e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:04/Issue:04/April-2022 Impact Factor- 6.752 www.irjmets.com

DESIGN & DEVELOPMENT OF SAVONIOUS HYDRO KINETIC TURBINE

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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 outlooking this source, it is better to utilize the water energy more effectively. Small hydro power has been Evolved as a solution to the adverse impact of large hydro power on the environnent. In Small hydro power, energy can be harnessed by static and kinetic method. Energy 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.

Keywords: Savonius Turbine, Tidal Energy, Torque Coefficient, Thrust Coefficient, Power Efficiency.

I. INTRODUCTION

Development of 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, with the help of Savonious Hydrokinetic Turbine it is possible to generate the electrical power for much more applications. Electricity from the water current of river may become one of the best renewable.

II. METHODOLOGY

1. To use the low head of minor tributaries and canals to generate electricity for supporting the rural population
2. Design & development of compact Hydro-Kinetic 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

1. Review Stage-

1. Anurag kumar, Dr. R. P. Saini, 2011-Development of Hydrokinetic Power Generation System [Hydrokinetic energy harnessing for river application.]
2. L.C. Emea, J. A.Ulasib, A. I. Alade Tundec and A. C. Odunze, 2019-Hydrokinetic turbines for power generation [This research proposes a novel system configuration to capture as much as kinetic energy from stream water current.]
3. W.I. Ibrahim , R.M.T.R. Ismail and M. R. Mohamed, 2020- Hydrokinetic Energy Harnessing for River Application [Development on Hydro power generation. Velocity and performance correction methodology]
4. Armand Z. Anthony and Sukanta Roy, 2020- Performance analysis of a modified Savonius hydrokinetic turbine blade for rural application [WIT Transaction on ecology and the environment.]

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2. Selection of Components-

Table: Components Table

Sr. No	Components	Quantity
1	Storage Battery	1
2	Alternator (Servo motor)	1
3	Fasteners	6
4	Pillar Bearings	2
5	Shaft	1
6	Solar Charging Circuit	1
7	Step up circuit	1
8	Supporting Frame	1

3. System Design-

System design mainly concerns with various physical constrains, deciding basic working principle, space requirements, arrangements of various components etc. Following parameters are looked upon in system design. Selection of system based on physical constraints. The mechanical design has direct norms with the system design hence system is designed such that distinctions and dimensions thus obtained in mechanical design can be well fitted in to it Arrangement of various components made simple to utilize every possible space. Easy of maintenance and servicing achieved by means of simplified layout that enables quick decision assembly of components Scope of future improvement.

4. Proposed Method-

- 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. In this proposed Savonius Hydro-Kinetic Turbine model. We will make two blade type savonius turbine to test the performance of the Savonius Hydro-Kinetic Turbine.
- The Hydro power turbine captures the water kinetic energy in a rotor (which is also known as Propeller) consisting of two blades mechanically coupled to an electrical generator. The alternator (stepper motor) is mounted on a top of the frame to enhance the energy capture. Alternator is connected to the solar charging controller with charging led indicator.
- 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.
- This 12volt storage battery is connected to step-up circuit which have property to increase voltage output after receiving lower input, which is 240v in proposed project model. The basic energy need of any household is obtained by using this turbine.

