

# Design and Simulation of Solar Parabolic Collector Dish for Stirling Engine

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**Abstract:**In the modern world, the demand for power has been increasing drastically and the use of conventional energy as power source has been increased. But as time passes the source of energy is decreasing as it is non-renewable. So, to meet the demand renewable source of energy like solar, wind, hydro has come under these circumstances. For power production use of IC engine has played an important role but due to decrease in fuel availability it has been challenge for people to overcome this problem. Use of solar as power source will replace the fuel for power production. To run an engine through solar power will be like producing power from infinite source. Use of stirling engine which runs on stirling cycle will fulfill the requirement of power, sterling cycle works on temperature gradient principle. In which one end is hot end which is at high temperature while other end will be at lower temperature known as cold end. Due to temperature gradient the gas which are filled inside the cylinder will be use to run the engine. In this way power can be produce by a stiring engine.

**Keywords —Solar energy, Stirling engine, Parabolic Collector Dish.**

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## I. INTRODUCTION

With the increase in the power requirement in various commercial & non-commercial fields, our limited conventional power resources such as coal & petroleum aren't able to satisfy our needs in nearby future which can also lead to huge loss in financial sectors. We had selected a very prone source of the field where we can use our upcoming technology which is concerned about creating pressure headsthat can be used in industries such as agriculture, chemical & fluid-based sectors. In, this article we are going to discuss our main innovation which is coupling a solar dish concentrator with a conventional Stirling Engine which in the end is going to be coupled to a hydraulic pump. Perhaps we can also use this innovation wherever there is a requirement for power generation. In India, many rural areas in India are still suffering from a lack of access to energy services for water pumping, especially electricity supply. Solar energy could play an important role to supply electrical energy

needed in rural, remote, and deserted areas for electrification. Similarly, solar energy can be used for pumping water in areas where electricity is not available. This project is a revolutionary concept in the energy sector.

## II. METHODOLOGY

Various parameters and specifications had been thoroughly referred by our team for the proper analysis and creation of this innovative concept which is going to be the revolutionary step in the field of the energy sector while referring to various literature related to this subject matter.

Solar Energy is one of the most available sources of the natural free form of energy, hence using an autonomous machine can be used in our product, the main focus of our project is how can we generate the max output of this solar energy and develop max power out of for further operations. Here we

are using a solar parabolic dish collector which continuously concentrates the solar rays at an auxiliary focal point where the hot end of the Stirling Engine is being placed on a reciprocating bar which continuously helps our system to generate max output irrespective of the sun position

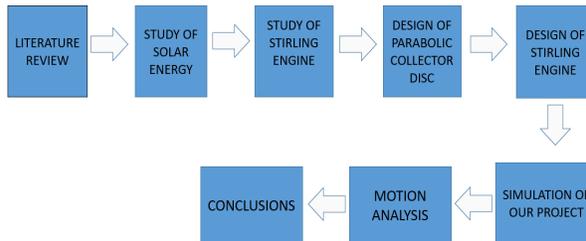


Fig 1. Methodology

Study of the Stirling Engine is thoroughly done by our team in the previous semesters and generated optimum temperature & efficiency relations which we can use in our product for generation of a particular locus of focal points where we can get max temperatures at the hot end the efficiency can be boosted to the maximum value resulting in quicker cost back of the investment done.

### A. Literature Review

This project tried to get optimum energy from solar energy as a primary source by tracking solar by LDR software so to get the basic idea and to know the basic functions of our system we have to go through various literature from where we came to know about different aspects like design, Simulation, temperature, etc of parabolic dish collector for Stirling engine

### B. Study of Solar Energy

To obtain power from renewal energy Solar is best in all fields and easily available. So to get solar energy firstly we have studied the nature,

requirements, efficiency, limitations, etc of solar energy

### C. Study of Stirling Engine

Our main focus to generate power is by Stirling engine as compare to ic engine Stirling engine has various advantages and to use that we studied the functions, working, limitations, advantages, application of Stirling engine

### D. Design of Parabolic Collector Disc

For focusing solar energy at Stirling engine are of many types like trough shape, circular shape, semicircular, etc.

But we choose parabolic collector dish as it has many advantages like easy handling, fast response, fewer space requirements. But one of the main advantages is its concentration factor as its only focus on one point and its the main requirement for the Stirling engine.

For the design of the parabolic collector dish we have used Solidworks software in which based on required dimensions and shape we had applied various loads like gravity, wind load, etc. Stimulation obtained in Solidworks is as shown in fig.2

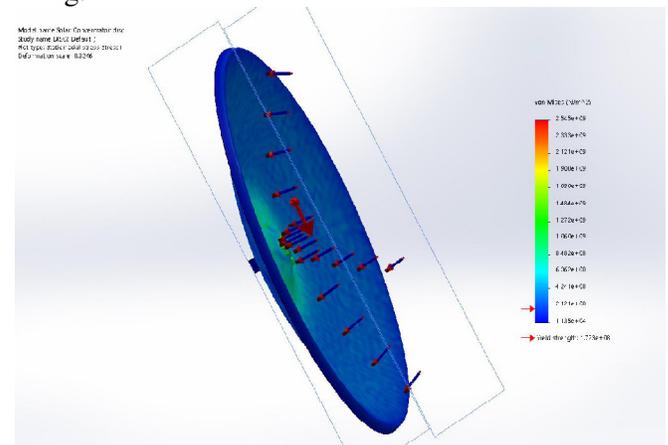


Fig 2. Simulation of parabolic dish Collector

### E. Design of Stirling Engine

Alpha type Stirling engine is been designed based on dimensions in Solidworks also the maximum power and efficiency which must be produced by this engine are considered.

