Solar Tracking System

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Abstract- Solar tracker is a unique invention for next solar power generation. It is device which is the integration of smaller mechanical components specifically designed to generate higher efficiency in solar energy with respect to other solar energy devices such as solar panels, dry cells etc. It approximately tracks 30 to 40% solar energy more than the devices mentioned above. The solar tracker will increase the energy output of PV array 30% - 50% compared to the fixed PV array with the same rated output power. Currently solar cells are becoming extremely popular for utilizing solar energy to use different ways such as producing electricity, transportation etc. So many solar panels have been installed all over world and most of them are stable. They are installed in the direction of maximums radiation on sun light. But now the problem arises that the sun is moving. So, we cannot use maximum radiation receiving position only comes once in 24 hours. Solar tracker is the best solution for maximum radiation. By moving the solar panel to the movement of sun, we can always receive the maximum radiation. So, we have come up with an innovative idea for tracking, we have used the principle of dynamic balancing of weights (attached on both ends of solar panel) in order to track the sun. This makes our project quite simple, cost effective and practical one and has much scope in future for further development.

Keywords: Solar Tracker, PV Array, Dynamic Balancing Of Weights.

1. INTRODUCTION

One of the most promising renewable energy sources characterized by a huge potential of conversion into electrical power is the solar energy. The conversion of solar radiation into electrical energy by Photo-Voltaic (PV) effect is a very promising technology, being clean, silent and reliable, with very small maintenance costs and small ecological impact. The interest in the Photo Voltaic conversion systems is visibly reflected by the exponential increase of sales in this market segment with a strong growth projection for next decades. According to recent market research reports carried out by European Photovoltaic Industry Association (EPIA), the total installed power PV conversion equipment increased from about 1GW in 2001 up to nearly 23 GW in 2009.

The continuous evaluation of the technology determined a sustained increase of the conversion efficiency of PV panels, but none the less the most part of the commercial panels have efficiencies no more than 20%. A constant research preoccupation of the technical community involved in the solar energy harnessing technology refers to various solutions to increase the PV panel's conversion efficiency. Among PV efficiency improving solutions we can mention: solar tracking, optimization of solar cells geometry, enhancement of light trapping capability, use of new materials etc. The output power produced by the PV panels depends strongly on the incident light radiation.

The continuous modification of the sun earth relative position determines a continuously changing of incident radiation on a fixed PV panel. The point of maximum received energy is reached when the direction of the solar radiation is perpendicular on the panel surface. Thus, an increase of the output energy of a given PV panel can be obtained by mounting the panel on a solar tracking device that follows the sun trajectory. Unlike the classical fixed PV panels, the mobile ones driven by solar trackers are kept under optimum insulation for all positions of the Sun, boosting thus the PV conversion efficiency of the system. The output energy of PV panels equipped with solar trackers may increase with tens of percent's, especially during the summer when the energy harnessed from the sun is more important. Photo-Voltaic or PV cells, known commonly as solar cells, convert the energy from sunlight to DC electricity. PVs offer advantages over the other renewable energy sources in that give off no noise and require practically no maintenance. A tracking system must be able to follow the sun with a certain degree of accuracy, return the collector to its original position at the end of the day and tracks during periods of cloudy over.

2. PRINCIPLE: -

The energy output of a PV panel changes based on the angle between the panel and the sun. The angle at which the sun hits a PV panel determines its efficiency and is what engineers use in the design of an efficient PV array for a specific location.

Tracking systems continually adjust the angle and direction of their solar panels to achieve the greatest potential harvest at all times by literally tracking the sun's movement across the sky. This inherent advantage can net a 40% greater efficiency than traditional static systems, resulting in fewer panels (and in some cases arrays) needed to meet a particular energy requirement. One more additional innovation is there in the project, as we are using water to track the sun means at the end of day the filled tank may fully empty so one can say that the water is wasting or its daily work to fill the tank and give the start to tracker, so to have an answer for the question Why I fill the tank daily? So, we are incorporating the water filter in the dripper mechanism so water removing from the tank may get filtered.As by Lambert's co-sine rule for total incident radiations on surface area, the intensity of that radiations is given by following equation,

$$In = I \times \cos \Theta$$

Where, In= normal intensity of incidence radiations,
I= average intensity of radiations,
Θ= angle of incidence.

According to above equation, if we make that angle exactly or nearly equal to 0 degrees (with vertical and incident radiation), we can get maximum intensity of radiation and hence can obtain maximum power from solar panel.

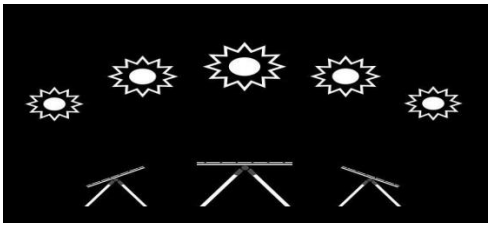


Fig. 1. Tracking positions

3. WORKING:

Figure 2 gives the details about the working of the project, also below are few simple steps that could explains the working of the project.

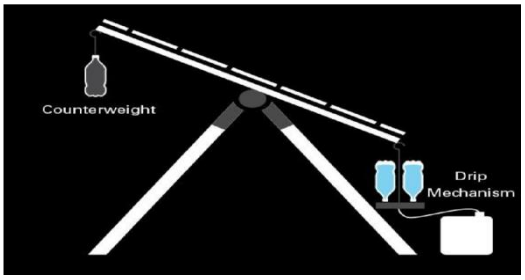


Fig. 2. Working

- Collect 20liters of Water.
- Setup water tanks into a drip mechanism.
- Adjust the flow rate.
- Attach counterweight to other side.
- As the water drips from the can and gets filtered, the mechanism tracks the sun.
- At the end of the day you have 40% more power and filtered water.

