

Generation of Electrical Energy From Overhead Water Tanks of Multistoried Buildings

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Abstract- Water is an essential requirement for human being like as air, food etc. Multistoried buildings consist of overhead water tank for everyday use. Energy can be extracted from flowing of water, a MHTG may be fitted in water pipe. A MHTG converts potential energy of water into electrical energy. Study is done on prototype model. From the result, electrical energy is estimated for 10 storied building on per day and per year basis. This performance of MHTG sets available in the range of head and discharge which are used for other application. The result is shown that, generated energy is less which is stored in the battery and used for small applications.

Keywords- Overhead tank; MHTG-micro hydro turbine-generator set; discharge; generation

I. INTRODUCTION

Energy is important input in the process of economic, social and industrial development. Hydro power is a renewable source of energy. It is non-polluting and environmentally source of energy. Overhead tanks on buildings store large quantity of water. Potential energy is converted into kinetic energy. Moving water from water pipe line is fall on turbine, the blades of turbine spins a generator and electricity is produced.[4]

In this work, by using MHTG with the dc generator, generate electricity and it is used for the domestic purpose.

Hydropower is an important resource, only a few recent projects in developed countries such as US and Canada have been reported. However, with improvements to small hydropower (SHP) and Mini hydropower (MHP), consist new devices, materials and improve in design and operation. The cost of SHP units has become more competitive.[3]

Early in the last decade, a United Nations report incisive that clean and renewable energy, SHP/MHP must be developed as a priority both for its economic benefits.

Energy demand is increasing day to day with fast growing of industrialization. Such conventional energy

sources like coal, oil are going to last for few decade. Human being looking towards renewable energy sources for surviving. Research is going on for further development of renewable energy technologies.[1]

Potential energy is available with water stored in overhead tank on the buildings. Energy can be extracted from water by MHTG when it flows down from tank to flats. The energy is stored in battery which can be used for staircase lighting and other domestic appliances.[2]

II. METHODOLOGY

Overhead tank on buildings stores water for every day use. Energy can be extracted from flowing water when it is supplied to apartments. A micro hydro turbine may be fitted in water pipe line to convert potential energy of water into electrical energy. Paper describes techno-economic feasibility of the concept. Study is done on 5 storied building.

The literature survey carried by author indicates that, no such micro turbine generator set is available in market which exactly matches the application. Paper briefson performance of MHTG sets available in that range of Head and discharge which are meant for other applications. Electrical energy generation for 5 storied building is estimated on per day and per year basis. It is shown that, energy generated is not just sufficient to power staircase lighting of the building, but also in addition conserve substantial part of energy required for lifting water.

III. CONCEPT OF PROTO TYPE MODEL

The storage of water in the overhead tank on multi storey building used for domestic purpose. This water possesses potential energy because of head created it can be converted into mechanical energy with the help of turbine. By using velocity or water force a turbine can be rotated and electrical energy is generated. In this project we are going to generate a DC power by using DC generator. This method of generation of electrical energy has become very popular because it has low production and maintenance cost.

