

Design And Development Of Savonius Hydro – Kinetic Turbine

Mr. Pravin Renuke, Laukik Bhanu, Tejus Bagul, Ashutosh kadam, Saurav Sontakke

1. Mr Pravin Renuke, Head Of Department Mechanical Engineering, Sanghvi College of Engineering

2. Mr Laukik Bhanu, Student, Mechanical Engineering, Sanghvi College of Engineering

3. Mr tejus Bagul, Student, Mechanical Engineering, Sanghvi College of Engineering

4. Mr Ashutosh Kadam, Student, Mechanical Engineering, Sanghvi College of Engineering

5. Mr Saurav Sontakke, Student, Mechanical Engineering, Sanghvi College of Engineering

Abstract - The contribution of renewable energy in the global electricity production is 26.2% of which 15.8% is the share of hydropower (REN21, 2019).

Hydropower is the largest contributor in renewable energy but has various negative impacts on biodiversity and now-a-days, society aims to produce energy in an efficient and sustainable manner. This is the reason that growth rate of large hydropower is reduced. But unlike solar and wind, hydro is 24X7 available, reliable and predictable source of energy and therefore instead of out-looking this source, it is better to utilize the water energy more effectively. Small hydropower has been evolved as a solution to the adverse impact of large hydropower on the environment. In small hydropower, energy can be harnessed by static and kinetic method. Energy is harnessed by creating water head in static method and using flow velocity in kinetic method. Now-a-days hydrokinetic technology is growing extensively and emerging as a promising technique which utilizes the flow velocity for the energy generation. In the present study, an attempt has been made to savonius hydrokinetic turbines with the aim to develop hydropower as low head turbines. The methodology of the study comprises of five steps involving data collection from the study area, turbine designing, numerical simulation followed by post processing and analysis of the results.

Key Words: low head, hydrokinetic, savonius turbines, hydropower.

1.INTRODUCTION

Almost throughout the year, consistent water currents are observed in rivers or canals in most of the parts of India. However, development towards the use of kinetic energy from river currents is not explored substantially in India. Development of electricity from the water current of river may become one of the best renewable sources as it is predictable compared to wind or solar energy. Hence, there is a need for a simple hydro turbine which can take advantage of these naturally available sources. This type of run of the river hydroelectricity

systems utilizes kinetic energy from rivers or canal water-flow, which does not require huge dams. Strong candidate for the utilization of these hydropower sources is Savonius turbine because of its simplicity in construction and better starting torque. It is made of two or more semicircular vanes (or blades) attached to a vertical shaft. It can be used as standalone plant at remote locations away from the power grid and nearer to the water current source.

2.NEED STATEMENT

Energy needs of today are incessant and their thirst cannot be quenched only through fossil fuel based non-renewable energy resources. India's capacity for renewable energy in the hydro power sector has been pegged at about 84,440 MW but we have only been able to access about 1/4th of this capacity. Hydro power on the other hand also has a lot of tenacious environmental impacts, discuss and design a different way to access and harness the enormous renewable capacity in the rivers of India with minimal environmental impact. Comprehend this design on the parameters of economical, efficiency, and sustainability. India has a lot of small rivers and canals which have low heads and thus are inefficient to be used in high head power generation and thus the possible ways to harness this renewable energy.

3.OBJECTIVES

1. To use the low head of minor tributaries and canals to generate electricity for supporting the rural population.
2. Design and development of compact hydrokinetic turbine.
3. Study the properties of this design and compare it on the bases of cost, efficiency and environmental impact.
4. To record and analysis the characteristics of this turbine with respect to power and efficiency.
5. To analyze the cost pro-efficiency and the payback period for the demonstrated piece and use that analysis to support the commercial viability claim for the technology.

4. LITERATURE REVIEW

Imron Hamzah, Ari Prasetyo, D. D. D. Prija Tjahjana, Syamsul Hadi, done the work on, Effect of Blades Number to Performance of Savonius Water Turbine in Water Pipe, according to his work, Savonius is usually known as a wind turbine that works efficiently at low wind speed. In this research, the Savonius turbine is proposed for a pico hydro power plant that is installed straightly on the 3-inch vertical pipeline of rainwater and household waste. The Savonius water turbine was designed with blade curvature angle of 70° , the aspect ratio of 1, turbine diameter of 82 mm, and endplate ratio of 1,1. The experimental study investigated the effect of blades number to the performance of Savonius turbine on various volume flow rate of water. Savonius turbine with three blades number generated the highest coefficient of performance of 0.23 on tip speed ratio of 1.7 compared to turbines with the number of other blades. Rainwater and household waste at the high rise building which is commonly just wasted without first being used have a great potential as an energy source for a power plant. The water which flows only by gravitational force has a bigger momentum than air, so it has a higher capability to directly move a turbine connected to a generator. Another while application of the wind turbine as a water turbine becomes an interesting topic of research recently. For example, the Savonius turbine is commonly known as a Vertical Axis Wind Turbines (VAWT) which is recognized to be able to work efficiently in a low wind speed. Various methods have been conducted to raise the performance of Savonius turbine. Research which compared a 2-blade Savonius wind turbine with a semi cylindrical blade type from 3-blade Savonius wind turbine of the same blade type was conducted.