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III. MODELING

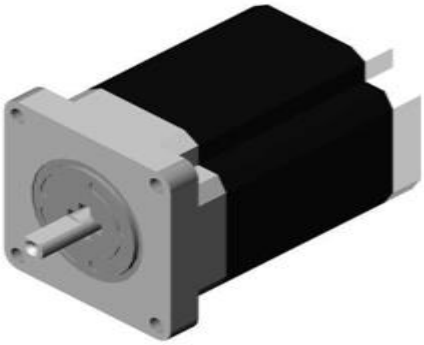

Fig: 3.1.Alternator

Fig: 3.2.Propeller

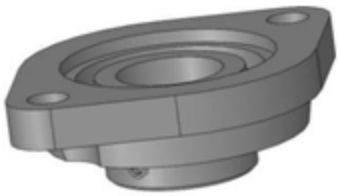

Fig: 3.3.Pillow Type Bearing

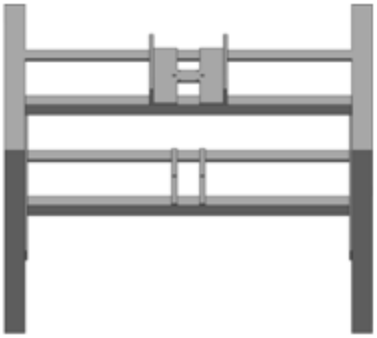

Fig: 3.4.Frame

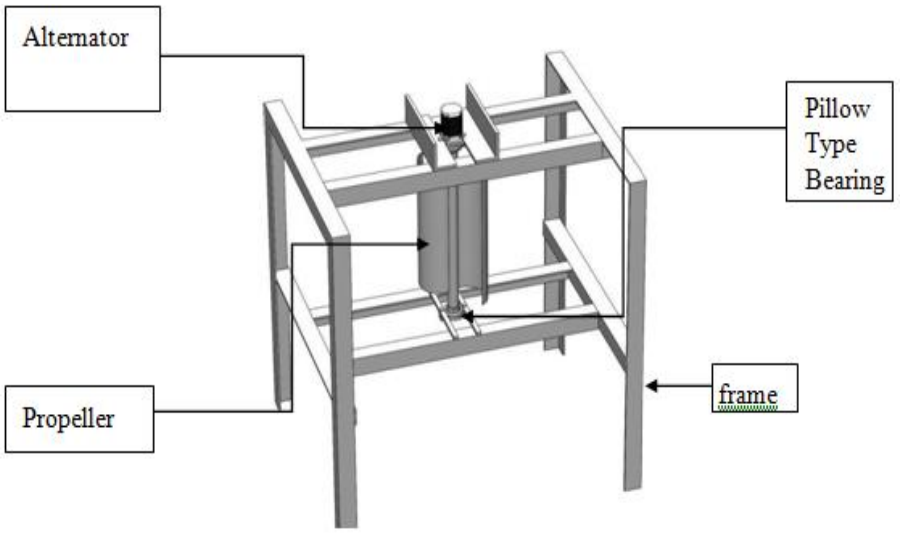

Fig: 3.5.proposed model

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IV. RESULTS AND DISCUSSION

Calculations for power output-

The linear velocity of water to travel 10 meter flow.

T1=76.87 Sec.

T2=78.82 Sec.

T3=72.20 Sec.

T4=75.18 Sec.

T5=77.12 Sec.

T_{avg} =76.03 Sec.

We know that,

Velocity = $\frac{Dist.}{Time}$

$= \frac{10}{76.03}$

v = 0.1315 m/sec. (Actual velo.)

Speed of turbine is 120 rpm.

Angular Velocity of turbine is,

$\omega = \frac{2x\pi x120}{60}$

$= \frac{2x3.14x120}{60}$

ω = 12.56 rad/sec.

Radius of turbine r=20cm=0.2m

Diameter of water wheel D=40cm=0.4m.

Hn = Net Head =30cm=0.3 m

Area of c/s of water napped through water in river. (Rectangular Canal.)

A = b x d

=10 x 0.3

A = 3 m^2

Discharge of water through river.

Q = A.V_{act}

= 3 x 0.1315

Q = 0.3945 m^3/s.

Normal Thrust exerted by water on turbine blade.

$F_n = \rho A(V - u)^2$

$= 1000 \times (3) \times (0.1315 - 0)^2$

F_n = 51.87 N

Mass Flow rate of water through river.

M = pAV

= 1000 x 3 x 0.1315

m =394.5 kg/s.

Mass Flow rate of water through river in each Second.M = 394.5 kg

Kinetic Energy of water through canal.

K.E. = 1/2 mv^2

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$= \frac{1}{2} \times 394.5 / 9.81 \times 0.1315^2$

K.E. = 0.3476 N

Power transmitted to turbine by the water.

P = ρQg*Hn*.

= 1000x 0.3945 x 9.81 x 0.3

P = 1161.01 Watt

Center distance of water wheel R= 20mm= 0.02m.

Normal Thrust exerted by water on turbine blades. Fn= 51.87 N

T =F * R

= 51.87 *0.02

T=1.0374N.m.

We know that,

$P = \frac{2\pi nT}{60}$

$P = \frac{2\pi \times 120 \times 1.0374}{60}$

P = 13.036 Watt.

Power Transmitted to alternator by turbine propeller rotation of **120 rpm** is **13.036 Watt.**

V. CONCLUSION

In addition, a turbine has history with pro and cons some see a great benefit some might go for other power alternatives such as wind but it's a great invention and need for many people who now get their electricity from Water power. It is an environmental friendly method that helps reuse are carbon foot print on the environment. A water turbine can be uses for a renewable energy source and are designed to run for decades. They already produce significant amounts of the world's electrical supply, 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 emphasis 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 3-6watt per sec.

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