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شبكة المعلومات الجامعية

بسم الله الرحمن الرحيم



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شبكة المعلومات الجامعية



شبكة المعلومات الجامعية التوثيق الالكتروني والميكرو فيلم



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شبكة المعلومات الجامعية

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

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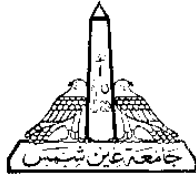


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بالرسالة صفحات لم ترد بالأصل





AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
Mechanical Power Engineering

Effects of Blade Design Parameters on The Performance of a HAWT

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

Master of Science in Mechanical Engineering

(Mechanical Power Engineering)

by

Zakaria Mostafa Abdo Salim Marouf

Bachelor of Science in Mechanical Engineering

(Mechatronics Engineering)

Supervised By

Prof. Dr. Mahmoud Abdel Rasheed Nosier

Prof. Dr. Mohamed Rafat Okelah

Prof. Dr. Ashraf Ghorab

Cairo - (2019)



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

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.

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Thesis Summary

In view of the increasing concerns about wind energy exploitation as one of the promising alternatives of renewable energy systems, numerous efforts are directed to rotor blades design in order to achieve the best performance. Forces acting on rotor blades of horizontal axis wind turbine (HAWT), and hence the turbine power coefficient, are greatly affected by deviations in blade profile shape and surface roughness from design conditions. Both may change due to environmental impacts such as dust, sand, ice...etc. One of the methods proposed for restoring performance of blades suffering from such changes is to attach a winglet at the tip of the blades.

The present work examined the winglet effect on blade performance at different operating conditions. An experimental study on a model of HAWT was carried out at the project laboratory to investigate the winglet positive effect on power coefficient. Blades are tested in six modes namely; clean surface with and without winglet, rough surface with 1-mm and 3-mm height models and rough surface with 1-mm and 3-mm height models provided with winglet.

Primary variables were measured at different air speeds and blade angles of attack, and performance parameters were deduced. A remarkable improvement in power coefficient was generally obtained.

A winglet effect, WE, was investigated to show the effect of winglet on blade performance. It was shown that mounting winglets at the tips of the blades have positive and negative variations in power coefficient depending on operating conditions.

A restoration factor, RF, was introduced to indicate how much of the blade-power lost due to increased surface roughness could be restored when attaching a suitable winglet. Although RF varies greatly with operating conditions, with values ranging between zero% to 100%, its average positive effect was obvious. The favorable effect of the winglet extended to include improving the performance of blades even at the clean mode (designed). A power enhancement factor, PEF, was thus introduced and estimated. Calculated results showed an increase in power coefficient exceeding 20% at test conditions.

Key words:

HAWT, Blade Surface Roughness, Winglet, Power Coefficient, Restoration Factor.

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