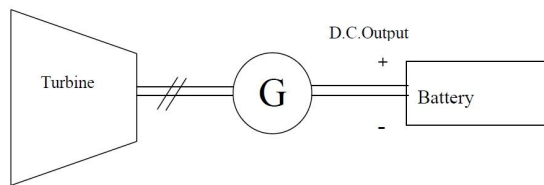


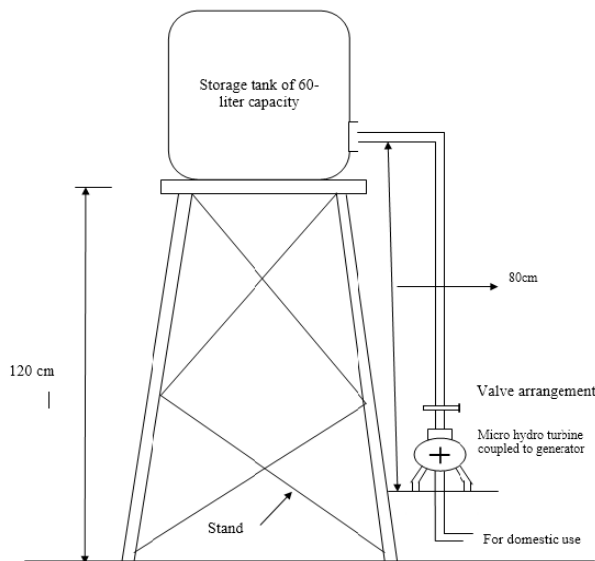
Fig -1: Micro Hydro Turbine System

3.1 POTENTIAL ENERGY OF WATER.

Mass that has been raised above the Earth's surface has a potential energy relative to the same mass on the Earth's surface. Running water over a turbine, some part of this potential energy can be converted into kinetic energy. This kinetic energy is then converted into an electrical energy. The amount of electrical energy that can be generated is equal to the potential energy of stored water[1]. This gravitational potential energy is equal to the product of mass, height, and gravitational constant (9.81 m/s²).

IV. ACTUAL IMPLEMENTATION BY PROTOTYPE MODEL

The regeneration of electrical energy can be obtained by converting the kinetic energy of water stored at top level. The same principle is established in a small model containing all the phenomenon of the micro-hydro generation plant. The model has storage of 60 liters' capacity. This storage tank is kept on the stand of the height of 120cm=1.20m. The height of outlet flow pipe from stand is 80cm=0.80m. So the total head up to the ground level is 1.6m. If the turbine is located in the path of the flow, electrical energy can be generated when the water flows downward.



PROTO TYPE MODEL



4.1 DESIGN OF MICRO HYDRO TURBINE GENERATOR

The minimum available water head for energy generation is around 3 metres for single storied building with addition of 3 metres for every added floor. The minimum water discharge produced by partial opening of a water tap is found to be fraction of a litre per second by measurements taken. Micro hydro turbine-generator sets can be made which can produce power with water discharge as low as 0.18 litres/second and those with water head as low 2 metres². Literature survey carried out so far, indicate that micro hydro turbines are not available in markets, which exactly match this application. The water use is not continuous and so the discharge. That's why energy is required to be stored in battery. One micro hydro turbine-generator set to be commissioned on each floor. The Head availability ranges from 3 metres to 30 metres for 10 storied building.

4.2 CALCULATING THE GENERATED ENERGY FROM PROTO TYPE MODEL

1. Diameter of pipe use for discharge of water = 25.4mm.
2. Head available for ground floor turbine = 0.79m.
3. Time required to reach the water flow to turbine = 0.26 seconds.

Therefore,

$$\text{Power generated} = QgH \text{ k watt}$$

where,

Q = water discharge rate in cubic meter per second.

$$g = 9.81\text{m/s}^2$$

H = net head in meter (m).

Then,

$$Q = (52.4 \times 10^{-3})^3 / 0.26$$

$$Q = 6.302 \times 10^{-5} \text{ m}^3/\text{sec.}$$

Therefore,

$$1. \text{Power generated} = QgH$$

$$= (6.302 \times 10^{-5}) \times 9.81 \times 0.79$$

$$= 4.883 \times 10^{-4} \text{ watt}$$

Similarly,

As calculations are followed by:

Table 1: Generated energy from prototype model.

Sr. No.	Height(h) Meter(m)	Voltage(V) Volts	Power(P) Watts(w)* 10 ⁻⁴
1	0	0	0
2	0.79	2.72	4.883
3	0.84	2.74	5.193
4	0.89	2.76	5.502
5	0.94	2.79	5.811
6	0.99	2.80	6.120
7	1.04	2.84	6.429
8	1.09	2.87	6.738
9	1.14	2.90	7.047
10	1.19	3.1	7.356

4.3 RESULT

From the above table of prototype model, it is seen that as per design specification MHTG is most useful. The power generated is about 4.883×10^{-4} watt, We use this concept for 10 storied building.

V. ACTUAL GENERATED POWER:

Power generated is tested by connecting a pilot lamp at the terminals of generator. Voltage available is 3V and current is 0.95 m Amp. Valve arrangement can give better efficiency. The cost of proto type model for installing generator and turbine is obtained as Rs.1000.

