HARNESS THE ENERGY FROM DRAINAGE SYSTEM BY USING A PICO TURBINE (PICO TURBINE)

A Major Dissertation submitted

in partial fulfillment of the requirements for the award of the degree of

Master of Technology

In

Thermal Engineering

By

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Roll No. **2K12/THE/25**

Session **2012-15**

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STUDENT'S DECLARATION

I hereby certify that the work which is being presented in the manor project entitled **"HARNESS THE ENERGY FROM DRAINAGE SYSTEM BY USING A PICO TURBINE (PICO TURBINE)"** in partial fulfillment of the requirements for the award of the degree of Master of Engineering in Thermal Engineering, submitted to the Department of Mechanical Engineering, is an authentic record of my own work carried under the supervision of Dr.R.K.Singh Department of Mechanical Engineering , Delhi Technological University, Delhi.

I have not submitted the matter embodied in this major project as whole or in part, for the award of any other degree.

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M.Tech.(Thermal Engg.)
Session 2012-15

Date: ___________

CERTIFICATE

This is to certify that the Major Project Thesis entitled "**HARNESS THE ENERGY FROM DRAINAGE SYSTEM BY USING A PICO TURBINE (PICO TURBINE)**" which is being submitted by Shri KIRAT SINGH, is the authentic record of student's own work carried by him out under my guidance and supervision for partial fulfillment of the award of the degree of Master of Technology in Thermal Engineering, Department of Mechanical Engineering, Delhi Technological University, Delhi.

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ABSTRACT

In modern period, we require harnessing of energy from various possible opportunities in the living world, as non- renewable energy sources are limited and getting depleted day by day which need conservation and some new methods of unconventional energy resources for future. There is ample amount of energy available in the environment. But it is necessary the focus should there. The energy is available in the flowing water and the power was generated in the large amount but in this project the focus had been given on the harnessing energy from low amount of water. The elementary idea of the project i.e. harnessing energy from drainage system by using a cross flow pico-turbine. Which have usually minimum of i.e. a head of about .25 to 0.5 m for the discharge of the water coming out through the drainage system or the general irrigation systems . So in this project work the idea has been kept on focus that the energy must be harnessed whatever small amount that is it may be from 0.1 W -10 W.

So two small size runner diameter 225 mm and the width 100 mm, which are identical but in opposite blade type was assembled on a frame so that they can be installed in a open channel of irrigation system or the municipal drainage system channel. But there must be some flow velocity available.

In experiment the discharge was controlled by the sluice gate and the head was calculated with the upstream and down stream heads. The supply of water was done on a recirculation type experimental setup. The rpm of rotation was measured by using digital tachometer (rpm measuring device) and the torque was measured by rope brake dynamometer. Thus using this actual power was calculated and hence efficiency of the system was calculated.

The results of this project are not much interesting in testing the generated power was of an amount of .01 W. Since there was a heavy friction whose order was 2 W was present in the model. But it was observed that very small size turbine can be installed in the system where the head available is .5 m – 10 m and discharge from 2 litre/s to 50 lit/ sec.

The most advantageous thing about this project is that the cost of installation is very low. It is economical for a common man. The cost of the whole project is around Rs. 2000-5000. Not only this but also the method of installation of the project is very easy. The

system is completely pollution free and it is not dangerous in operation as it is a small system.

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Hydropower is another form of solar energy. Of the Sun's radiation that enters the Earth's atmosphere, about half is converted into heat directly at the Earth's surface, a quarter is reflected back into space, and the remaining quarter is spent in evaporating water, mostly from the oceans. It is this solar energy, converted into the latent heat of evaporation of water, that powers the hydrological cycle on which hydropower depends. Hydro-electricity is usually associated with the building of large dams. In the 20th century, hundreds of massive barriers of concrete, rock and earth were placed across river valleys worldwide to create huge artificial lakes. While they create a major, reliable power supply, plus irrigation and flood control benefits. In many cases, rapid silting up of the dam has reduced its productivity and lifetime. Hydropower on a small-scale, or micro-hydro, is the exploitation of a river's hydro potential without significant damming, and is one of the most environmentally benign energy options available.

Hydropower has various degrees of 'smallness'. To date there is still no internationally agreed definition of 'small' hydro; the upper limit varies between 2.5 and 25MW. A maximum of 10MW is the most widely accepted value worldwide, although the definition in China stands officially at 25MW. In the jargon of the industry, 'mini' hydro typically refers to schemes below 2MW, micro-hydro below 500kW and pico-hydro below 10 kW. This paper focuses mainly on schemes below 500kW, although this is an arbitrary division and many of the principles involved will also apply to larger schemes. Micro-hydro is in most cases 'run of river'; in other words, any dam or barrage is quite small, usually just a weir, and generally little or no water is stored. The civil works purely serve the function of regulating the level of the water at the intake to the hydro-plant. Therefore run-of-river installations do not have the same kinds of adverse effect on the local environment as large hydro. Micro-hydro started with the wooden waterwheel. Waterwheels of various types had been in use in many parts of Europe and Asia for some 2000 years, mostly for milling grain. By the time of the Industrial Revolution, waterwheel technology had been developed to a fine art, and efficiencies approaching 70 per cent were being achieved in the many tens of thousands of waterwheels that were in regular use.

It has been observed that the water is flowing in nature due to natural and artificial flow. But the natural resources are very less in the nature. The bigger hydro turbines can be installed only few places where the ample amount of water and head is present. But there are micro power plant (100 kW- 1 MW) are being installed in the hill area. In the plain and residential areas there is enough amount of water discharged in the drainage and that energy can be harnessed in many ways. The enough amount of energy is available in the metropolitan cities. It is obvious that the in the drainage system available head may be available of normal height of 0.3 - 2.5 m. But it is assumed that few Watt can be generated by using the hydro system.

There are different types of turbines and water wheel has been developed but it is very tough task in order to design and fabricate a Kaplan or Francis type runner for such a low head and it will not be prudential. So it was assumed to go for simpler water wheels. Since here efficiency is not a big issue so it can that the cross flow turbines.

Nowadays, developing countries are suffering from the problem of energy as there is raising cost of fuel and shortage of water is there. It is essential for us to seek this opportunity. But it can be observed that there are drainage is available in many areas, e.g. drainage system, canal flow etc.

CHAPTER 2

LITERATURE REVIEW AND RESEARCH OBJECTIVES

2.1 Literature Review

Chukwuneke *et. al* [1] has solved the power output of the Pelton wheel (turbine) for horizontal related gas Turbine and the efficient use of hydro (micro) electric power generation system. There is same analytical or simulation turbine results on Pelton turbine or head situation there is high head or low discharge flow. and deliver more energy on the blade. We consider the result by MATLAB some results show the volumetric flow rate decrease from 0.24 m^3/s to 0.6 m^3/s. They used water Jet to increase Turbine speed . And the shaft power also increased by their results .to Increase reservoir elevation and in that condition hydraulic power is decrease.

Dharmesh *et al*. [2] basically worked on the river current generation uses energy in that condition the kinetic energy of current into a turbine force by faked a water Turbine in the river current by the experiments kinetic energy from the canal is not explored by new experiment there is new and Innovative Arial there turbine is coming out in a market for utilization of canal current for flowing the fled exposer to effective utilization of Kinetic Energy of water resources available in India. It is inform of flowing river water or canal water by using new experiment or new ideas for axial flow hydraulic turbine. Our first motive to increase the performance of axial flow turbine for fled vane angle. This set up to use the axial flew turbine. This is done on vaki-kakrapar irrigation river at passer area from that experiment show the max 16% current of power (cp) at 4.04 tip speed ratio.

Deepak *et al.* **[3]** in this paper we consider the micro hydro turbine utilized of external low head hydro power. This is a less than 3m for this experiment we consider the new small pelton turbine are designed a fabrication and tested and its performance and efficiency and model prediction CFD is best program to solved the any results.and materials and the nozzle life is also increased to be increase and nozzle working under the condition of high back pressure. but it is too difficult to calculate the discharge consult nozzle system is in terms of performance of pressure and investigation for open loop system. erosion condition may also be considered in nozzle of the pelton turbine to coming out the sand particular to this problem also considered. In 22 MW Chilime hydro plant in Nepal. There we use Turgo tube is wok as impulse turbine like as Pelton wheel working a pie hydro system this design aspect and probes approach for a generator facility. There is generation reliability valuation of another routine resource. We used other municipal was to water also used and based on micro hydro power plant.

