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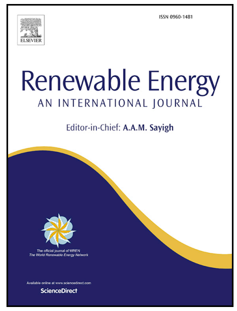


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# Impact of channel blockage on the performance of axial and cross-flow hydrokinetic turbines

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**Abstract**

This work investigates the effect of channel blockage on the performance of axial and cross-flow turbines with the objective of filling a gap in the literature on suitable blockage corrections for cross-flow turbines. Our investigation is based on 3D computational fluid dynamics simulations at high Reynolds number. Blockage corrections are proposed for axial and cross-flow hydrokinetic turbines. These corrections allow the estimation of the drag, power and tip speed ratio of the theoretically unconfined turbine, based on results of the confined turbine. It is found that a blockage correction based on a simple linear momentum actuator disk theory, is quite adequate when applied to both axial and low-solidity cross-flow turbines. Results suggest that for the 3-bladed (high-solidity) cross-flow turbine, this method slightly underpredicts the correction factor, more so for drag than for power. Normalizing with the bypass flow velocity improves the drag correction. For both technologies, the power extracted is found to be almost insensitive to blockage when dynamic stall is present. To discriminate between lateral and vertical confinement is usually not required, the performance being mostly dependent on the blockage ratio (ratio of turbine and channel frontal areas) unless the confinement asymmetry differs by more than a factor of 3.

*Keywords:* Blockage, Hydrokinetic, Cross-flow, Turbines

## 1. Introduction

It is well known from the best practices in wind tunnel measurements that forces measured should be corrected for wall interference, i.e., to correct the data to account for the accelerated flow due to confinement [1–3]. By continuity, the acceleration of the flow bypassing an object in a confined environment depends on the level of blockage caused by the presence of the object itself (geometry blockage) and its wake (wake blockage). In a confined environment, the flow cannot expand as much as in the unconfined case

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