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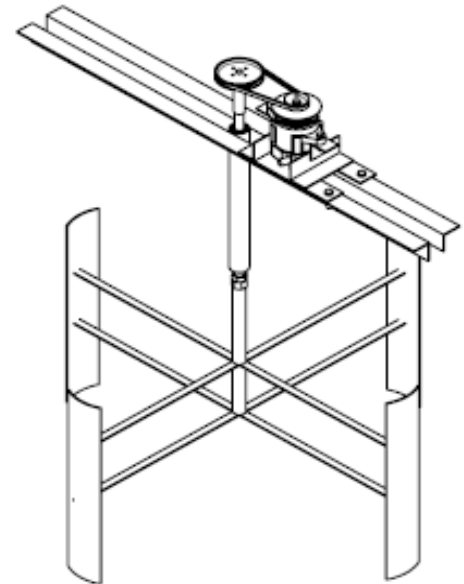
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H-DARRIEUS

PICO HYDRO CURRENT WATER TURBINE

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INTRODUCTION

- The Pico Hydro is a term used for hydroelectric power generation of under five kilowatts (5kW). Hydro power system of this size benefit in terms of simplicity from different approaches in the design, planning and installation than those which are applied to larger hydro power.
- It is useful in small, remote communities that require only a small amount of electricity for example, to power one or two fluorescent light bulbs and a TV or radio in 50 or so homes. Even smaller turbines of 200-300 Watts (W) may power a single home in a developing country with a drop of only one meter.
- Pico-hydro setups typically are run-of-stream, meaning that a reservoir of water is not created, only a small weir is common, pipes divert some of the flow, drop this down a gradient and through the turbine before being exhausted back to the stream.
- Like other hydroelectric and renewable source power generation, pollution and consumption of fossil fuels is reduced, though there is still typically environmental cost to the manufacture of the generator and distribution methods.

OBJECTIVE

The aim of this study is to generate electricity by using a pico hydro current turbine. The objectives are as follows:

1. To study the literature review.
2. To analyse theoretically.
3. To design a pico hydro water turbine.
4. To test the prototype in fluid lab.

PROBLEM STATEMENT

- The disadvantages of the H-Darrieus rotor is it has reverse force on the returning blade and it will make the burden for the rotor to rotate.
- Darrieus also has a drawback of low starting torque.
- As we built for the small scale electrical generation, we are only targeting for rural areas.
- Rural electrification is often considered to be the backbone of the rural economy.

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- Development of rural electrification
- In today's context, rural electrification has five major facets:-
 1. Setting up of rural electricity infrastructure
 2. Providing connectivity to households
 3. Adequate supply of desired quality of power
 4. Supply of electricity at affordable rates
 5. Providing clean, environmentally benign and sustainable power in efficient way

LITERATURE REVIEW

Hydro power Technology system have two criteria classification:

1. Technology

- dammed reservoir, run of river, in stream, pumper storage, vortex power

2. Capacity

-larger hydro,smaller hydro, micro hydro, pico hydro

General Pico Hydro Water Current Turbine Principle

Water current turbine produce electricity directly from the flowing water in a river or a stream. The energy flow of the water stream is depend on the density, cross sectional area and velocity cubed

$$P = \frac{1}{2} \rho C_k A V^3$$

The scale of pico hydropower schemes cover a broad range and larger schemes generally requires damming to create storage capacity and regulate water flow .Given the greater amount of power generation, they are typically grid connected to supply high levels of demand, at the smallest scale are so called “ Pico Hydro”

Components of turbine system

1. Turbine

Turbine is the main parts in the pico hydro system, where the task is to convert water power to rotational force in order to drive generator. It is important to select the right turbine as most of the losses are due to this component