Bilal [4]**:** We consider the Pelton turbine was performed on high head and low water flow by the simple micro hydro electrical power plant mounting and we got a according vacuumed parameter we increase the efficiency of Pelton turbine. We consider these parameters like turbine power torque. Runner diameter rammer linked. Rammer speed bucket dimension no of Bucket and nozzle dimensions and tube speed.

Bilal Abdullah Nasir [5] In the terms of renewable energy micro hydroelectric power is both and reliable from of clean source. This is most harnessing renewable energy from small canal or river and streams. This turbine of hydro project run of river or canal in it is required minimizes or there is no resources in order propose. Mat Lab simulating Computer progressing to electric all the parameters as micro hydro power plant in Implemented turbine selection depended upon the need & flow rate of site the ratio of the speed and power directly proportional to tube of site head but some specific point for max speed and flow for variation of the site flow 5 to 10% head loss in pensions in a across head it depends upon length and its velocity and efficiency of turbine range from 80 to 95%. its depended upon the turbine of used and its generate of efficiency near about 90%. After selection of site there is no measure issues to show the design of micro hydro turbine there is lots of feasibility in that project and implementation stage of the micro hydroelectric power plant.

Williamson [6] In this paper first of all we decided criteria to selection of the head, speed, specific speed and flow rate. The range of Pico 5 kw as compare high head or large scale turbine is best consider high head or large scale turbine is best considerable idea.and working system. by result is best of PICO turbine head is low. reduced head at considered at non-traditional parts or compare such as low speed generators from this paper. We decided to best turbine system in which low head suitable for PICO turbine system. in which low head suitable for PICO turbine. and system in which low head suitable for PICO turbine and study of 13 turbines and design. these turbine are working and considered by quantity and quality wise. Basically these types of turbine design to remote side or near to canal or river based. There is low head and variable flow of water and selection of propeller turbine or of turbine for single test or turgo turbine for this specification site .Reaction Turbine has superior power density. as the head increase the power density of impulse turbine and water wheel improved and scrow decrease the canal. There is a extra pipe work for turgo tubes to food the test take of single that super to impulse tube super to all other turbine as the need increase speed also increase removing the gear box rotation to increase overall efficiency of turbine so variation in the we generated score over need range this show the propeller turbine with draft tube is the most suitable solution above 0.5 m to 1.5m typical head with. Note: propeller and radical turbine with draft tube have a similar weighted score to single jet turgo tube above 1.5m head. Turbine turgo turbine can be used low head. It low speed and runner site do not possess problems after calculation the runner diameter for a single jet turgo tube.

Guilherme *et al.* [7] considered the pump as a tube ad considered feasibility of the solution is good and wrote and results on propeller turbine from the lots of work water supply to turbine generation starts by the generator in that case we consider pump as a tube to generator and at generator DC current (motor) which was connected to the propeller tube. There we consider the all there data to optimization a calculate generator choice for computer modeling by this results to micro hydro tube is used other in lots of situation we rescaling or resizing for a larger tube system and applying for power electronics efficiency enhancing.

Jan Piers *et al.* [8] considered the 10mm diameter to a single stage axial micro tube turbine this is coming from a 10.5% of development this is also used micro-generator and there is energy generation from the fuels from the fabrication the tube is made of stainless steel. This is also we sin icing electro discharge Machine from this machine testing of speed up to 160,000 rpm and then rotation near about 28w with efficiency 18 to 19% . This is coupled to a generator. There is a generates 16w it is corresponding to the efficiency for a total system of 10.15%. There is another explanation of micro turbine is a single stage axial impose tube. In the terms of expansion gas takes place in the stationary nozzle between the rotary blades.

Patel and Pakale [9] In present situation demand of electricity and water and energy in the terms electricity need of every one according to increase population for small scale micro hydro power is one of the best energy resources and other benefits like a e-commerce society and present environments and increase the demand of hydro power generation. After studying a lots of paper and turbine cross flow is best suitable for micro hydro turbine, in present sentence is population turbine to micro hydro turbine small head small water flow rate. In micro hydro turbine with cross flow tube at 100% paper is implementation from this paper.

Bryan & Lubitz [10] From this paper location of availability of review supplied electricity for PICO hydro generators. These are the united sources for rural areas design system is very important thing out. This for urgent battery changes and any other for battery. Further we extended for more generator and increase the turbine capacity flow and power to increase base load from 100 to 500w. it is also operating low head (2-10m). There is lots of problem faces under the very low head for this purpose we going the experiment side. To get the proper result by the experiments, turbine is testing apparatus these are depends upon the construction by this paper results will be used for base line in comparison for new turbine.

Paish [11] worked on one of the best cost effective energy technology to be considered in hydro power or micro hydro on small scale for rural areas (sites) and developed or undeveloped countries. For Europe, They have considered on large scale generation plating for larger scale exploited some times ago and would now be considered environmentally acceptable for the large scale generation we need the clam but there is lots of problems to short out this type of problems we consider the micro hydro turbine and from the hydro or micro turbine we start the new technology from the maintenance purpose. No more investment as well as cost effectives of the technology. It is a long last technology environment impact 6 Feb 2002.

Paish [11] worked on large scale as well as small scale for renewable power production provide near about 19% as plants electricity they have already working on hydro tube to rural area in Europe after increase the capacity in of 4500 mw 50% by the year of 2010. UK has 100 mw and existing small hydro power plant capacity under (5 mw) and near about 1210 sites. At least 4500 mw unexploited potential small power plant is favorable working on small hydro power plant at large scale generator in next 10 years from hydro power plant technology new innovations being developed.

O.B. Yaakob [12] made a review on micro hydro gravitational vertex power and turbine system: This paper works need of every one in terms of electrical power generation for daily used like lighting, heating communications computer system and transport after lots of experiments and expensive hydro power is best in terms of adaptable nature non harmful. This paper work on main five storage stream technology and new technology gravitated vertex this work on according to large small micro PICO hydropower but this paper focusing in micro hydropower specially aravitable vertex power which increase the sustainability and health of the water as a whole it overview from both flus and power points and discuss free surtanevortue. This paper basically work on free surface vertex in terms of hydraulic phenomenon and that application from engineering fields like micro hydro power site from that application from surface vertex is achieve great significance in global environment.

Stream value: This company work on the categorization of small hydro power generation overview of small hydro power system in hydro power plants system all time as less than 100 kw no solve universal standards define exists today 1000 to 10000 kw and in small hydro 100 to 1000 kw and mini hydro less than 100 kw. Micro less than 1 kw PICO hydro small hydro power used less than 10000 kw.

There us two beginning generator first one by pass invented- generally depends upon river , canal or reservoir and second open canal invented generator instable bottom of two head drop. We applying existing canal and use it need drop or slop without penstocks General category of turbine: Impulse water tube Reaction turbine aridity water wheel shape of water turbine fled technology turbine for hydro power system is smitten to wind power there is quite difference between wind and hydro energy system the potential energy and it does not possess viscosity.

Jean-Francois [13] Cry *et. al workd on* To small hydropower plant identity the suitable sites to give a territory is indispensible to developed small hydro power renewable energy project there a methodology applying a synthetic hydro network. It is created elevation models to ensure praise hydro head estimations to a cannel base flow for all drainage areas in the study there is estimate as function of the hydro head and max penstock length in the terms as small hydropower opportunity. It has a good small hydropower resource using a head (10m) penstock length (3000m) 690 potential status have been identified over the territory and new Brunswick is 368 MW for conventional hydro electric reservoir small hydro constitution system.

From the above survey it has been observed that there is tremendous scope in area of water flowing due to gravity. There are new technologies have to inducted in the area of very small water turbine of the range of less than 5 kW.

