DEVELOPMENT OF ROTOR FOR AXIAL FLOW COMPRESSOR

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‘I admit to have read this report and it has followed the scope and quality in Partial Fulfillment of Requirements for the Degree of Bachelor Mechanical Engineering (Thermal Fluid)’

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This report for Projek Sarjana Muda is submitted in partial fulfillment for Bachelor of Mechanical Engineering (Thermal Fluid)

Faculty of Mechanical Engineering

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APRIL 2009

"I admit that this report is my own work except for some summaries and information which I have already stated"

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This report is dedicated to my lovely mother Mrs. Arseh@Rukinah Sukardi, my father Mr. Hussin Hj. Tengah, and my family.

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ABSTRAK

Mesin turbo merupakan mesin di mana pertukaran tenaga berlaku di antara bendalir yang mengalir dengan bilah kipas yang berputar, hasil daripada tindakan dinamik dan menghasilkan perubahan tekanan dan momentum ke atas bendalir tersebut. Dalam Projek Sarjana Muda ini, kajian terhadap kecondongan sudut bilah dan halaju putaran rotor terhadap kadar alir udara, tekanan, dan kecekapan pemampat dijalankan untuk merekabentuk sebuah rotor pemampat paksi. Beberapa siri eksperimen dijalankan ke atas unit *FM36 Air Flow Compressor Test Rig* yang terdapat di Universiti Teknikal Malaysia Melaka bagi mendapatkan parameter yang optimum bagi bilah bersudut 50°, 60°, 70° dan 80°. Didapati bahawa halaju dan tekanan udara yang dimampat berkadar terus dengan halaju putaran. Sudut bilah yang kurang bertepatan dengan halaju menyebabkan pemampat kehilangn kecekapan disebabkan fenomena ketegunan. Hasil analisis data digunakan dalam penentuan sudut pintalan bilah rotor, di mana ia merupakan faktor penting dalam penghasilan sesebuah rotor pemampat paksi. Kajian ini amatlah penting bagi menambah kefahaman yang mendalam terhadap sesebuah mesin turbo terutamanya pemampat paksi. Hasil daripada kajian ini akan digunakan dalam pembangunan rotor pemampat paksi pada peringkat yang seterusnya.

ABSTRACT

A turbomachine is a device in which energy transfer occurs between a flowing fluid and a rotating element due to dynamic action, and results in a change in pressure and momentum of the fluid. This Projek Sarjana Muda was aim to investigate the effect of blade pitch angle, and rotational speed of rotor to air volume flowrate, net head and efficiency of axial compressor to develop a rotor. Series of experiment will be conduct on FM36 Axial Flow Compressor Test Rig at UTeM's laboratory to obtain optimum parameter for blade with pitch angle 50°, 60°, 70° and 80°. Found that flowrate and net head are directly proportional with rotational speed. Too large or too steep blade pitch angle will made compressor running with low efficiency caused by stall. Analysis from collected data was used to determine amount of twist for rotor blade, which is it was important factor to develop a good and efficient axial compressor. This case study is important to enhance knowledge on turbomachine especially axial compressor. This project will be used for further research in development of rotor for axial flow compressor.

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α	=	Angle of attack (°)
D	=	Diameter (*m*)
g	=	Gravity (9.81*m/s*)
H	=	Net head (*mmWg*)
$\cdot$	=	mass flow rate (*kg/s*)
N	=	speed (*rpm*)
r	=	radius (*m*)
T	=	Torque (*N.m*)
U	=	Blade speed, ωr
	=	Tangential blade speed in a radius r (*m/s*)
V	=	Absolute velocity (*m/s*)
V_{in}	=	Inlet velocity (*m/s*)
ω	=	Rotation speed, rad/s
W	=	Relative velocity
Q	=	volume flow rate, m^3/s

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CHAPTER I

INTRODUCTION

A turbomachine is a device in which energy transfer occurs between a flowing fluid and a rotating element due to dynamic action, and results in a change in pressure and momentum of the fluid. Mechanical energy transfer occurs inside or outside of the turbomachine, usually in a steady-flow process. Turbomachines include all those machines that produce power, such as turbines, as well as those types that produce a head or pressure, such as centrifugal pumps and compressors. The turbomachine extracts energy from or imparts energy to a continuously moving stream of fluid.

The turbomachine as described above covers a wide range of machines, such as gas turbines, steam turbines, centrifugal pumps, centrifugal and axial flow compressors, windmills, water wheels, and hydraulic turbines. Pressure, force values of fluid flow on blades are very important for design.

In turbomachine problems, pressure, force values of fluid flow on blades are very important for design. Designers need to know how their compressor works before design a model of rotor blade, especially the moment and propulsive force values supplied by fluid in environment. More, they also need to know the behavior of these rotor blades for