2. Transmission

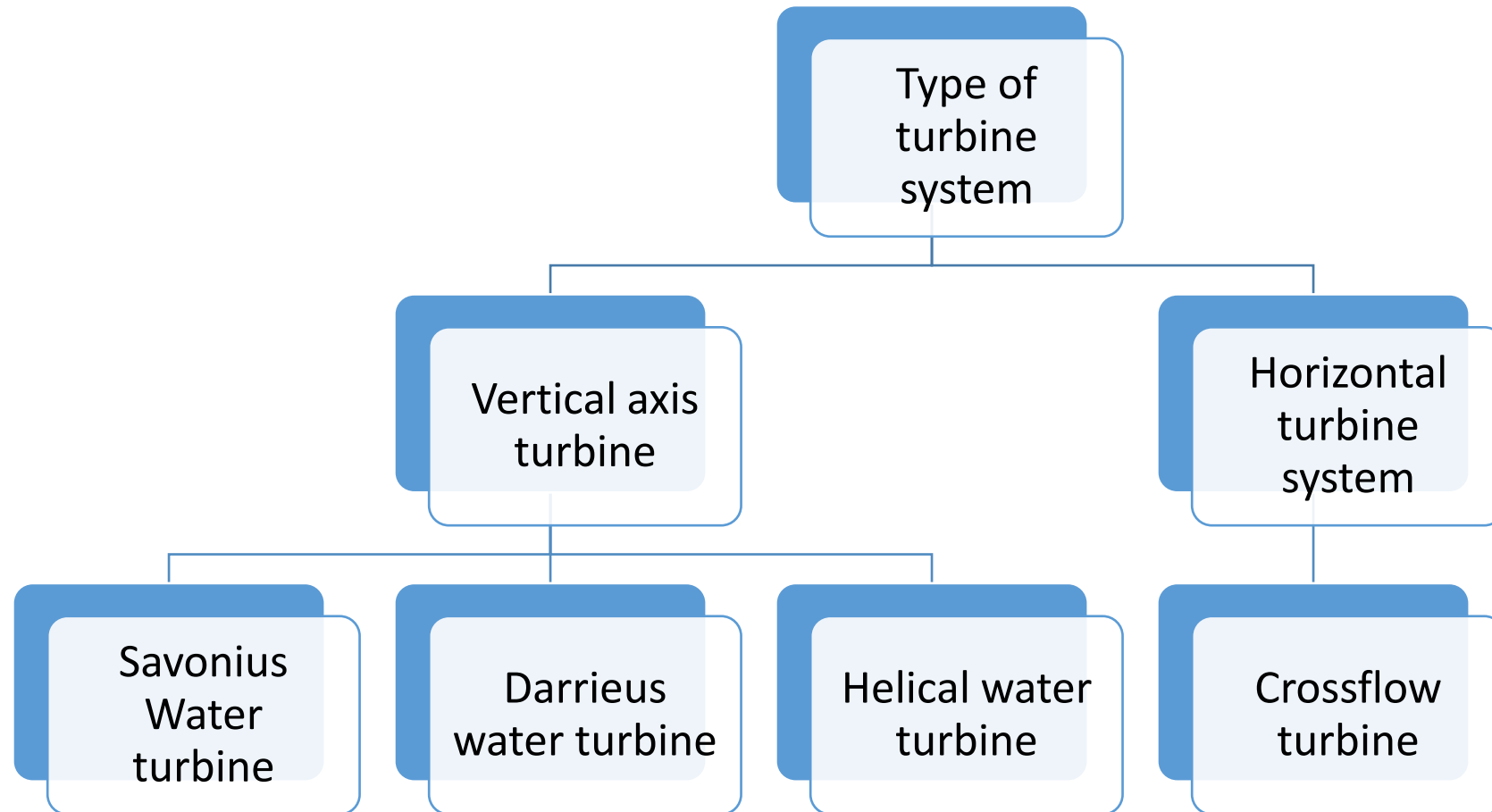
The spur gear of a car and car shaft were used for rotational transmission to increase the rotational speed.

Circular plate adapters were attached to the spur gear and the shaft by bolts.