<u>Why is the particular topic chosen?</u>

Since in our country production of electricity mostly is done by thermal plants around 72%, these thermal plants run on non-renewable energy resources like coal, gas, diesel, etc. But these resources are getting depleted day by day hence we have to search out for various new methods of producing energy either from renewable resources or by harnessing energy from various system present in our environment just like this project in which the energy in form of head is being wasted can be easily transformed into some useful form of energy. So this topic is chosen for sustainable development and utilization of waste resources, e.g. solar, wind & other well known as renewable energy resources. But in the geologically plain area of metropolitan cities, the wind energy cannot be harnessed, but there is also a source of energy.

Objective of the project:

The main objective of the project is to produce a reasonable amount of actual power about 100W from a miniature reaction turbine with a minimum efficiency of the fabricated turbine about 10% from the waste discharge coming from drainage system having a head of about .5m to 2.5m head from normal flow.

CHAPTER 3

METHODOLOGY

AND

FORMULATION

3.1 Designing & its Assumptions:

1. Design parameters were created to better define our pico turbine.
2. Maximum component weight 20 to 25 kg i.e. of turbine system.
3. Minimum operating head .5 to 2.5m.
4. Adaptable to a range of head.
5. Proper working of components.
6. Safe and easy operation 12

3.2 Methodology

This project focuses on the **Harness of energy from drainage system by using a pico-turbine** by utilizing the waste water coming through it as discharge of drainage system. The waste water of drainage system has a head of about 0.5 to 2.5m which is utilized for rotating a pico turbine which was fabricated by us in our college workshop. This turbine was designed by us on the basis of calculations made on the data available such as head & flow discharge, power and mass flow rate,

The designing includes designing of impeller, vanes with appropriate angle, axle, bearing, hub, discharge tank.

The fabrication started with fabrication of impeller by folding vane sat appropriate angle using mild steel as material to provide sufficient strength to vanes and then welding it at the axle. After this the spiral casing was made of tin material alloy to make it light. This both parts are assembled and are put on a stand beside a discharge tank. The drainage water through a strainer was sent to the pico turbine and the turbine starts rotating.

The rpm of rotation was measured by using digital tachometer (rpm measuring device) and the torque was measured by rope brake dynamometer which was self-made in the workshop by the design made by us and our guide. Thus using this actual power was calculated and hence efficiency of the system was calculated.

3.3 Cross Flow pico Turbine:-

Cross flow pico turbines are those turbines in which the water flows in the tangentially direction. The water may flow tangentially outwards to inwards (i.e. towards the axis of rotation) or from inwards to outwards. If the water flows from outwards to inwards through the runner, the turbine is known as inward radial flow turbine. And if the water flows from inwards to outwards, the turbine is known as outward radial flow turbine. Means that the water at the inlet of the turbine possesses kinetic energy as well as pressure energy. As the water flows through the runner, a part of pressure energy goes on changing into kinetic energy. Thus the water through the runner is under pressure. The runner is completely or partially submerged in water so that there is no requirement of air-tight casing.

Statement about the problem:

From the above literature survey it was assumed to develop the turbine for dead low head of 100 to 150 mm and discharge in the channels. The main idea of the work is that can be installed in canals in order to produce 2 kW. So a model is made by assumptions and then the work was proceed by reverse engineering.

Power Gained by Fluid

The power gained by the fluid from a pump or fan can be expressed as:

3.4 Theoretical calculation:-

$P = m\ w$ (1)

Where P = power m = mass flow rate

w = specific work

Specific work - w - can be expressed:

$w = g\ h$ (2)

where h = head g = acceleration of gravity

Mass flow rate - m - can be expressed:

$m = \rho\ Q$ (3)

where ρ = density Q = volume flow rate

Combining (1), (2) and (3) the power gained by the fluid from a pump or fan can be expressed as:

$P = \rho\ Q\ g\ h$ (4)

With specific weight expressed as:

$\gamma = \rho\, g$ (5)

where γ = specific weight

equation (4) can be modified so the power gained by the fluid from a pump or fan can be expressed as:

$P = \gamma\, Q\, h$ (6)

Power generated by turbine

$$P_{Turbine} = \tau \cdot \omega \quad (7)$$

$$= 2.\, \Pi.\, N.\, T$$

T = F.r

Where r is the radius of rope brake dynamo meter

F is the load on rope.

$$Q = A \cdot Cd \cdot \sqrt{2 \cdot g \cdot H}$$

Where A=b x h

$$\eta = \frac{P_{Actual}}{P_{theroretical}}$$

All above formula is used to calculate the performance characteristics parameter of PICO Turbine.

CHAPTER 4

EXPERIMENTATION

4.1 Main Parts of a cross flow pico turbine.

The following parts are given in Table 1.

Table: 1. Geometry parameter of Pico Turbine assebly

S. No.	DESCRIPTION	SIZE	QUANTITES
1	Impeller		2
	length	100 mm	
	dia	220 mm	
2	PULLY		2
3	SHAFT		1
	diameter	18 mm	
	length	280 mm	
4	blade		35
	inlet angle	36°	
	outlet angle	34°	
5	dynamometer pully		
	pully.1		1
	diameter	65 mm	
	pully.2	40 mm	1
	thickness	12 mm	
6	guide blade angle open	130 mm	

4.2 Runner:-

Runner is a circular wheel on which series of radial curved vanes are fixed. The surfaces of the vanes are made very smooth. The radial curved vanes are so shaped that the water enters and leaves the runner without shock. The runner is made of Plastic in our case due to easy in manufacture. But here in our case, for cross flow pico-turbine the material used for vanes is plastics as vanes are made by. The impeller or runner was fabricated by initially cutting a circular piece of specified dimensions from theoretically calculated diameter.

Then vanes were cut with specified dimensions of pieces were folded in the required shape by the process of cold forging. The following diagram shows the runner.