4. DESIGN& ANALYSIS:-

Design parameters

1. Base stand
2. Shaft.
3. Frame and support

Design of Column with Both End Fixed:

Let,

P = crippling load at which column just buckled.

E = modulus of rigidity.

I = mass moment of inertia.

L_e = effective length of column.

Frame (vertical support) is designed by using crippling load theory. Total load to carry by support is about 60 kg, so by crippling load.

$P=\pi^2EI/Le^2$

(E=2.1E5N/mm2 for M.S bar, Le= effective length= L/2)

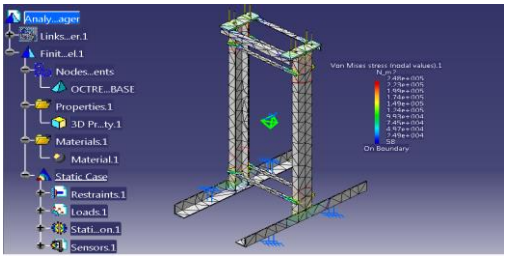
So the by using crippling load theory,

We get the crippling load =823.21N

Hence the vertical column is safe under buckling, so for considering optimum safety of the components the dimensions are kept as below:

- Base = L section of 0.61m in length and 0.9 m distance between two L section
- Vertical column =C-section of width 76.2mm* side length 38.1mm.
- Height from ground is 1200mm.

- Analysis of base stand on CATIA V5



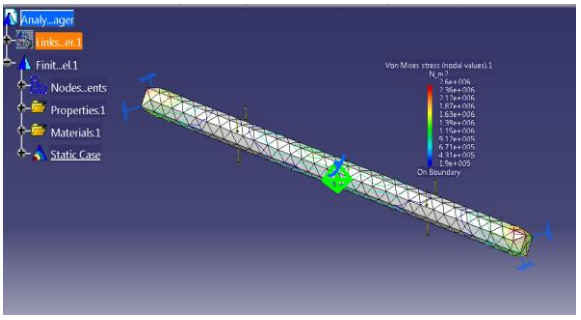
From the above analysis we can conclude that the design for base stand is safe under the buckling load as desired for our application.

Shaft Design:-

For ductile material, the design by maximum shear stress theory is on safer side. Therefore maximum shear stress theory is most widely used while designing shaft.

But for ductile materials the distortion energy theory is very accurate. Therefore distortion energy theory is used for designing shaft when very accurate results are required

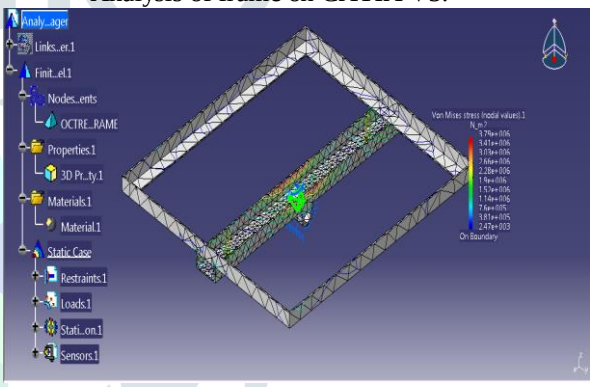
Analysis of shaft in CATIA V5



The same analysis was also made on CATIA V5. Analysis results verify that the stresses generated in our shaft are very less than yield strength and thus our shaft is safe for required application.

Frame and Support:-

Analysis of frame on CATIA V5.



We have done the analysis of FRAME on CATIA V5. We loaded the frame with 200N point load on each end and performed analysis.

From Analysis results above shown, we conclude that our frame is safe for application as desired.

5. ADVANTAGES: -

- Produces 40%more electricity per day.
- Powered by water displacement.
- Filter's at least four liters of water per day.
- Easy assembly and maintenance.
- Inexpensive.
- Helps to earn carbon credits.

6. APPLICATIONS: -

- The Solar Tracking System has the following applications: -
- The Solar Tracking system can be utilized for tracking the sun and thus pointing the solar panel at the point of maximum solar intensity.
- Off-grid areas can be effectively electrified.
- Most efficient for pumping water and other agricultural applications.
- Governmental schools, hospitals etc. can effectively use and thus help in improving their carbon image.

7. CONCLUSION: -

The Sun Follower supports impoverished communities in meeting their need for both electricity and clean water. Using the weight displacement of water passing through the filter, a Sun Follower rotates solar panels throughout the day, to optimize energy collection by up to 40 percentage. Now, a

family that an struggled with limited electricity an insufficient clean water has both.

From the design of experimental setup with Solar tracking system using dead weight. If we compare tracking using mass imbalance with fixed solar panel system, we predicted that the efficiency of solar tracking system is improved by 30-40% and it was found that all the parts of the experimental setup are given the good results. Moreover, this tracking system does track the sun in the continues manner. And this system is more efficient and low-cost effective in long run. From the result it is found that, by automatic tracking system, there is 30% gain in increase efficiency when compared with non-tracking system. Even purification of water can be achieved.

8. FUTURE SCOPE: -

The goals of this project were a purposely kept within what was believed to be attainable within the allotted timeline. As such, many advance improvements can be made up of initial design of solar tracker. It is felt this design represents a functioning scale model which could be replicated for a much larger scale. following recommendation are provided as ideas for future expansion for this project.

- We can use wood and other locally available materials instead of Mild steel and thus reduce the cost further.
- A spring of appropriate stiffness could be designed to avoid sudden jerks.
- Provisions for safety of solar panels from rain.
- More accuracy can be achieved by providing measures against wind vibrations

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