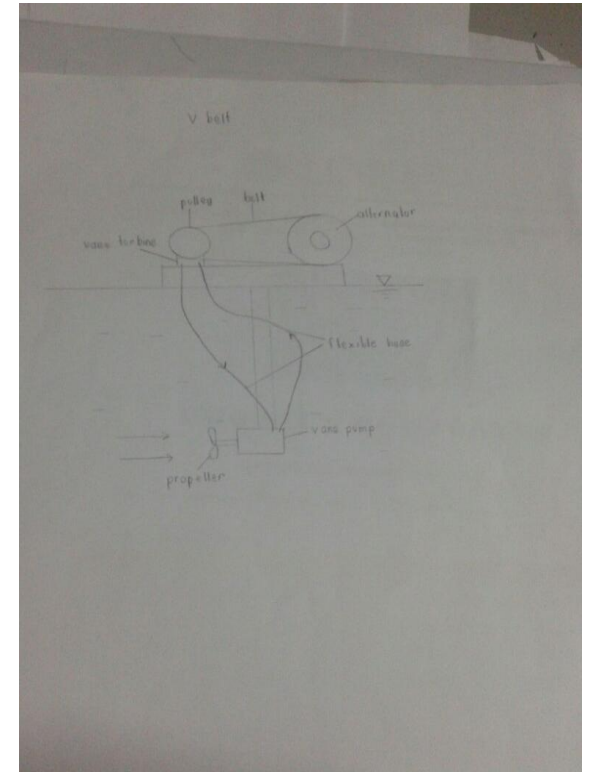
3. Generator

An alternator removed from a scrapped car, widely available in Malaysia was used as the generator. Car alternators are designed to generate 100-200 W of power comparably low rotational speeds (<1200 rpm). Thus car alternators are suitable for pico hydro systems with open waterwheels, which run at low rotational speeds and have a low power output

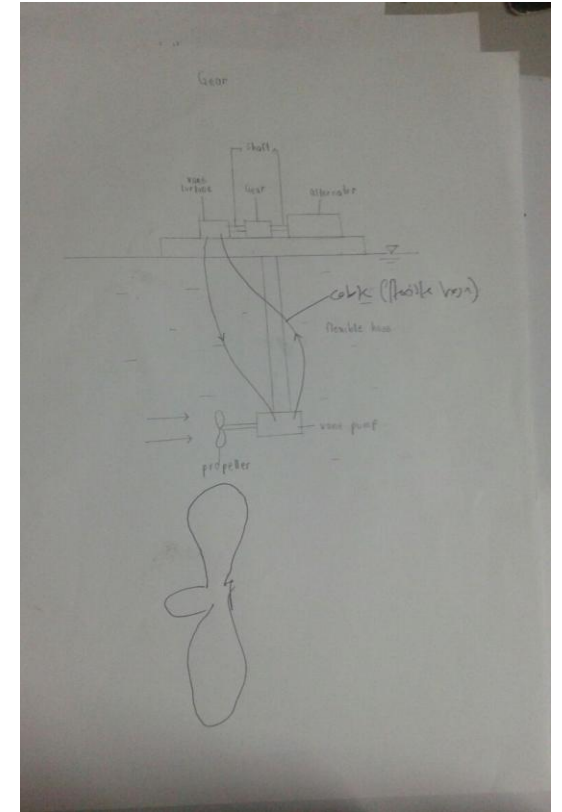


DESIGN METHOD

- There are a few designs of Pico Hydro Water Current Water Turbine.
- Main Ideas and initial designs:
 - 1.
- Use hydraulic fluid in vane pumps.
- Pulley and timing belt – Transmit power to alternator.



- 2.
- Use hydraulic fluid in both vane pumps.
- Gears – Transmit power to alternator.