Fig: 1 Runner and shaft assembly side view

Fig. 2 Runner and shaft assembly top view

Fig. 3a Assembly of Experimental set-up on plume channel set-up

Fig. 3b Assembly of Experimental set-up on plume channel set-up

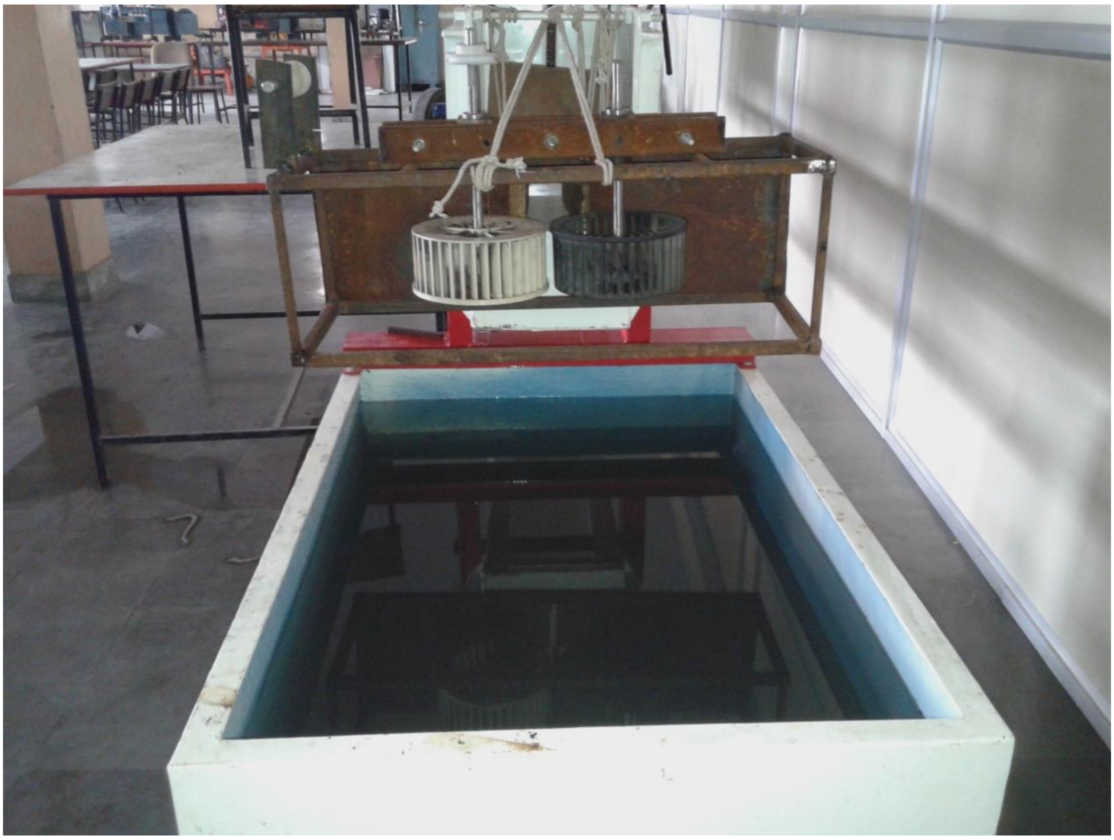

Fig. 3c   Assembly of Experimental set-up on plume channel set-up

Fig. 4 Assembly of plume channel set-up

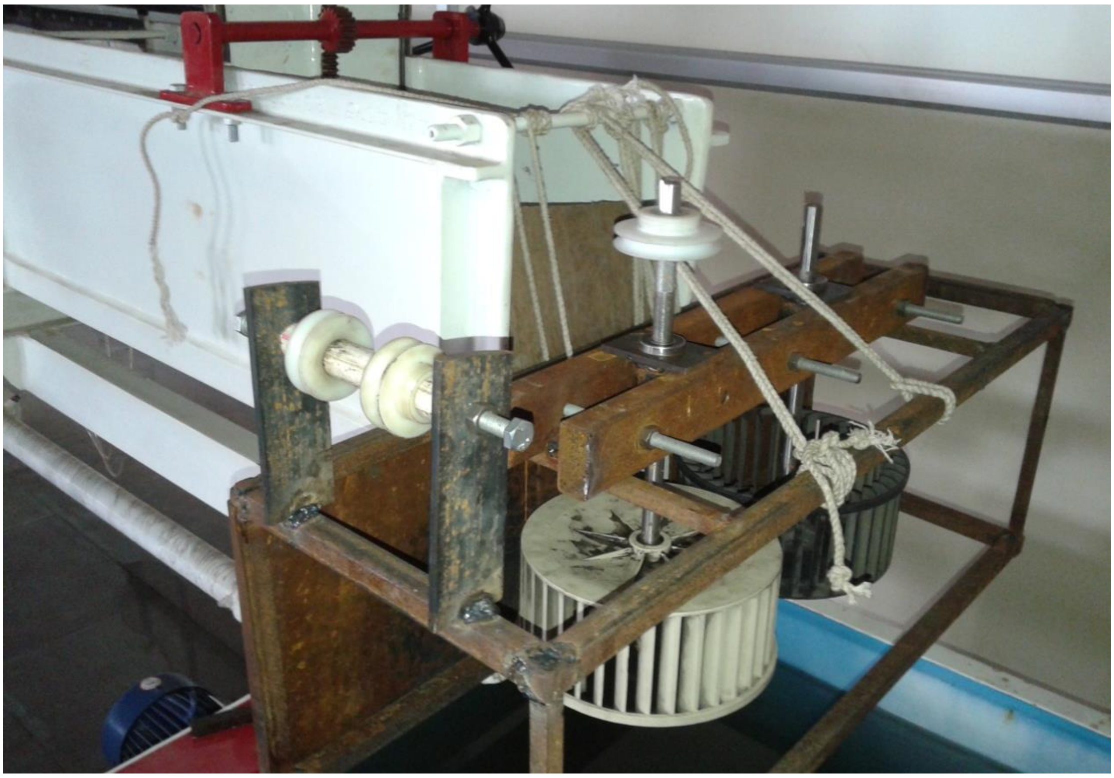

Fig. 5 Assembly of plume channel set-up with runner assembly

Fig. 6 Stand assembly for runner fixing

4.3 Steps of the fabrication of the pico turbine:-

1. Fabrication of runner done by molding and fitting processes It has taken in care that the blade angles must be identical for all the 35 blades.
2. Shaft was turned and the bearing sizes made at appropriate positions and runners was fitted on the shaft by set screw.
3. The frame was fabricated of square pipe of 1 inch size for the light in weight.
4. Two identical but in opposite directions, the runner was assembled on the frame.
5. The opening of 130 mm was provided for the flow of water.
6. The proper adjustments was provided in order to vary the shaft space for different
7. A rope brake dynamometer was made by

4.4 Precautions in the project running & fabrications:-

First of all the water coming from the drainage system of the house and flow area or building contains a lot of dirt, which needs complete removal, so a good quality strainer should be used to strain the waste water.

1. The strainer should be periodically cleaned as there will be accumulation of a lot of dirt which will block the pores of the strainer and hence the flow of water will be stopped.
2. The pipe which is used for drainage should be clean sufficiently and smooth so that coefficient of friction is very small, which increases the efficiency.
3. There should be no leakage in the pipe used for drainage system otherwise it will reduce the head.
4. The nozzle used should be able to maintain good quality of pressure.
5. The casing should be made in such a way that, it should be as much as air tight so that pressure energy & kinetic energy are maximum utilized.
6. The casing should be designed & fabricated in such a way that that there is no creation of hindrance in rotation of the runner.
7. The casing should be always full of water so that pressure energy is maintained properly.
8. The parts in contact of water should be painted or galvanized so that there is no rusting to increase the life of the miniature reaction turbine.
9. The draft-tube used should be always dipped in tail race.

10. The surface of the vanes and inner part of the casing should be as smooth as possible so that there is no shock.
11. The bearings used should be properly lubricated so that there is minimum friction and hence efficiency is not reduced due to frictional loss in bearings.
12. The rope brake dynamometer should have minimum coefficient of friction so that it slips when the load is applied.

4.5 Testing technologies, methods & equipment:-

A rope brake dynamometer consists of two wooden blocks clamped together on a revolving pulley carrying a lever as shown in the above figure. The friction between the blocks and the pulley tends to rotate the blocks in the direction of rotation of the shaft. However, the weight due to suspended mass at the end of the lever prevents this tendency. The grip of the blocks over the pulley is adjusted using the bolts of the clamp until the engine runs at the required speed. The mass added to the scale plan is such that the arm remains horizontal in equilibrium position; the power of the engine is thus absorbed by the friction.

Frictional torque = Wl = Mgl

Power of the machine under test = $T\omega$ = Mgl*($2\pi N/60$)

The expression for power is independent of the size of the pulley and the coefficient of friction

Digital Tachometer:-

This is an electronic instrument which is used for the purpose of measuring the rpm of the rotating axle. A reflector is mounted on the rotating shaft which reflects the light falling from the tachometer and tachometer counts the revolution of the axle.

Process of testing and taking observation from the pico turbine:-

The weights were kept for power calculation on the rope brake dynamometer by the help of string and various readings were taken by placing various weights and corresponding rpm were measured by the help of tachometer and then calculation of power is done.

CHAPTER 5

RESULT AND DISCUSSION

5.1 RESULTS AND DISCUSSION

The results are given in the following tables. It can be observed that there was a heavy discharge loss. The power is very low since the available power is also very less at 200 mm water head. The power was maximum when the shaft spacing was 235 mm. The plot between discharge and power is shown in the figure and it was observed that the efficiency and power are high as discharge is increased.

