iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 13 **Issue:** IV **Month of publication:** April 2025

DOI: https://doi.org/10.22214/ijraset.2025.69803

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue IV Apr 2025- Available at www.ijraset.com

Feasibility Study of Mini Hydel Power Plant

Abhishek Lokare [1], Rohit Akhade[2], Nikhil Chavan[3], Rushikesh Pawar[4], Tejas Yadav[5], Zaid Patvekar[6], Prof. Hanmant Kumbhar[7]

[1, 2, 3, 4, 5, 6]*Final Year B. Tech, Department of Civil Dr. Daulatro Aher College of Engineering Karad, India*
[7]*Vice Principal, Dr. Daulatro Aher College of Engineering Karad, India*

Abstract: ***This research paper presents a practical implementation and analysis of a small-scale hydroelectric generation plant designed for an educational institution. The project utilizes rooftop rainwater harvesting, a vertical Kaplan turbine, and solar-assisted pumping to generate renewable energy. Detailed design parameters, turbine selection, prototype testing, annual energy output, and economic analysis are discussed. The model serves not only as a viable green energy solution but also as a demonstrative educational tool.***

Keywords: Hydropower, Kaplan Turbine, Micro-Hydro, Renewable Energy, Sustainable Campus, Rainwater Harvesting.

I. INTRODUCTION

Small-scale hydropower harnesses renewable energy from flowing water, offering efficient, environment-friendly electricity. In this project, a compact hydropower system using rooftop rainwater is developed for an academic institution. The combination of civil, mechanical, and electrical disciplines aims to reduce dependency on grid power while promoting sustainable development.

II. LITERATURE REVIEW

Relevant literature highlights global progress in distributed generation, Kaplan turbine optimization, feasibility of urban hydro systems, and integration of hybrid renewable energy sources. These studies underline the viability of small hydropower in rural as well as institutional urban contexts.

III. METHODOLOGY

1) Site Selection: College rooftop with adequate rainwater collection potential
2) Discharge Measurement: 249.84 L/min (0.004164 m^3/s
3) Head: 13 meter
4) Power Output Calculation: 424.83 W theoretical, 297.38 W actual (after generator efficiency
5) Turbine Design: Vertical Kaplan type, 30 mm runner, 10 mm shaft, 5 blade
6) Component Design: Includes intake, penstock (50 mm dia.), forebay, draft tube, and generato
7) Prototype Development: 3D printed components, tested on-site



Fig.no.1. Calculation of head with the help of the total station.



Fig.no.2. Taking the staff reading help of total station

©IJRASET: All Rights are Reserved



Fig.no.3. Selection of water tank location



Fig.no.4. Selection of turbine location

In India, the classification of small, mini and micro schemes has been done by the Central Electricity Authority (CEA) based on total station capacity as well as unit rating Indian standard code IS: 12800 (Part-111)-1991 defines small hydro up to 15MW station capacity.

Table-I. Classification of Mini Hydro Schemes Depending on Capacity

Type of scheme	Station capacity (KW)	Unit rating (KW)
Small hydro	25000	1001-5000
Mini hydro	2001-25000	101-1000
Micro hydro	1001-2000	100
Pico hydro	10-100	-

Mini hydro plants are also classified according to the "Head" or the vertical distance through which the water is made to impact the turbines. The usual classifications are given below.

Table-II. Classifications of Mini Hydro Schemes Depending on the Available Head

Ultra-low head	Below 30 meters
Medium head	30 to 75 meters
High head	Above 75 meters

IV. COMPONENTS OF PROTOTYPES HYDROELECTRIC MODEL

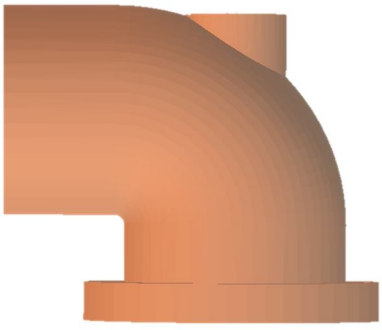


Fig.no.5. Elbow Casing



Fig.no.6. Shaft

©IJRASET: All Rights are Reserved | SJ Impact Factor 7.538 | ISRA Journal Impact Factor 7.894 |