### F. Simulation of Our Project

In this stage after the design of our whole system stress-strain simulation is been performed on each component. Different types of load and its different magnitude are applied on components like parabolic collector dish, support stand, and Stirling engine components.

### G. Motion Analysis

Motion analysis is performed on Solidworks through different inputs value and its performance is been noted out. A various graph like Power consumption vs time, Linear velocity vs time, angular velocity vs time, torque vs time is been plotted.

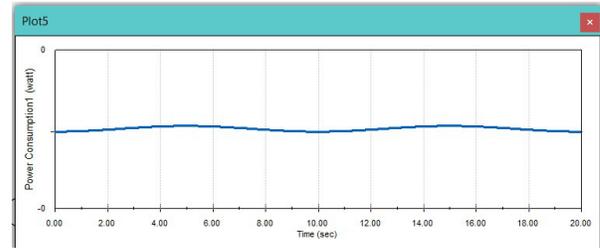


Fig 5. Power Consumption Vs Time Graph

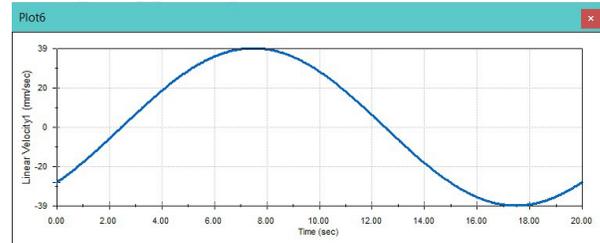


Fig 6. Linear Velocity Vs Time Graph

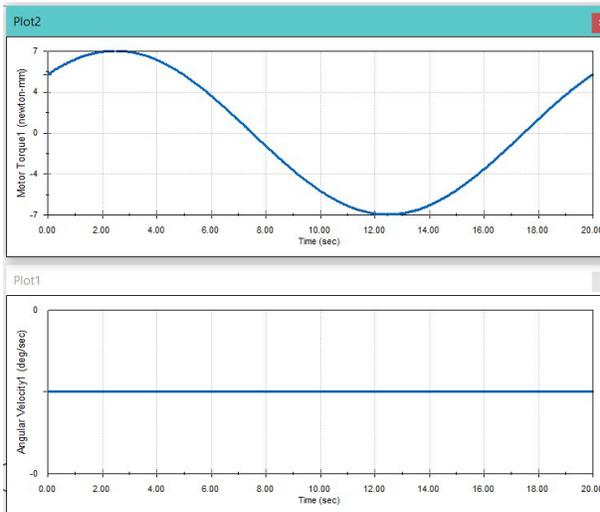


Fig3. Motor Torque Vs Time Graph

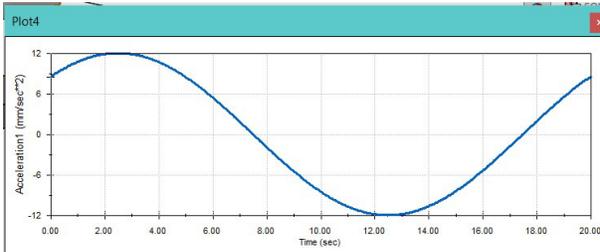


Fig4. Acceleration Vs Time Graph

### III. CONCLUSIONS

In this project, we have achieved a system that generates maximum power by optimizing solar power consumption. We have successfully Design and simulated the parabolic collector dish for the Stirling engine in which various stress is generated by the cause of different loads.

### REFERENCES

- [1] M. Kordab, Priority option of photovoltaic systems for pumping in rural areas in ESCWA member countries, *Science Direct, desalination*, 209, 2007, 73-77.
- [2] G. Walker, *Stirling engine* (Oxford Clarendon Press, Calgary).
- [3] W. B. Stine, *Stirling Engines*, (CRC Press, Boca Raton, 1998).
- [4] M. J. Dadi, I. M. Molvi, A. V. Mehta, The most efficient waste heat recovery device: a gamma type Stirling engine, *International journal of advanced*

*engineering technology*, January – March, 2012,  
189 – 195.

[5] G. Cronenberg, *the Stirling Engine*, Uppasala University, 2005.

[6] B. Kongtragool, S. Wongwises, A review of solar powered Stirling engines and low temperature differential Stirling engine, *Science Direct renewable and sustainable energy*, 7 ,2003, 131 – 154.

[7] D. Aranda, K. LaMott, S. Wood, *Solar*

[8] A. Asnaghi, S. M. Ladjevardi, P. Saleh Izadkhast, and A. H. Kashani, Research Article Thermodynamics Performance Analysis of Solar Stirling Engines

[9] Aditya A1 , Balaji G2 , Chengappa BC3 , Chethan Kumar K4 Dr. S A Mohankrishna5, Design and development of Solar Stirling Engine for power generation

[10] Department of Mechanical Engineering, Technological University, Design of Single Suction Centrifugal Pump and Performance Analysis by Varying the Speed of Impeller

[11] Rakesh K Bumataria, Review of Stirling Engines for Pumping Water using Solar Energy as a source of Power