5. SYSTEM DEVELOPMENT

5.1 System Overview

The aim of this project is to generate electricity from the kinetic energy of flowing water in rivers and canals without using dams. We designed a two-blade Savonius turbine made from PVC blades mounted on a vertical shaft. When water flows, the turbine rotates and drives a DC generator to produce electrical power. The generated energy can be stored in a battery and used for rural electrification, street lighting, irrigation systems, and other low-power applications. This system is low-cost, eco-friendly, easy to manufacture, and suitable for remote areas. Our prototype successfully generated around 2 to 3 watts of power, demonstrating the potential of hydro-kinetic energy as a sustainable renewable energy source.

Sr. No	Components	Quantity
1	Storage Battery	1
2	DC Motors	1
3	PVC Blades	2
4	Ball bearings	2
5	Shaft	1
6	Spur gears	2
7	Fasteners	20
8	Supporting frame	1

5.1.1 Ball bearings:

This type of bearing consists of i) a cast iron pedestal, ii) gun metal, or brass bush split into two halves called “brasses”, and iii) a cast iron cap and two mild steel bolts. The detailed drawing of a pedestal bearing is shown in image below. The rotation of the bush inside the bearing housing is arrested by a snug at the bottom of the lower brass. The cap is tightened on the pedestal block by means of bolts and nuts. The detailed part drawings of another Plummer block with slightly different dimensions are also shown in image below.



5.1.1. Shaft:

Shaft is a common and important machine element. It is a rotating member, in general, has a circular cross-section and is used to transmit power. The shaft may be hollow or solid. The shaft is supported on bearings and it rotates a set of gears or pulleys for the purpose of power transmission. Material for Shafts is generally ferrous, non-ferrous materials and nonmetals are used as shaft material depending on the application.

Features include:

Low power consumption

Clear visual output

Compatible with microcontrollers



5.1.1. DC Motors:

A DC motor is a mechanically commutated electric motor powered from direct current (DC). The stator is stationary in space by definition and therefore so is its current. The current in the rotor is switched by the commutator to also be stationary in space. This is how the relative angle between the stator and rotor magnetic flux is maintained near 90 degrees, which generates the maximum torque. DC motors have a rotating armature winding (winding in which a voltage is induced) but non-rotating armature magnetic field and a static field winding (winding that produce the main magnetic flux) or permanent magnet..



5.1.1 Turbine blade:

The number of blades is selected for aerodynamic efficiency, component costs, and system reliability. PVC is generally used material for Turbine blade.



6. WORKING PRINCIPLE

Hydro power is energy from the water flow. It is renewable, inexhaustible and environmental pollution free. Hydro power is a natural phenomenon related to the movement of water masses caused. The Hydro power turbine captures the water kinetic energy in a rotor consisting of two blades mechanically coupled to an electrical generator. The turbine is mounted on a top of the frame to enhance the energy capture.

In the proposed Savonius Hydro-Kinetic Turbine model, a charge controller is used to regulate the power generated by water turbine. It also simultaneously charges battery and gives power to the load. The controller has reverse current protection and short-circuits protection. A specifically chosen battery is used to store the generated power. In this present project we will make two blade type savonius turbine to test the performance of the Savonius Hydro-Kinetic Turbine.

7. RESULTS AND DISCUSSION

Overcoming disadvantages of standalone renewable electrical energy generation system.

Producing much more efficiency as renewable energy generation system.

Since, the system doesn't complexity of system testing and understanding became easy in terms of difficulties.

System maintains is remarkably reduced and becomes easy.

Wind as a renewable energy sources are utilized so, no waste production.

Producing clean, friendly to environment, renewable energy.