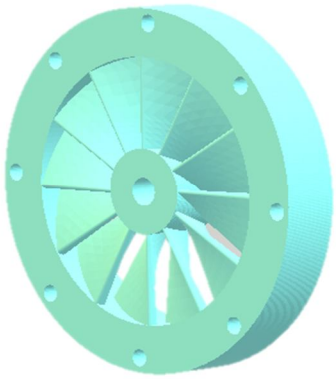


Fig.no.7. Wicket

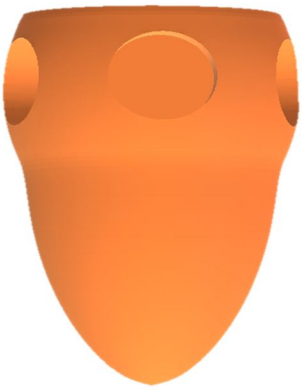


Fig.no.8. Runner

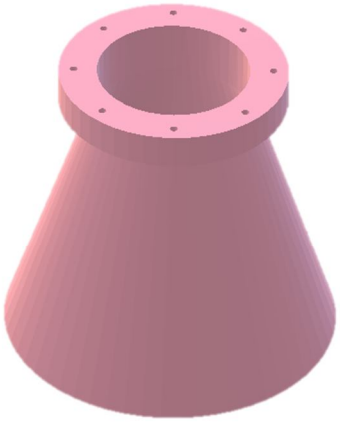


Fig.no.9. Draft tube.



Fig.no.10. Blade.

V. SYSTEM DESIGN AND CALCULATIONS

- Intake Area: 0.01388 m² (velocity limited to 0.3 m/s)
- Penstock Flow: Velocity = 2.12 m/s, Head loss = 0.18 m
- Generator Matching: PMDC motor or bicycle dynamo (70% efficiency)
- Annual Energy Output: 1085.44 kWh/year (10 hr daily use)
- Freeboard/Safety: 20% water depth allowance, 1.3 bar pressure rated pipes

VI. RESULTS AND DISCUSSION

- System classified as micro-hydro (<1 kW)
- Annual savings potential in grid dependency
- Educational benefits through real-time demonstration
- Prototype performance validated through testing

VII. ECONOMIC ANALYSIS

- Total Estimated Cost: ~Rs. 11,500 – 12,000
- O&M Cost: Rs. 500–700 annually
- Cost per kWh (5 years): Rs. 2.67/kWh

©IJRASET: All Rights are Reserved | SJ Impact Factor 7.538 | ISRA Journal Impact Factor 7.894 |

VIII. CONCLUSION

The implementation of a small hydroelectric power system within a college campus demonstrates both technical feasibility and cost-effectiveness. It aligns with sustainable development goals and offers a scalable model for educational and remote area applications.

