AIN SHAMS UNIVERSITY

FACULTY OF ENGINEERING

Mechanical Power Engineering

Performance Analysis of S-Shaped Helical Wind Turbine (SHWT)

A Thesis submitted in partial fulfillment of the requirements of the degree of

Master of Science In Mechanical Engineering

(Mechanical Power Engineering)

By

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Master of Science In Mechanical Engineering

(Mechanical Power Engineering)

Faculty of Engineering, Ain Shams, 2016

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Dr. Ashraf Abd El Badee Ghorab

Cairo - (2016)

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Date: 21 November 2016

Statement

This thesis is submitted as a partial fulfilment of Master of Science in Mechanical Engineering , Faculty of Engineering Ain shams University degree in Mechanical Power Engineering.

A huge work in this thesis is carried out by the author. This work includes, designs of six S-Shape Helical wind turbines SHWT 90˚, 120˚ and 180˚, single and double, then manufacture all of them, then testing the SHWT turbines in an open system wind tunnel with calibrated measurement instruments.

The author carried out the work included in this thesis, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

Yahia Salah El Din El-Masry

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Thesis Summary

In this study we present an experimental and numerical investigation for the performance of a specially designed S-Shaped Helical Wind Turbine (SHWT). The study is carried out for single blade & double blade turbines with three different helical angles; namely (90, 120 & 180 degree). The turbines fabricated from ply wood with 0.6 m diameter, 0.7 m length and 2 cm thickness.

Experiments are performed using 0.8×0.8 m^2 wind tunnel cross section area at a constant wind speed of 8 m/sec. Experiments are performed to obtain the turbine performance for the several considered designs and comparing between them. Numerical analysis using computer software "Ansys V14.5" is used to develop single blade turbine with helical profile 90 angle degree to study the velocity and pressure contours. This aims to compare the results with the obtained experimentally for the verification of the selected model.

Several results are obtained for the selected designs. It is found that, within the tested range, the double blade turbine with helical angle of 120 degree has the highest performance compared with the other configurations. The obtained Power Coefficient (C_p) is 0.12 at Tip Speed Ratio (TSR) of 0.52. Double blade S-Shaped Helical Wind Turbines SHWT has higher torque coefficient than single blade at the same helical profile and the single and double blade S-Shaped Helical Wind Turbine SHWT at helical profile 180 degree has the lowest performance and torque coefficient compared to other SHWT turbines, where single blade at 180 degree the power coefficient is 0.058, torque coefficient 0.24 and the double blade at 180 degree the power coefficient is 0.0853, torque coefficient is 0.28.

All of the obtained results are compared with other investigators and a fair agreement is found.

Key words: S-Shaped Helical Wind Turbine, Horizontal Axis Wind Turbine, Coefficient of Power, Torque Coefficient, Tip Speed Ratio, Single Blade, and Double Blade.

Acknowledgment

I want to express my deep gratitude and appreciation to:

Prof. Dr. Mohamed Abo El Enein El- Samanoudy, professor doctor of, Mechanical Power department, Faculty of Engineering Ain Shams University.

And

Assistant Pro. Dr. Ashraf Abd El Badee Ghorab, Assistant professor doctor, Mechanical Power department, Faculty of Engineering Ain Shams University.

For their guidance and continuous encouragement through this huge work and their sincere assistance, continuous help. I also appreciate their following up and continuous advice and constructive remarks in the preparation and all the process of this thesis.

November 2016

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