higher latitudes, the reduction will be greater.

If a south-facing roof is unavailable, or the total solar array is larger than the area of a south-facing roof section, an east or west-facing surface is the next best option figure (3). Be aware that solar power output decreases proportionally with a horizontal angle, or "azimuth," greater than 15° from due south. The decrease in annual power output from a latitude-tilted east or west-facing array may be as much as 15% or more in the lower latitudes or as much as 25% or more in the higher latitudes of the United States. Avoid directing your tilted solar panels northwest, north or northeast, as you'll get little power output.

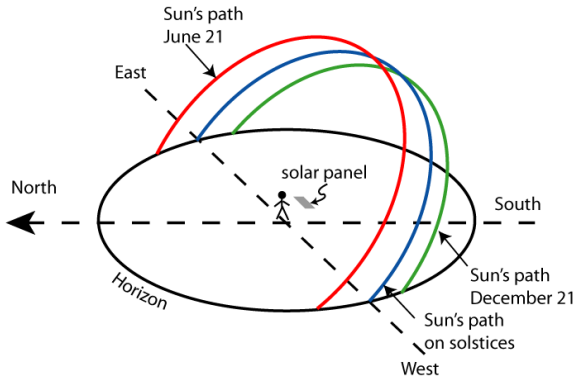

Fig (3) shows facing south and sun path [3]

Magnetic declination, the angle difference between magnetic south and true solar south, must also be taken into account when determining proper solar array orientation. If a magnetic compass alone is used to determine where to point the array, you may not capture the maximum amount of solar radiation [3,6,8,9].

The momentary output of your system depends on the angle of the sun and the clearness of the sky as well as the temperature and the cleanliness of the solar module glass. An

idealized "typical" profile of system output during a day is shown. In the early morning, even though the day is "bright" to the eye, the angle of the sun to the solar modules is very low resulting in a reduced power output. As the sun rises in the sky, it moves more directly in front of the modules and the output rises to a peak value near noon. As the sun begins its decent, the angle of the sun to the panels gets lower and reduces the power output of the system. Some actual daily profiles are shown here to illustrate the effects of sky conditions on output. Notice how the real profiles vary moment to moment compared to the smooth idealized profile . This is a more true representation of how your system output will vary during a day.

If the building orientation is east to west about 80 percent of the solar energy is available to the panels. In both situations, the assumption is made that panels have the correct tilt and no shading,

If the roof orientation doesn't allow for a southern exposure or aesthetics many solar panel's placed on a ground rack at the ideal tilt

Seasonal changes in Sun's angle along with shortened daylight, and weather also affect annual sun hours or solar isolation. Solar insulation refers to the amount of solar energy, direct or diffuse, reaching the earth per a unit of time [2,7,9]

1- Procedure:-

1-1- Equipments experimental included:-

Restriction the orientations facing for installation panels in five directions to recognize optimum orientation like (east , south-east , south ,south-west and west).Shown in figure (4).

Fig (4) shows the five orientation facing

2-1 - We amounted the (5) solar panels in tilt angle 35 degree to reach more amount of solar radiation on solar panel surface as winter tilt angle and in a sunny area the solar panel that properties 80 watt open circuit17 V short circuit 5.4 Amp mono crystalline type shown in figure (5)

Fig (5) shows the five solar panels installation in five direction

3-1- We read solar radiation form weather station with Data logger to read solar radiation in (w/m^2) watch dog type, this reading with time to long day hours to know how much can solar panel produce the energy follow to incident solar radiation.

4-1- Multimeter for measure the current in short circuit state for five solar panels 80 watt with time to long day hours to five panels (in sunny day)

Results and Discussion :-

We measure the solar radiation from the weather station at every quarter hour to long day and beginning the measure from the 8 A.m. to 2 p.m. Figure (6) shows the solar radiation with time in 6/4/2010 , to camper between the amount of solar radiation accident on facing orientation solar panel , and the amount of solar radiation begins in sunrise a small amount, because the air mass be bigger amount and it is dependent on cosθ this causes attenuation for solar radiation and reach to peak power of solar radiation in midday the cosθ closer to 1 about 11.45 A.m. because the angle between sun and solar panel surface changes for long day and solar radiation accident on solar panel is different in every angle.