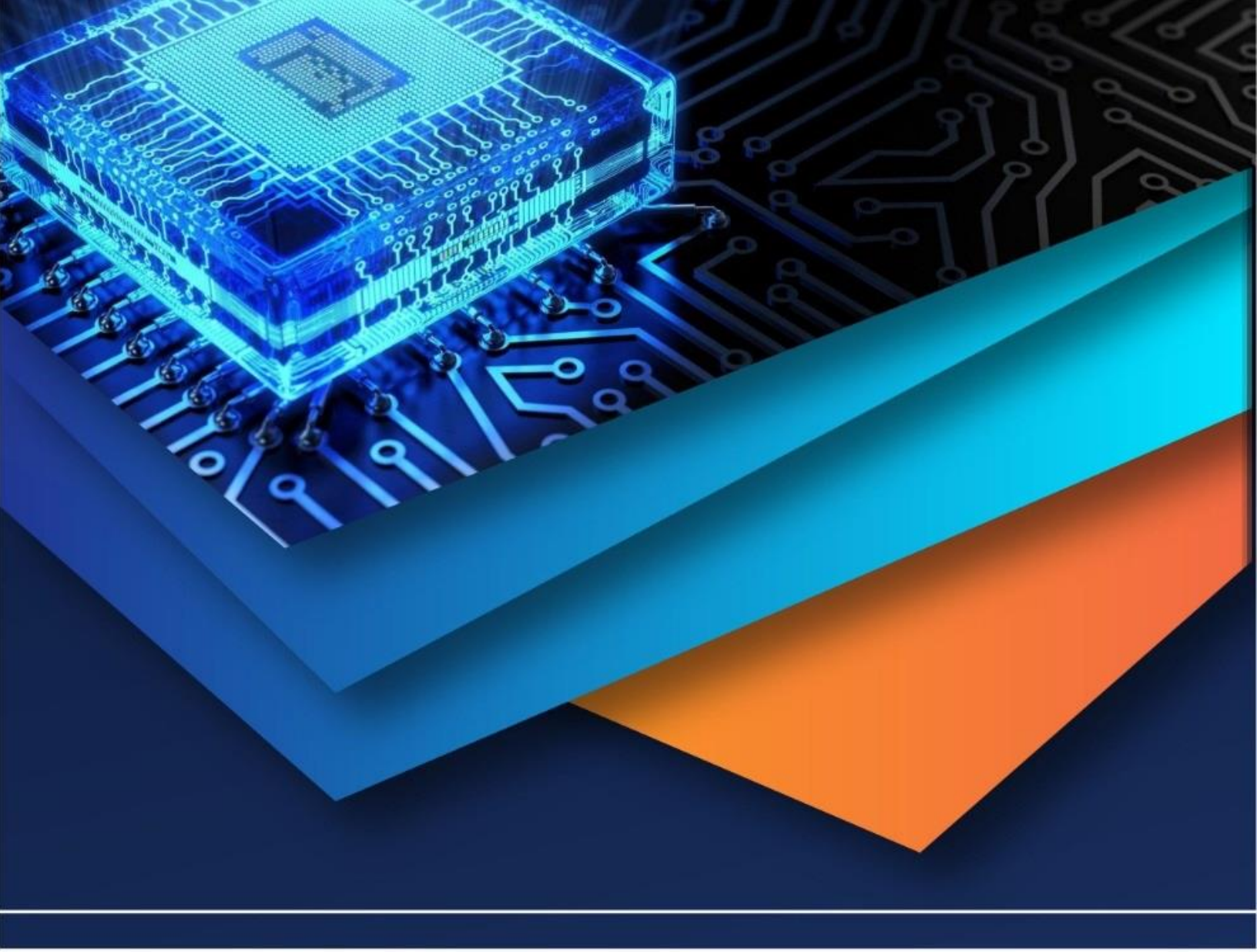
IX. ACKNOWLEDGMENTS

We extend our gratitude to our college faculty and technical staff for their constant support and guidance. Special thanks to the Department of Mechanical Engineering for providing resources for 3D printing and prototype development.

REFERENCES

[1] Adhau.S "Economic Analysis and Application of Small Micro/Hydro Power Plants (2009) "Environmental Impact Assessment for Small Hydropower Projects"
[2] Aliewuebdametew (2016) "Environmental Impact Assessment for Small Hydropower Projects"
[3] Alvi N. et al. "Performance of Tawa Hydroelectric Power Plant-A Case Study" (2007)
[4] Bower, J. Hamm C "An Emieevaleation of Small-Scale Distributed Electricity Generation Technology (2003)
[5] Hussein I. Raman, N "Reconnaissance Study to Identify Micro Hydro Potential Sites in Malaysia" (2010) "Environmental Impact Assessment for Small Hydropower Projects"
[6] Jha R. Krishna S. et al. "Spatial Decision Support System for Assessing Micro, Mini and Small Hydel Potential" (2004)
[7] Ministry of New and Renewable Energy "Environmental Impact Assessment for Small Hydropower Projects" Standards/Manuals Guidelines for Small Hydro Development Version 2 (2011)
[8] Oliver P. Of Derwent Hydro, "The British Hydropower Association" Guide to U.K. Mini Hydro Developments, (2005)
[9] Steven Spicer (2014) Feasibility Study on Proposed Micro Hydro Electrical Power Plant
[10] Thoradeniya B, et al. "Social and Environmental Impacts of a Mini-Hydro Project on the Ma Oya Baste in Sri Lanka" Published by Department of Civil Engineering, University of Moratuwa, International Conference, Sri Lanka (2007)

©IJRASET: All Rights are Reserved | SJ Impact Factor 7.538 | ISRA Journal Impact Factor 7.894 |



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Call : 08813907089 (24*7 Support on Whatsapp)