Table: 2 Variation of power output with discharge of water at Shaft distance 215 mm, and 125 RPM of rotor

S. No.	Discharge (m^3/s)	RPM	Power (Watt)
1	0.0018	125	0.00948969
2	0.0036	125	0.0185998
3	0.0054	125	0.02581197
4	0.0072	125	0.03169558

Table: 3 Variation of power output with discharge of water at Shaft distance 215 mm, and 160 RPM of rotor

S. No.	Q (m^3/s)	RPM	Power
1	0.0018	160	0.00850277
2	0.0036	160	0.01651966
3	0.0054	160	0.02599417
4	0.0072	160	0.03206757

Table: 4 Variation of power output with discharge of water at Shaft distance 215 mm, and 165 RPM of rotor

S. No.	Q (m^3/s)	RPM	Power
1	0.0018	165	0.00751584
2	0.0036	165	0.01628431
3	0.0054	165	0.02705701
4	0.0072	165	0.03306968

Table: 5 Variation of power output with discharge of water at Shaft distance 215 mm, and 167 RPM of rotor

S. No.	Q (m3/s)	RPM	Power
1	0.0018	167	0.00811407

2	0.0036	167	0.01698883
3	0.0054	167	0.02738498
4	0.0072	167	0.03347053

Table: 6 Variation of power output with discharge of water at Shaft distance 225 mm, and 121 RPM of rotor

S. No.	Q (m3/s)	RPM	Power
1	0.0018	121	0.00881858
2	0.0036	121	0.01837205
3	0.0054	121	0.02553714
4	0.0072	121	0.03123248

Table: 7 Variation of power output with discharge of water at Shaft distance 225 mm, and 142 RPM of rotor

S. No.	Q (m3/s)	RPM	Power
1	0.0018	142	0.0075462
2	0.0036	142	0.0146612
3	0.0054	142	0.02306982
4	0.0072	142	0.02845997

Table: 8 Variation of power output with discharge of water at Shaft distance 225 mm, and 162 RPM of rotor

S. No.	Q (m3/s)	RPM	Power
1	0.0018	162	0.007379185
2	0.0036	162	0.015988235
3	0.0054	162	0.026565068
4	0.0072	162	0.032468416

Table: 9 Variation of power output with discharge of water at Shaft distance 225 mm, and 168 RPM of rotor

S. No.	Q (m3/s)	RPM	Power
1	0.0018	168	0.012243982
2	0.0036	168	0.025508296

3	0.0054	168	0.035456531
4	0.0072	168	0.043364102

Table: 10 Variation of power output with discharge of water at Shaft distance 235 mm, and 130 RPM of rotor

S. No.	Q (m3/s)	RPM	Power
1	0.0018	130	0.00947451
2	0.0036	130	0.019738562
3	0.0054	130	0.027436601
4	0.0072	130	0.033555555

Table: 11 Variation of power output with discharge of water at Shaft distance 235 mm, and 170 RPM of rotor

S. No.	Q (m3/s)	RPM	Power
1	0.0018	170	0.009034188
2	0.0036	170	0.017552137
3	0.0054	170	0.027618803
4	0.0072	170	0.034071795

Table: 12 Variation of power output with discharge of water at Shaft distance 235 mm, and 180 RPM of rotor

S. No.	Q (m3/s)	RPM	Power
1	0.0018	180	0.008199095
2	0.0036	180	0.017764706
3	0.0054	180	0.029516742
4	0.0072	180	0.036076018

Table: 13 Variation of power output with discharge of water at Shaft distance 235 mm, and 184 RPM of rotor

S. No.	Q (m3/s)	RPM	Power
1	0.0018	184	0.013410075
2	0.0036	184	0.027937657
3	0.0054	184	0.038833343
4	0.0072	184	0.047494017

Table: 14 Variation of power output with discharge of water at Shaft distance 245 mm, and 92 RPM of rotor

S. No.	Q (m3/s)	RPM	Power
1	0.0018	92	0.006705038
2	0.0036	92	0.013968829
3	0.0054	92	0.019416672
4	0.0072	92	0.023747008

Table: 15 Variation of power output with discharge of water at Shaft distance 245 mm, and 136 RPM of rotor

S. No.	Q (m3/s)	RPM	Power
1	0.0018	136	0.00722735
2	0.0036	136	0.014041709
3	0.0054	136	0.022095043
4	0.0072	136	0.027257436

Table: 16 Variation of power output with discharge of water at Shaft distance 245 mm, and 188 RPM of rotor

S. No.	Q (m3/s)	RPM	Power
1	0.0018	188	0.008563499
2	0.0036	188	0.018554248
3	0.0054	188	0.030828597
4	0.0072	188	0.037679397

Table: 17 Variation of power output with discharge of water at Shaft distance 245 mm, and 192 RPM of rotor

S. No.	Q (m3/s)	RPM	Power
1	0.0018	192	0.013993122
2	0.0036	192	0.029152338
3	0.0054	192	0.040521749
4	0.0072	192	0.049558974

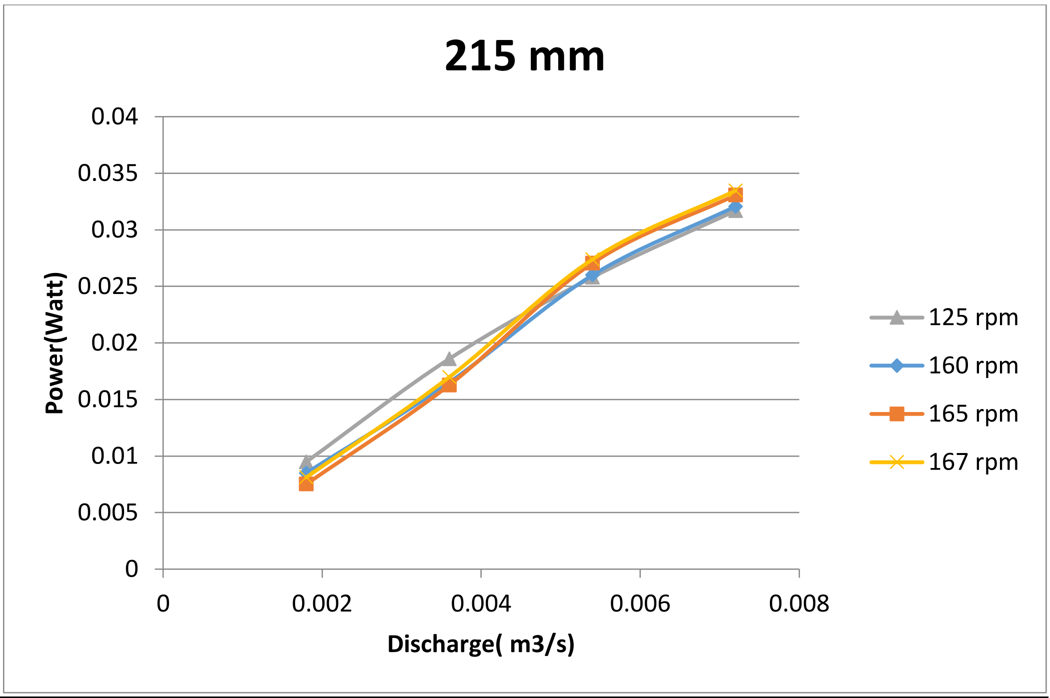

Fig. 7 Variation of power with discharge at different rpm of rotor (gap 215 mm b/w shafts)

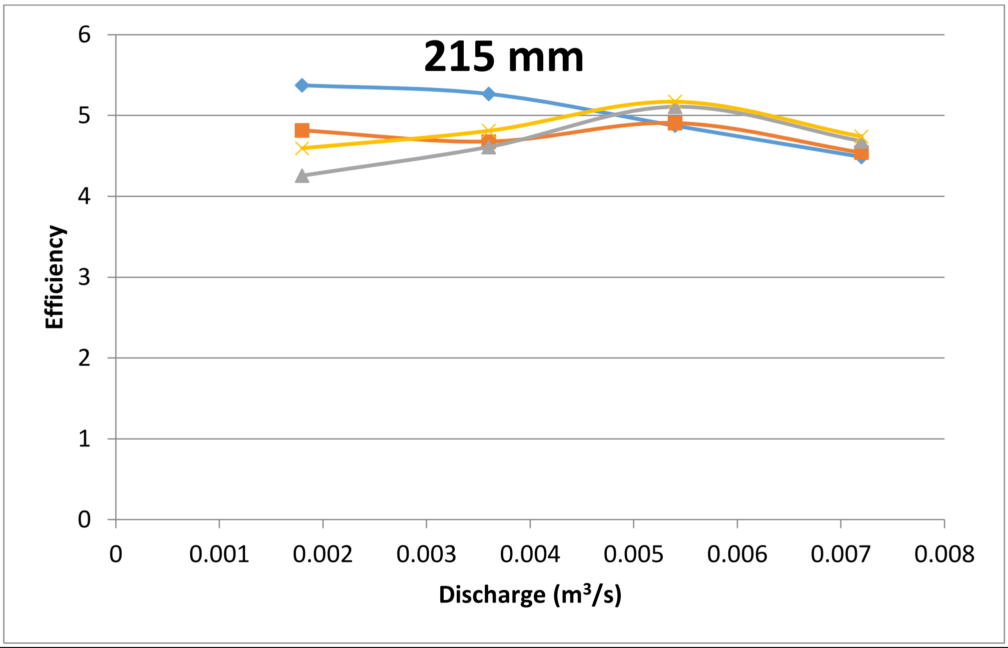

Fig. 8 Variation of efficiency with discharge at different rpm of rotor (gap 215 mm b/w shafts)