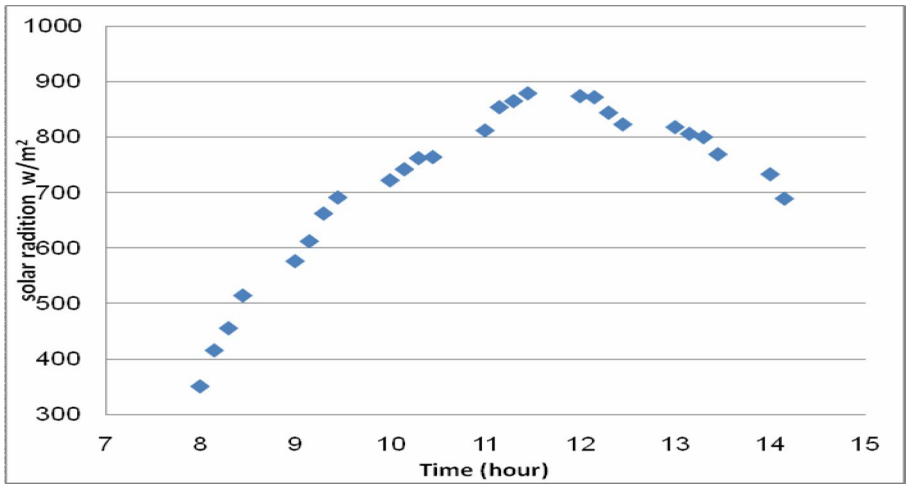

Fig (6) shows the solar radiation with time

We read the current for 5 panels by using multimeter in short circuit state with the time in every quarter hour to long day from the 8 A.m. to 2 p.m. this reading shown in figure (7) in sunny day the output for solar panel different in every angle sun position the output solar panel dependent on solar radiation amount and the peak output solar panel be when the sun position perpendicular on solar panel surface.

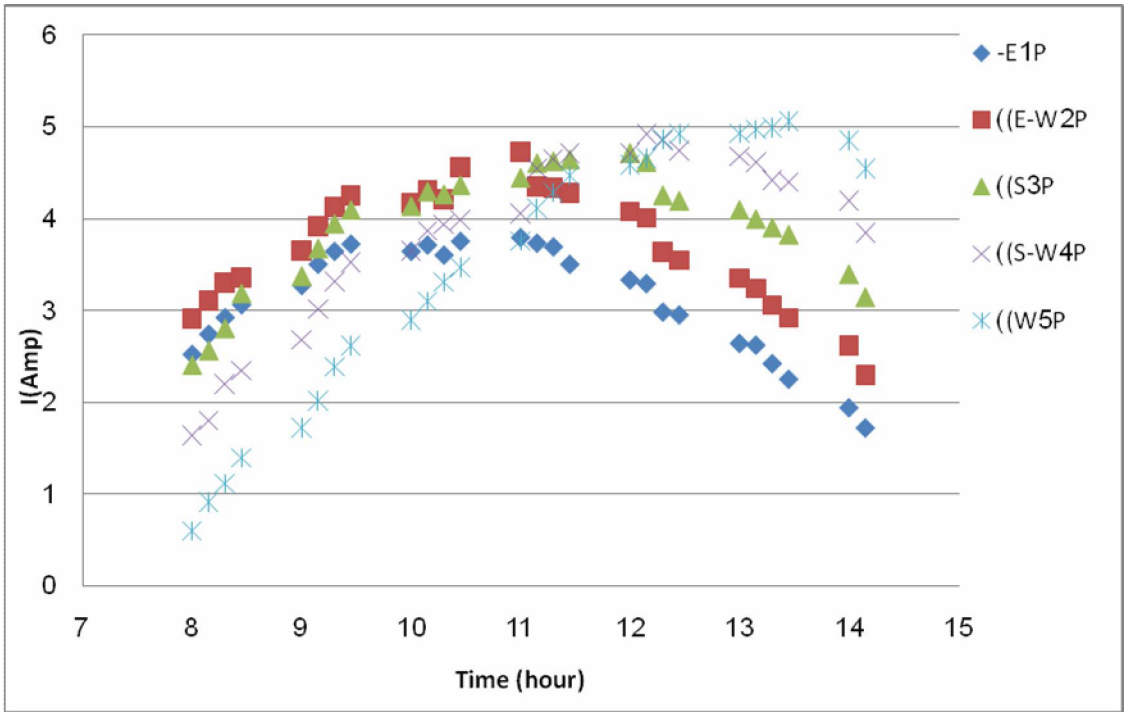

Fig (7) shows the output solar panels (current) with the time

Conclusions:-

From these result we have noticed that the output to the solar panel change for all solar panels are dependent on the amount of solar radiation because difference the facing between the sun and solar panel surface the panel on the east facing be low power output because the solar radiation be low dependent on air mass amount and the panels output facing to south - west , west be like to east panel because not be facing to sun in the mourning , the best facing orientation panel be in three facings (south , south - east and south - west) the peak output power solar panel be in south facing orientation because the sun path be proportionally perpendicular to solar panel to anther solar panels , from this curve there is some dip because there is some of pieces clouds in atmosphere causes attenuation solar rays.

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الاتجاه الأمثل لصفائح الخلايا الشمسية

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الخلاصة :-

في هذا البحث تم التحقق من الاتجاهات الصحيحة في تثبيت اللوح الشمسي للحصول على اعظم قدرة ومن ثم الحصول على أفضل توجيه للوح الشمسي لمدينة بغداد من خلال اختيار خمس اتجاهات للوح الشمسي (الشرق ، الجنوب الشرقي ،الجنوب ،الجنوب الغربي ،الغرب) .

ومن خلال االنتائج العملية تبين ان وضع الجنوب هو أفضل وضع لتنصيب اللوح الشمسي للحصول على اعظم قدرة من اللوح الشمسي .