VI. CALCULATING THE GENERATION ENERGY FOR 10 BUILDINGS

Assumption made

1. There are five flats per wings per floor.
2. The number of persons per flat is four.
3. 80 % of water is being used in morning four hours .This figure will be useful to find avg.water discharge.
4. One MHTG is set is to be installed per floor.

Energy estimation

For 10 storied building water head available with generator at ground floor H=30m with floor height of 3m . Water consumption of 150litres per capita per day 4, with 4 persons per family & 5 flats per floor, total water consumption per floor, per wing is equal to

Water consumption = $150 \times 4 \times 5 = 3000$ litres.

With 80% of water is used in morning 4 hours

Average discharge per floor in

litres/second, $Q = (3000 \times 0.8) / (4 \times 3600)$

$$= 0.167 \text{ litres/second} = 0.167 \times 10^{-3} \text{ m}^3/\text{s}$$

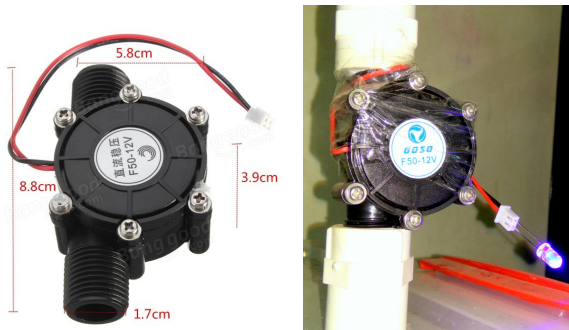
Available water power is given by $P_a = 1000 \times QgH$ Watts , Assuming overall efficiency MHTG set including losses in pipes to be of 50% (water to wire),

Table 2: Generated energy for 10 storey building.

Floor No.	Water head m	Power(p) Watt (w)	Electric energy Kwh	Cost of Energy in Rs.
1	3	4.91	0.0122	13.36
2	6	9.83	0.0245	26.83
3	9	14.74	0.0367	40.18
4	12	19.66	0.049	53.65
5	15	24.57	0.0613	67.12
6	18	29.49	0.0735	80.48
7	21	34.40	0.0858	93.95
8	24	39.32	0.0981	107.42
9	27	44.23	0.110	120.45
10	30	49.15	0.1226	134.25

VII. SUITABLE TURBINE

The turbine is required to be fitted in the pipeline. When all water taps are closed, water will be filled up in the turbine. So impulse type turbines will not be suitable for this application. Reaction turbines will be suitable in this case.



VIII. ENERGY STORAGE IN BATTERY

As the use of water and hence water discharge is not continuous, energy generated is required to be stored in battery. 12 V or 24 V batteries can be used. CFL lamps can be powered directly from batteries. For this purpose inverter circuits used in emergency lanterns which operate on 12 V dc supply will be most appropriate. For other loads inverters are to be used to convert 12 V/ 24 V dc into mains voltage.

IX. RESULT

Energy generated per day from 1st floor to 10th floor = 0.551 KWh

Energy generated per year = 201.15 KWh

Cost of energy per year @ Rs.4 per KWh = 938.85

Total energy generated per year for 10 storied building will be 0.551*365 KWh.

Cost of energy for 10 storied building will be Rs. 804.60 @ Rs. 4 per KWh.

Sum of energy generated for 1st to 10th floor per day will be 0.551 KWh.

Sum of energy generated for 1st to 10th floor per year will be 201.15 KWh.

Cost of energy generated for 1st to 10th floor per year will be Rs. 293679

X. CONCLUSION

From this result, we seen that by using this technology generated energy is stored in battery which can be used whenever required. Hydro electric energy has always important part of the world's electricity supply which provide harmless, reliable, cost effective electricity, and will continue to do so in the future.

XI. FUTURE SCOPE

Since, renewable energy is the future of the power generation as electricity to all by Shri Narendra Modi. A small MHTG set should be developed which can be fitted in water

pipe line and that model should be fixed on each floor of multi storey buildings.

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