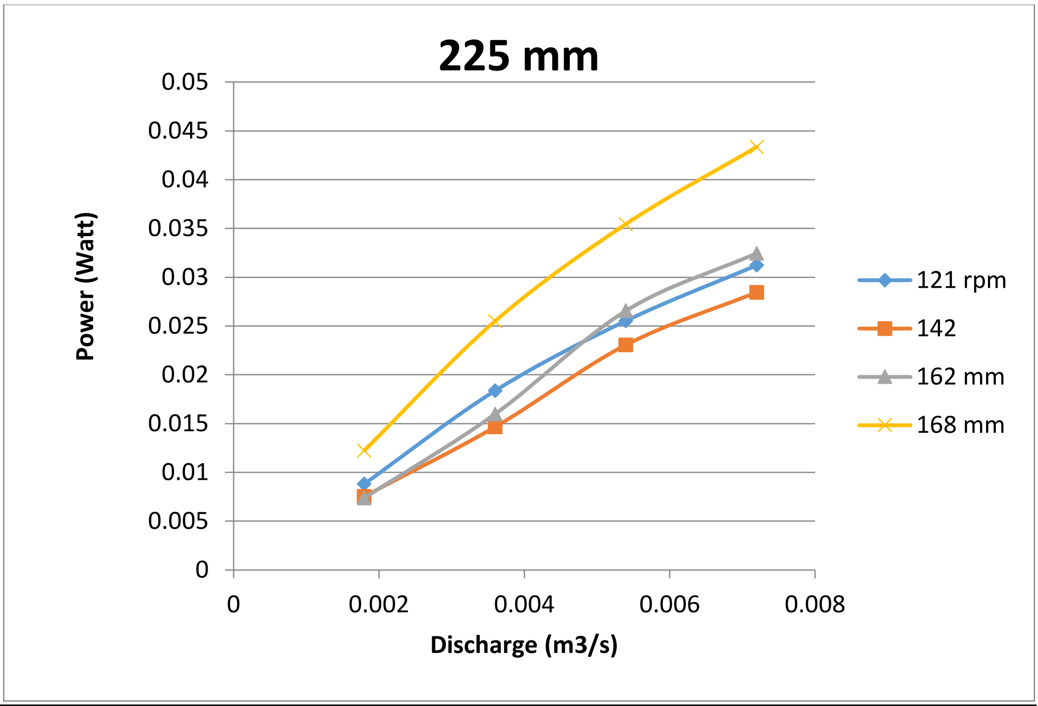

Fig. 9 Variation of power with discharge at different rpm of rotor (gap 225 mm b/w shafts)

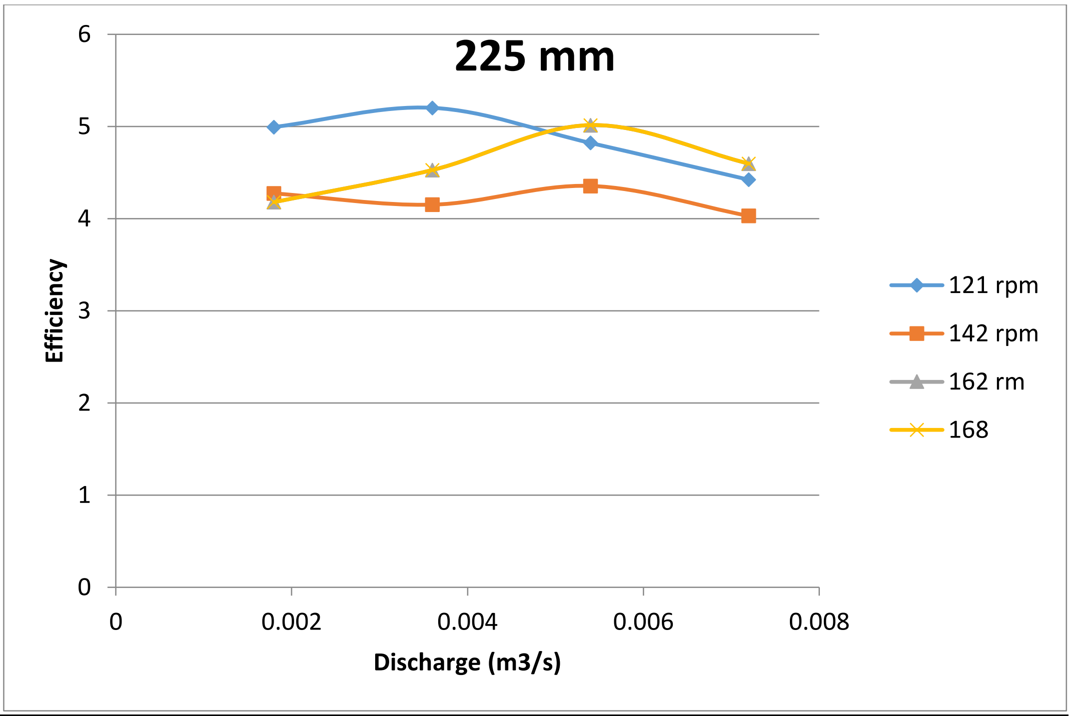

Fig. 10 Variation of efficiency with discharge at different rpm of rotor (gap 225 mm b/w shafts)

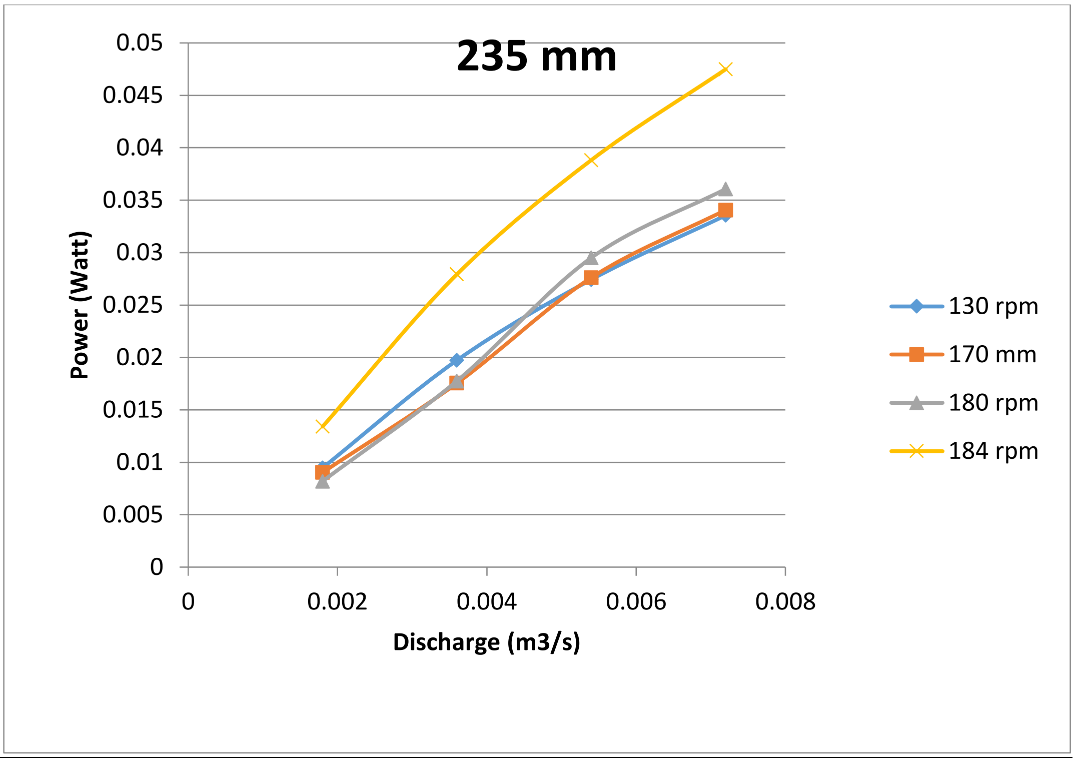

Fig. 11 Variation of Power with discharge at different rpm of rotor (gap 235 mm b/w shafts)