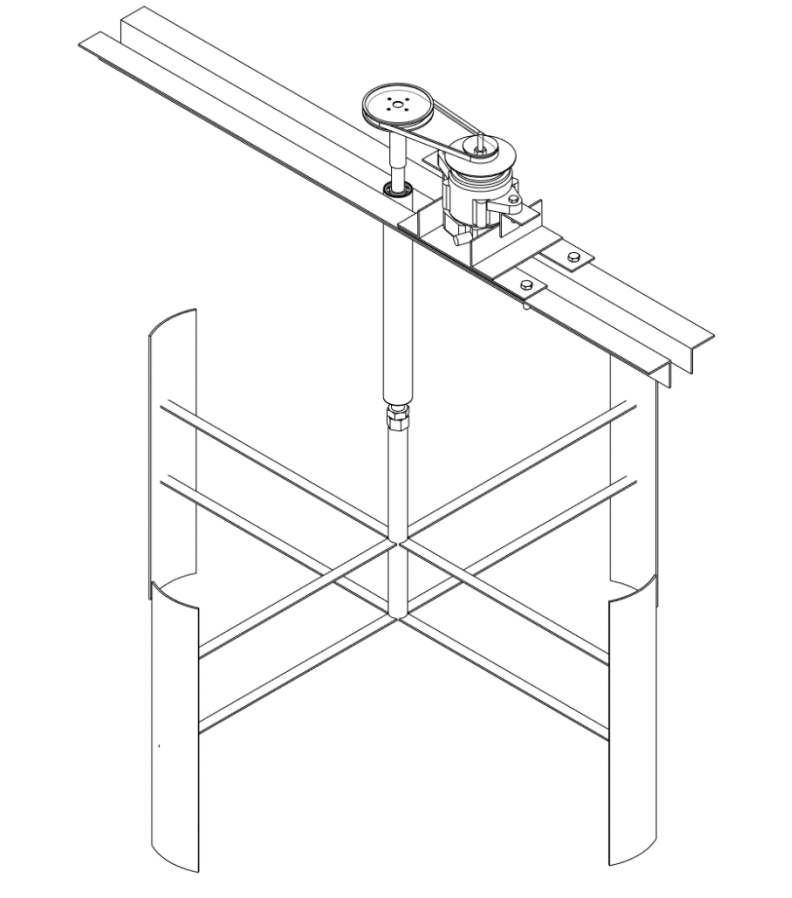


- 3.
- Power – Directly from blade of rotor.
- Based on H – Darrieus turbine.
- The final idea and the used design in modelling.

- Material Used – Mild Steel
- Suitable to withstand high pressure
- Heavy but high hardness
- General purpose steel bars for machining, suitable for lightly stressed components including studs, bolts, gears and shafts.
- Available at workshop

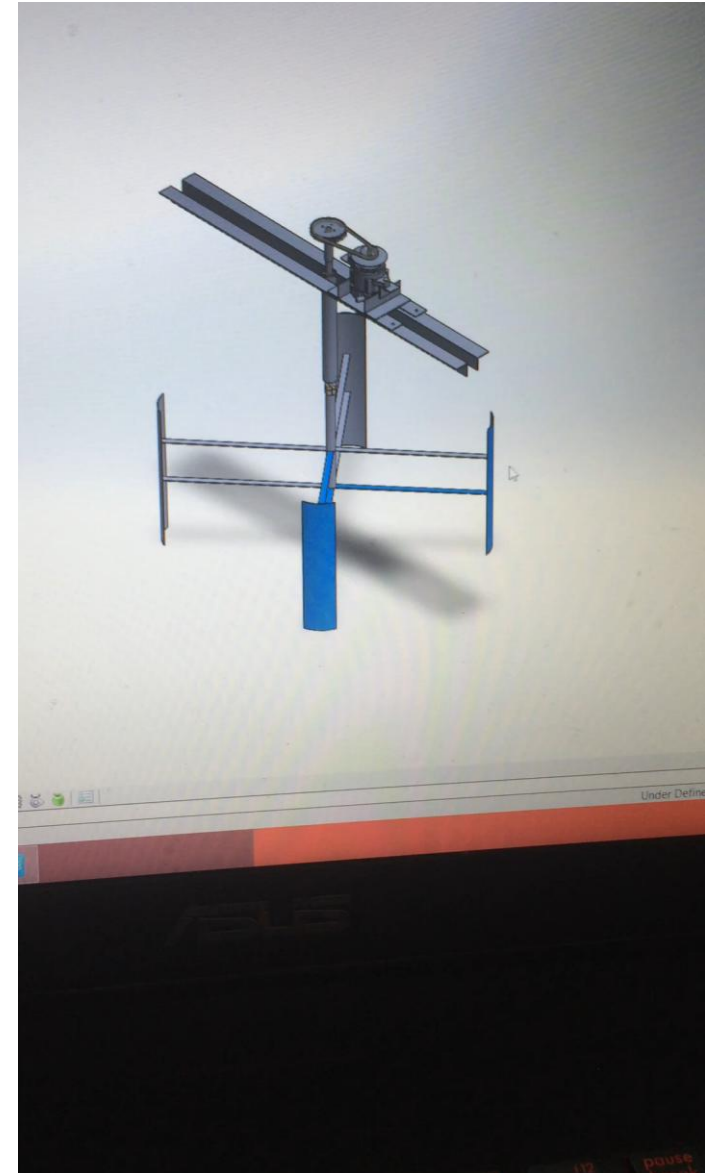
Mechanical Properties	Metric	Imperial
Hardness, Vickers (Converted from Brinell hardness)	131	131
Tensile Strength, Ultimate	440 MPa	63800 psi
Tensile Strength, Yield	370 MPa	53700 psi
Elongation at Break (In 50 mm)		

