



INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

The rapid dwindling of oil reserves, growth of climate change, harmful environmental effects of conventional energy producing technologies and proliferation of energy demand encourage the researchers to look for harmless, reliable, cheaper, sustainable and clean energy production technologies. Such explorations and accessibility of electrical energy determines the economic growth and social living standards. Among the available renewable sources, hydro and wind power seem to be the optimum choices. The absence of an efficient, low cost and environment friendly hydraulic energy converters suited for free-flowing water are still a major barrier to the exploitation of renewable energy source. Therefore, the present analysis is planned for understanding the feasibility of generating power by using a hydrokinetic turbine with emphasis on turbine design and performance. Advantageously, the hydrokinetic power generation system does not require a conventional dam and hence it is possible to reduce the construction costs, and at the same time to prevent the environmental pollution. Till date, hydrokinetic devices have not been extensively utilized in commercial power plants. Further, there are limited data available to estimate the turbine performance.

In view this, the present investigation is mainly focused on the performance analysis of hydrokinetic turbines (drag-based Savonius and lift-based helical-bladed turbines). The objective of the study is set to parametrically investigate the performances of Savonius and helical-bladed turbines in terms of power coefficient, torque coefficient and starting characteristics. Based on the literature review, the Savonius turbines are developed and tested by varying number of blades, and blade shape. Similarly, the helical-bladed turbines developed and tested by varying its solidity ratio and number of steps. The field tests have been conducted at various sites like open channel flow flume, irrigation sluice and river Brahmaputra. The experimental findings are further justified through unsteady CFD simulations using ANSYS Fluent.

Efforts are also extended to measure the output characteristics of the turbines at varying immersion levels as there can be an alteration in the associated water level due to seasonal changes. The experimental data for such conditions are not reported in open literature. At the same time, it is also important to review the relevance of solidity ratio and performance degradation due to change in immersion level. Besides this, the outcome of such explorations would reduce the scarcity of field data mostly required for validation of different computational algorithms for single and multi-phase flows or solvers of fluid structure interaction.