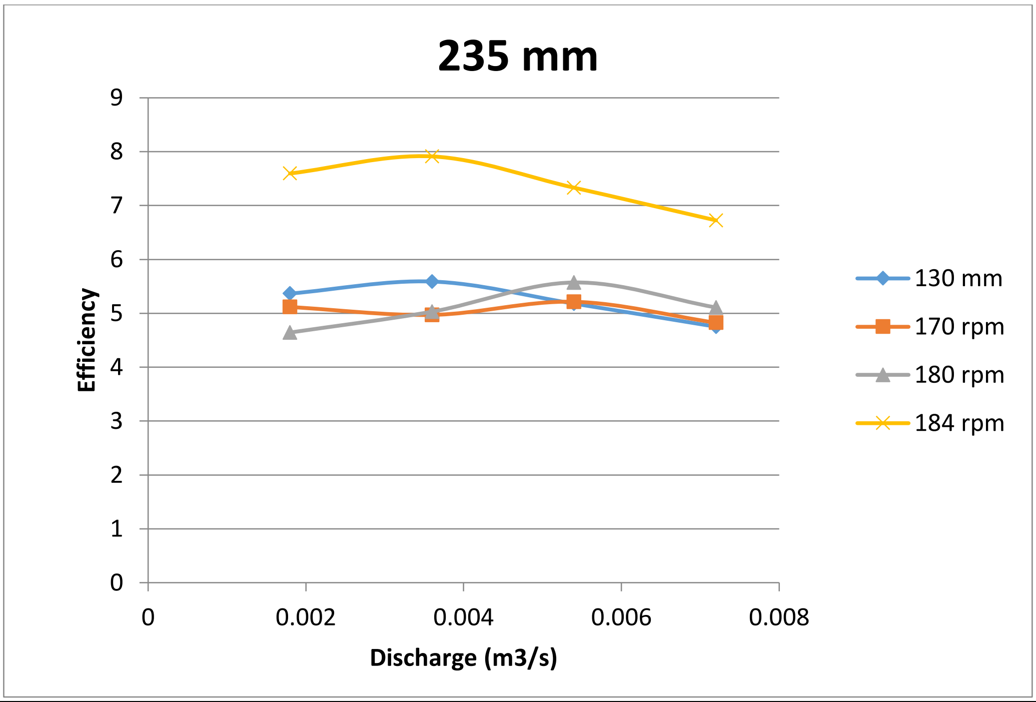

Fig. 12 Variation of efficiency with discharge at different rpm of rotor (gap 235 mm b/w shafts)

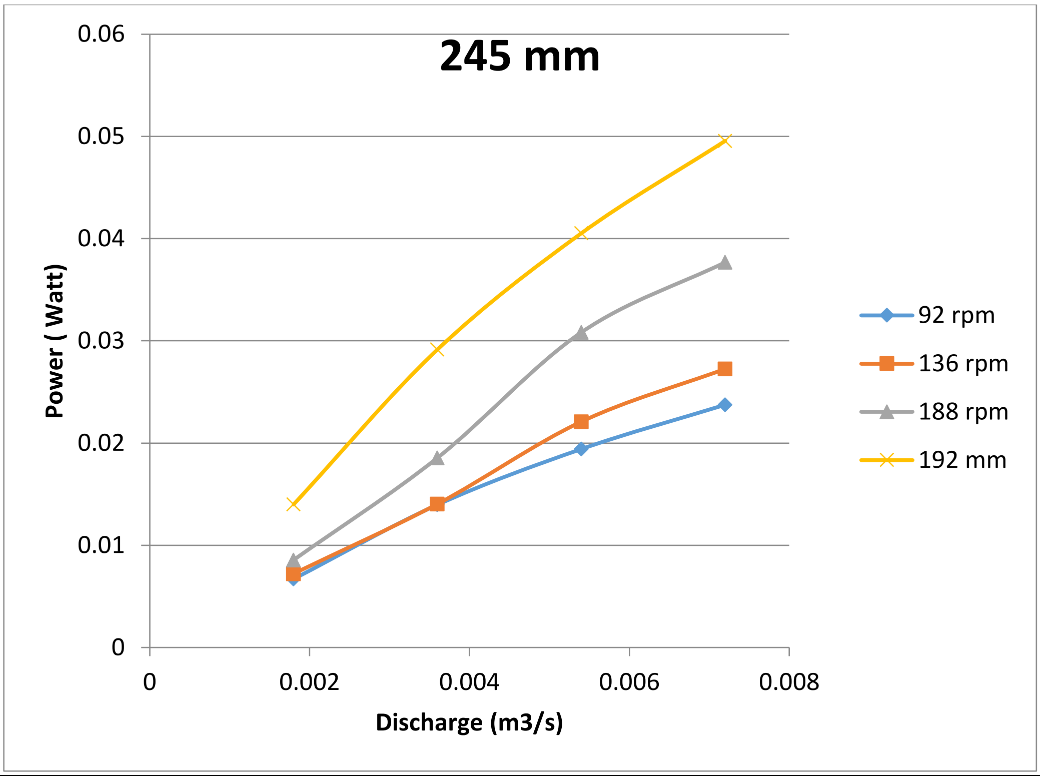

Fig. 13 Variation of Power with discharge at different rpm of rotor (gap 245 mm b/w shafts)

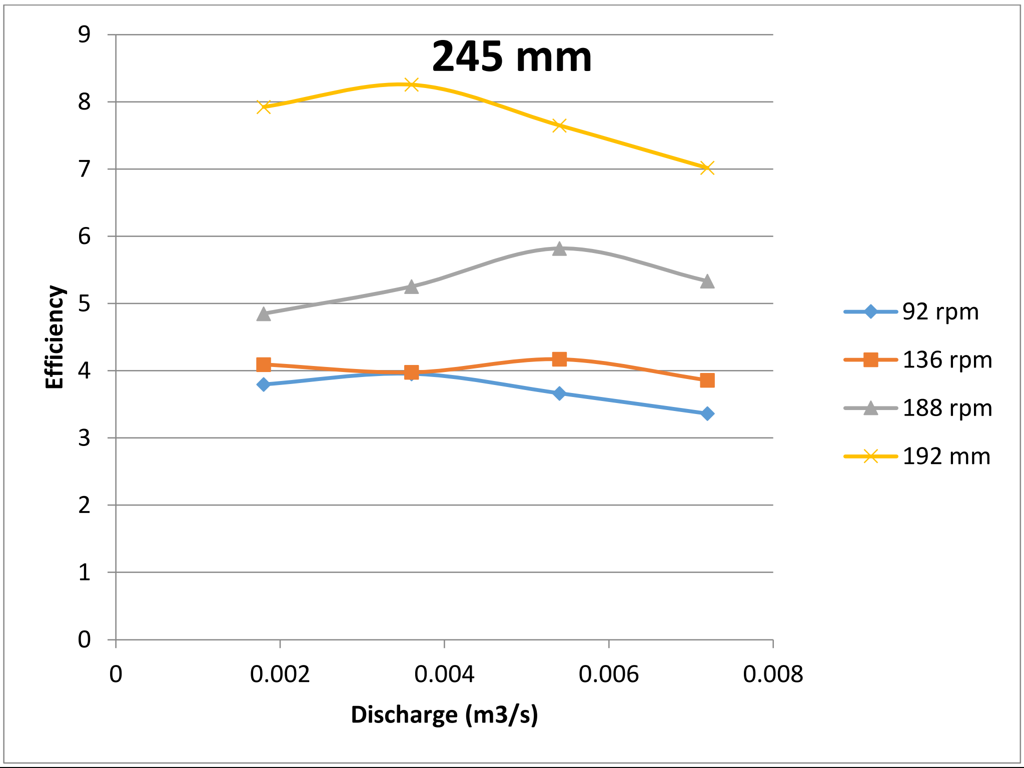

Fig. 14 Variation of efficiency with discharge at different rpm of rotor (gap 245 mm b/w shafts)