TECHNICAL DRAWING





VIDEO



FABRICATION PROCEDURE

*Cutting



*Welding



*Drilling



*Grinding



*Lathe Machine



ANALYSIS

- Velocity Calculation Procedure
 - the velocity of the river flow is calculated by throwing a ball in the river
 - let the ball move for a range of 3 metres.
 - dividing the distance travelled by the ball and the time for the ball to reach the destination
- Power Coefficient, Power Mechanical and Power Losses Calculation
 - By using formula $C_p = \frac{P}{\frac{1}{2}\rho AV^3}$, $\text{Power Mechanical} = \frac{\text{Power Generated}}{C_p}$, $\text{Power Losses} = \text{Power Mechanical} - \text{Power Generated}$, $A = 2\pi RH$

Velocity (m/s)	Area of Rotor (m ²)	C _p	Power Generated (kW)	Power Mechanical (kW)	Power Losses (kW)
0.23	1.51	0.55	5	9.26	4.26
0.24	1.51	0.48	5	10.42	5.42
0.25	1.51	0.42	5	11.80	6.80



DISCUSSION

From the graph plotted in figure 4.3.1, velocity value is increased with the increasing of C_p value because speed of the water was changed by the rotational speed of rotor. From figure 4.3.2, velocity value is increase by with the increasing of power mechanical value. This is because the torque of the shaft of the rotor is increased affected by the increasing of the velocity of the river flow. From figure 4.3.3, power mechanical value is increasing directly proportional to power losses value.



CONCLUSION

- It can be concluded that higher power output can be generated with the help of greater water velocity or in this case, river velocity. This is due to the pressure of water increases the velocity of the water flowing through the rotor. Besides that, based on the equation of power generated, the pressure of the water also affected the output power of the system. Moreover, due to high velocity of the water, it made the rotor of the turbine rotate faster and it can generate more output power.