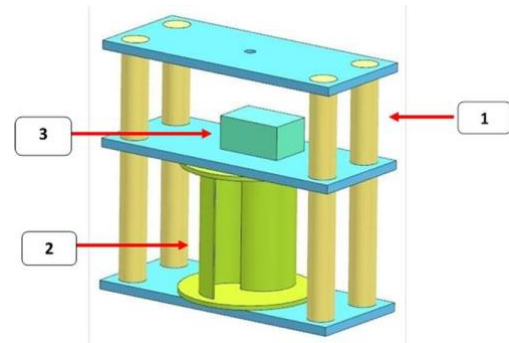
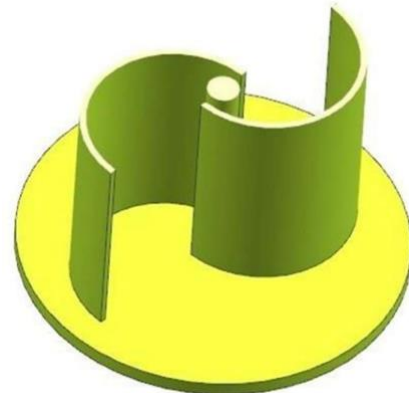


Fig. Proposed Model.

1. Support structure.
2. Savonius Turbine.
3. Generator Casing.



8. CONCLUSIONS

While concluding this report, we feel quite fulfill in having completed the project assignment well on time, we had enormous practical experience on fulfillment of the manufacturing schedules of the working project model. We are therefore, happy to state that the in calculation of mechanical aptitude proved to be a very useful purpose. Although the design criterions imposed challenging problems which, however were overcome by us due to availability of good reference books. The selection of choice raw materials helped us in machining of the various components to very close tolerance and thereby minimizing the level of balancing problem. Needless to emphasize here that we had lift no stone unturned in our potential efforts during machining, fabrication and assembly work of the project model to our entire satisfaction. Here the project model will capable to produce power 2-3 watt per sec. The model develops by us fulfill the required objectives that it will produce near about 3 watt power & hence we are satisfied with our project work.

REFERENCES

- [1] Imron Hamzah, Ari Prasetyo, D. D. D. Prija Tjahjana, Syamsul Hadi, Effect of Blades Number to Performance of Savonius Water Turbine in Water Pipe, The 3rd International Conference on Industrial, Mechanical, Electrical, and Chemical Engineering, AIP Conf. Proc. 1931, 030046-1–030046-4; pp.1-5.
- [2] Ibrahim Mabrouki, Zied Driss, Mohamed Salah Abid, Performance Analysis of a Water Savonius Rotor: Effect of the Internal Overlap, Sustainable Energy, 2014, Vol. 2, No. 4, 121-125 Available online at <http://pubs.sciepub.com/rse/2/4/1> © Science and Education Publishing DOI:10.12691/rse-2-4-1
- [3] Dandun Mahesa Prabowoputra, Syamsul Hadi, Jung Min Sohn, and Aditya Rio Prabowo, Research Article- The effect of multi-stage modification on the performance of Savonius water turbines under the horizontal axis condition, Open Eng. 2020; 10: pp.793–803.
- [4] H. Elbatrana, Mohamed Walid Abdel-Hameda, O. B. Yaakobb,c, Yasser M. Ahmed, M. Arif Ismail Hydro Power and Turbine Systems, Reviews Jurnal Teknologi ,74:5 (2015) 83–90 | www.jurnalteknologi.utm.my | eISSN 2180–3722 |,pp.83-90.
- [5] Golecha Kailash, T. I. Eldho, and S. V. Prabhu, ,Research Article- Performance Study of Modified Savonius Water Turbine with Two Deflector Plates, Hindawi Publishing Corporation, International Journal of Rotating Machinery, Volume 2012, Article ID 679247, pp.1-13.
- [6] Anuj Kumar a, Gaurav Saini, Flow field and performance study of Savonius water turbine, Materials Today: Proceedings Contents lists available at Science Direct August 2020, pp.1-5.
- [7] Bagus Wahyudi, Wirawan , Sarjiyana , Moh. Hartono , Satworo Adiwidodo, The Experimental Study of Hydrokinetic Cross Flow Savonius Horizontal Axis Turbine (CROSSHAT TURBINE), International Journal of Mechanical Engineering and Robotics Research Vol. 8, No. 6, November 2019, ,pp.966-971.
- [8] Armand Z. Anthony and Sukanta, Performance analysis of a modified Savonius hydrokinetic turbine blade for rural application Roy, 2nd International Conference on Materials Technology and Energy IOP Conf. Series: Materials Science and Engineering 943 (2020) 012034, pp.1-11.