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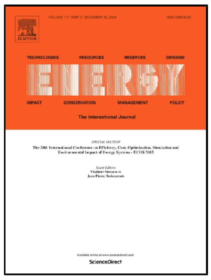

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HIGHLIGHTS

- Power and vortex characteristic are discussed with panel method.
- Effects of the rotor aspect ratio and solidity on the performance are investigated.
- For the $\sigma = 0.064$, the maximum power coefficient increases with increasing of *H/D*.
- Circulation amount ratio indicates a large negative value in the case of *H/D* = 0.9.
- Power at the blade central position increases with increasing of rotor aspect ratio.

ABSTRACT

Due to the complated flow field and aerodynamic forces characteristics, the performance and safety standard of straight-bladed VAWT have not been full developed. The objective of this study is to investigate the effect of rotor aspect ratio and solidity on the power performance in three-dimensional analysis by panel method. The panel method is based on the assumption of an incompressible and potential flow coupled with a free vortex wake. First of all, the fluctuations of power coefficient and the circulation amount distribution of the bound vortex are discussed at the fixed solidity of $\sigma = 0.064$ during rotation. Then, the fluctuations of power coefficient and the circulation amount ratio are also investigated in the spanwise direction of the blade. It can be observed from the results that the peak of power coefficient increases with the increase of the ratio of the diameter and blade span length *H/D* at the fixed solidity. However, the optimum tip speed ratio was expected to be increased with the increase of *H/D*. Moreover, in the case of the fixed rotor aspect ratio of *H/c*=6, the power coefficient depends on the rotor aspect ratio, rather than the ratio of the diameter and blade span length. Compared with the *H/D* = 1.2, the circulation amount ratio of *H/D* = 0.9 indicates a large negative value in the blade center position.

Keywords: Straight-bladed vertical axis wind turbine, Rotor aspect ratio, Solidity, Three-dimensional analysis, Panel method.

NOMENCLATURE

c	Airfoil chord length [m]
C_P	Power coefficient
C_{lP}	Local power coefficient
C_D	drag coefficient
C_L	Lift coefficient
$C_{L,\mathrm{inviscid}}$	Local lift coefficient
C_Γ	Circulation amount coefficient
D	Rotor diameter of wind turbine [m]

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