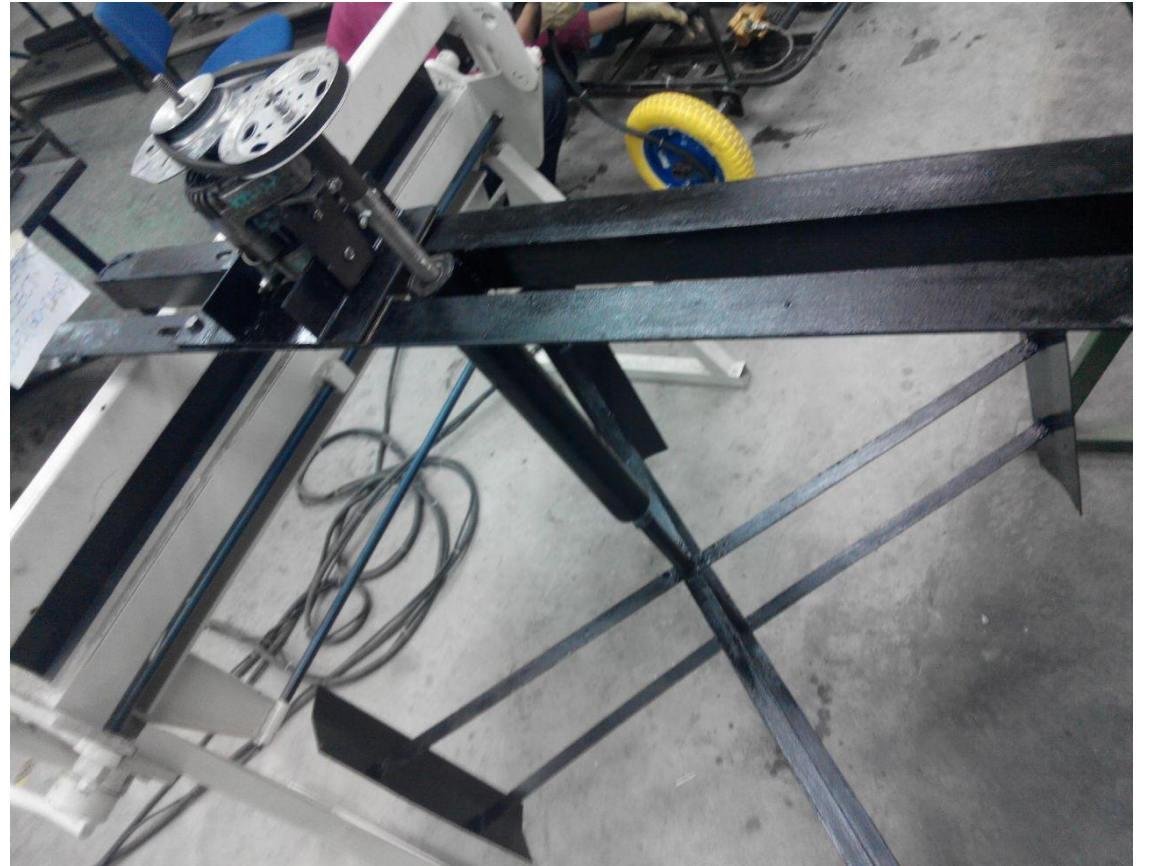
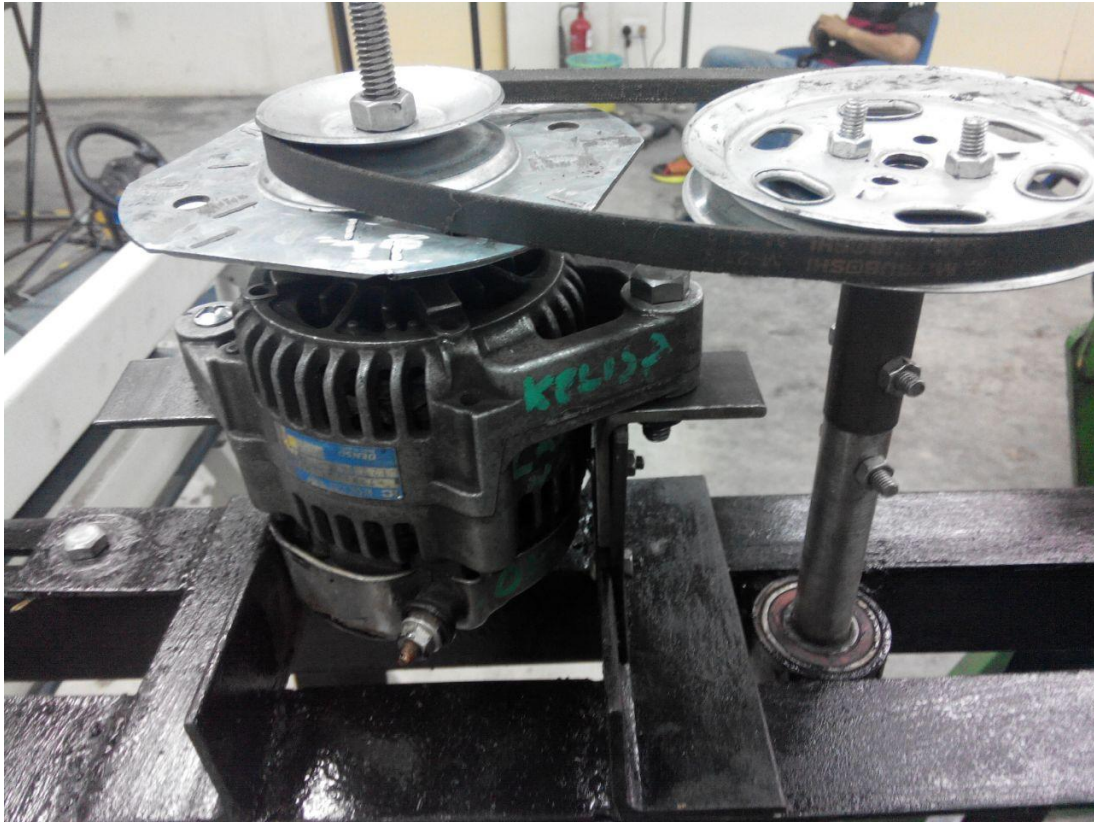
- Lastly, from the designed rotor view, the H-Darrieus with deflectors were able to generate more output power and gave more speed compared to traditional H-Darrieus turbine. With addition of deflectors, the turbine was able to increase drag force on the rotor when water stroked on its blade and the addition of H-Darrieus blade it gave more lift force on the rotor. The deflector was an important role on this project to generate more output power. The conclusion is made based on theoretical analysis. The turbine was made only as a prototype, it satisfies the H-Darrieus concept stated before but due to lack of time, we did not managed to bring this project to test it on the river. We only managed to calculate the possible outcome by using theory analysis.



APPENDIX







THANK
YOU!