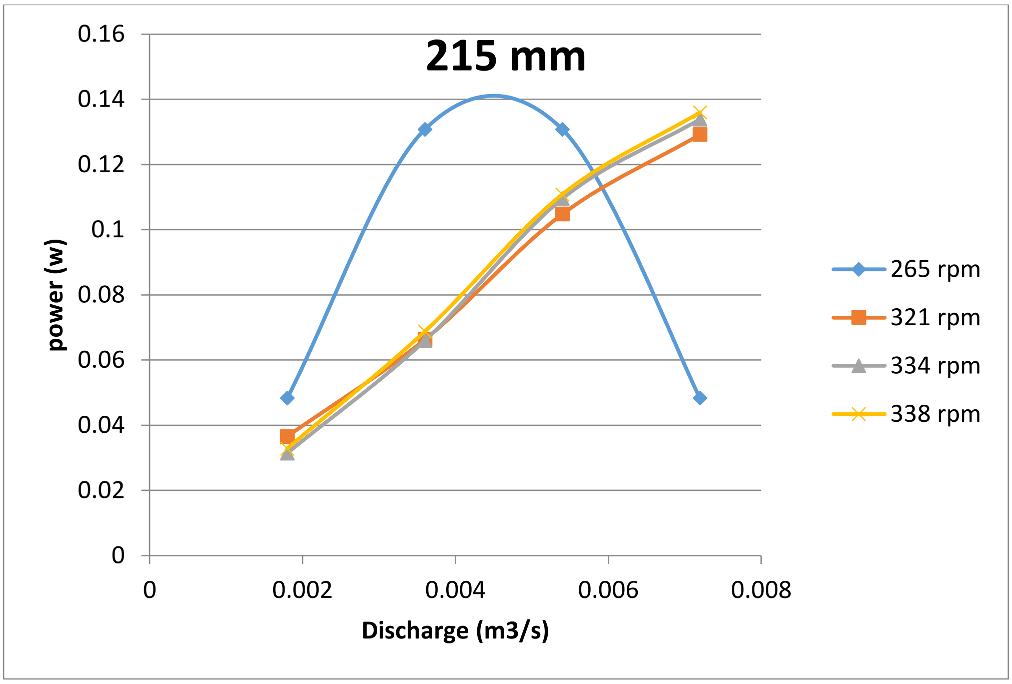

Fig. 15 Variation of Power with discharge at different rpm of rotor (gap 215 mm b/w shafts)

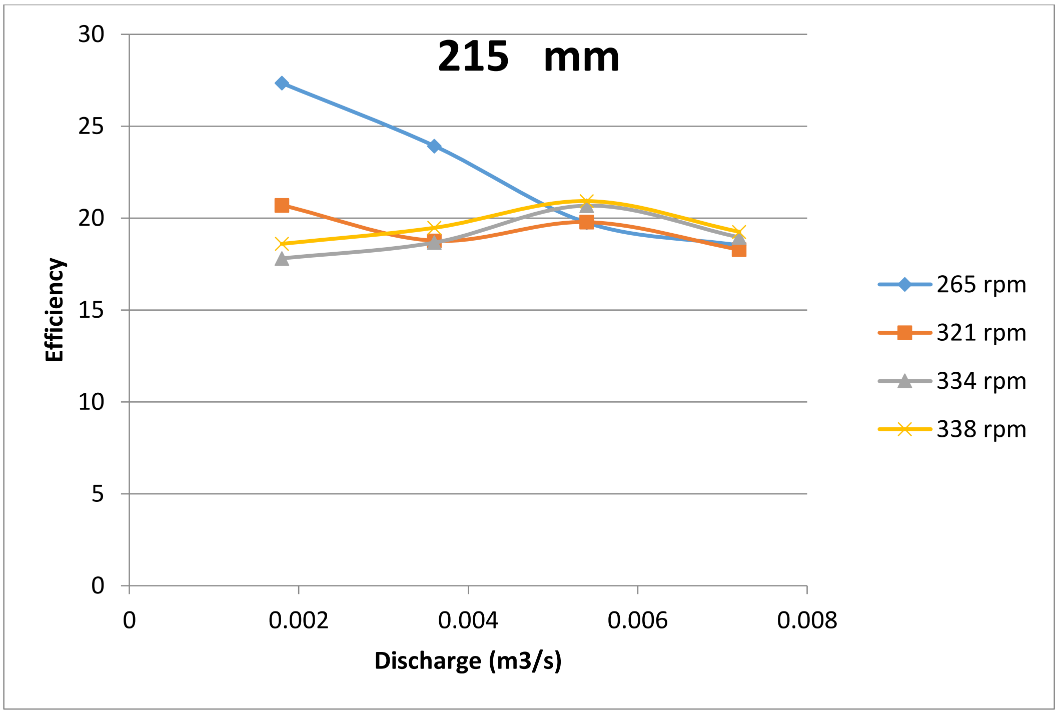

Fig. 16 Variation of efficiency with discharge at different rpm of rotor (gap 215 mm b/w shafts)

Calculation:-Hence, the efficiency of the fabricated pico reaction turbine is around 12-16%. And the power generated by the turbine by harnessing energy from the drainage system by the fabricated pico turbine is around 12-16 Watt

The runner power is low as compared to water power as the efficiency shows.

The turbine was designed for producing 100 Watt power by harnessing the energy from the waste drainage water from the normal or simply water availability .The waste water needs treatment before reaching to the impeller/runner blades by using a strainer to strain out the dirt otherwise the efficiency will automatically decrease and the turbine life cycle will be reduced at a higher rate. Here in our project, a lot of losses are there due to manufacturing defects in the various parts of turbine. The actual vanes which are forged vary with design, the casing is also having some defect, the bearings used are not perfect, and so these reduce the efficiency of the turbine by10-15%.

Suggestion for improvement in the project so that efficiency and power both increases from the present model:-

1. Two strainers should be used one with bigger pores and other with smaller pores.
2. Instead of using nozzle a proper guide vanes are designed and fabricated at proper angle
3. A governor can also be used if the head becomes more than .5 to 2.5m for the guide vanes.
4. The casing of the turbine should be casted and material used should be cast iron and then good quality of machining is done on its surface so that there is minimum frictional loss and the casing will become more air tight and on the stand it will become more stable.
5. The runner will be designed properly on basis of the assumed power and then it is fabricated by method of casting and not by method of forging as it will produce identical shape and there are no gaps and no welding is required which creates frictional losses.
6. The casted runner should be properly machined so that its surface becomes smoother and during working there is no shock.
7. There should be a ball bearing at the junction of the axle and the casing so that there is easy movement of axle and no frictional losses due to contact of the axle with casing.

8. The hub should be self-designed and ball bearings are used instead of the hub and bearing assembly used in this project.
9. The prony brake dynamometer and axle should be made of stainless steel so that there is minimum coefficient of friction between them.

CHAPTER 6

CONCLUSION
&
FUTURE SCOPE
OF
WORK

6.1 CONCLUSION:-

At the end of the project we conclude that the project is very successful and our motive is completed. Our initial task was to keep the efficiency more than 10% and in our project we get it. The energy of waste water coming out in drainage system of a .5 to2.5m head and harnessed by making a pico reaction turbine.

The turbine was fabricated by various processes like cutting, grinding, welding, forging, sheet metal working, etc. The turbine was initially designed by doing theoretical calculations and then according to the dimensions obtained we fabricated each and every part of the turbine. In modern period, we require harnessing of energy from various possible opportunities in the living world, as non- renewable energy sources are limited and getting depleted day by day which need conservation and some new methods of unconventional energy resources for future. This project has focused on one of the method of harnessing energy. This project has very wide scope in modern period in not only urban areas but also in rural areas as in rural areas also on .0.5 to 2.5m heads are being built. The power which is produced by harnessing the energy is a reliable amount and with change the head blade angle .the amount of power also increases.

6.2 Future Scope & Development:

The further increase in efficiency is possible by the following ways:

1. Change in size of the model.
2. Improvrment in blade anlge.
3. Change in orientation.
4. Increase in available head.
5. Installation in big canal.
6. Increase in velocity of upstream.

The above research is helpful in the development of rural areas.

CHAPTER 7

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