



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DESIGN ENHANCEMENT OF PADDLE FIN FOR

FISHING KAYAK

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering with Honours.



MUHAMMAD FIRDAUS BIN NORIZAN

B051710065

960424-14-6213

FACULTY OF MANUFACTURING ENGINEERING

2021

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

Tajuk: DESIGN ENHANCEMENT OF PADDLE FIN FOR FISHING KAYAK

Sesi Pengajian: 2021

Saya **MUHAMMAD FIRDAUS BIN NORIZAN** mengaku membenarkan Laporan PSM ini disimpan di Perpustakaan Universiti Teknikal Malaysia Melaka (UTeM) dengan syarat-syarat kegunaan seperti berikut:

1. Laporan PSM adalah hak milik Universiti Teknikal Malaysia Melaka dan penulis.
2. Perpustakaan Universiti Teknikal Malaysia Melaka dibenarkan membuat salinan untuk tujuan pengajian sahaja dengan izin penulis.
3. Perpustakaan dibenarkan membuat salinan laporan PSM ini sebagai bahan pertukaran antara institusi pengajian tinggi.

4. **Sila tandakan (X)

SULIT* Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia sebagaimana yang termaktub dalam AKTA RAHSIA RASMI 1972.

TERHAD* Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan.

TIDAK TERHAD

Yang benar,

Disahkan oleh penyelia:

.....*firdaus*.....

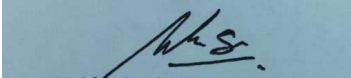
MUHAMMAD FIRDAUS BIN NORIZAN

Alamat Tetap: Lot 27965 Kampung

Segambut Tengah, 51200 Kuala

Lumpur

Tarikh: 2 September 2021



MAHASAN BIN MAT ALI
Lecturer
Faculty of Manufacturing Engineering
Universiti Teknikal Malaysia Melaka

Tarikh: 2 September 2021

*Jika Laporan PSM ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh laporan PSM ini

DECLARATION

I hereby, declared this report entitled DESIGN ENHANCEMENT OF PADDLE FIN FOR FISHING KAYAK is the results of my own research except as cited in references.



Signature:

.....*firdaus*.....
اونيزر بن محمد فيرداوس
کنیکل ملیسیا ملاک

Author : MUHAMMAD FIRDAUS BIN

NORIZAN

Date:

2 SEPTEMBER 2021


APPROVAL

This report is submitted to the Faculty of Mechanical and Manufacturing Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor Degree of Manufacturing Engineering with Honours. The member of the supervisory is as follow:



Signature:

Supervisor:


MAHASAN BIN MAT ALI
Lecturer
Faculty of Manufacturing Engineering
Universiti Teknikal Malaysia Melaka

ABSTRAK

Pengeluaran kayak telah mengubah kayak rekreasi mereka sekarang dalam beberapa tahun terakhir untuk memuaskan orang yang minat memancing dengan kayak rekreasi mereka. Kayak rekreasi sering dirancang untuk memberikan kecekapan maksimum. Jenis pergerakan yang dilakukan oleh pengguna biasanya dibatasi untuk mendayung. Oleh itu, objektif utamanya adalah untuk menyiasat jenis reka bentuk aerofoil lain yang dapat digunakan untuk memaksimumkan prestasinya. Beberapa jenis aerofoil yang ada dipelajari dengan beberapa kriteria aspek yang perlu dipertimbangkan untuk meningkatkan prestasi kayak memancing dengan perbezaan jenis aerofoil. Beberapa kaedah telah digunakan dalam projek ini untuk mencapai objektif projek. Kaedah pengumpulan data telah dilakukan untuk mencari beberapa jenis aerofoil yang sesuai untuk pemacu sirip dayung. Dari hasil pengumpulan data, langkah selanjutnya adalah mempelajari keperluan reka bentuk dan juga reka bentuk dengan menggunakan perisian reka bentuk dan analisis. Objektif ketiga yang telah dikenal pasti adalah untuk mengesahkan jenis aerofoil dengan tujahan ke depan yang optimum untuk memancing kayak. Setelah selesai menghasilkan reka bentuk sirip dengan pelbagai jenis udara dalam perisian Solidwork, reka bentuk sirip diimport ke perisian ANSYS untuk meneruskan analisis dalam projek ini. Berdasarkan hasilnya, reka bentuk pesawat udara yang mempunyai prestasi yang baik adalah NACA 2414 (separa simetri) berbanding dengan dua pesawat udara yang lain. Ini kerana NACA 2414 mempunyai prestasi yang baik dalam Coefficient of lift (CL), Coefficient of drag (CD) dan Lift force.

ABSTRACT

Kayak manufacturers have changed their current recreational kayaks in recent years to satisfy people who are interested in fishing with their recreational kayaks. Recreational kayaks are often designed to provide maximum efficiency, for example speed and directional stability, for good stability or balance between the two. The type of movement carried out by the user is normally restricted to paddling in a recreational kayak. Hence, the main objectives are to investigate other type of aerofoil design that can be used to maximize its performance. The literature review it was conducted to investigate the several type of aerofoil for paddle fin fishing kayak. A some existed type of aerofoil it was studied with several criteria an aspect was taken to considerate to improve the performance fishing kayak with differences type of aerofoil. Some method has been used in this project to achieve the objectives of project. A collecting data method has been conducted to find several types of aerofoils that suitable for paddle fin drive. From the result collecting data, the next step is to study the design requirements as well as the design by using design and analysis software. The third objective that has been identified is to validate the type of aerofoil with an optimum forward thrust for fishing kayak. After finish generate the fin design with different type of airfoil in Solidwork software, the design of fin was imported to ANSYS software to continue the analysis in this project. According to the result, the airfoil design that have good performance is the NACA 2414 (semi symmetrical) compared with other two airfoil. It is because the NACA 2414 have good performance in Coefficient of lift (CL), Coefficient of drag (CD) and Lift force.

ACKNOWLEDGEMENTS

The name of Allah, Alhamdulillah, I'm grateful because able to finish the project as one the requirements that want to be complete in the time given.

I want to give my appreciation and gratitude to all those who gave the corporation for finish the report. A special thanks to my supervisor, En Mahasan Bin Mat Ali, whose helped me to coordinate my project.

Next, thank you to my parents for encouraging and supporting me to finish this project. This project it was prepared with the support and cooperation from many people. Then, not to forget beloved friends for give many supports and suggestions to me for finish the project.

Last, I want to thanks those that contributed and involve directly or indirectly for complete this project.

DEDICATION

Alhamdulillah,

Praise to Allah S.W.T

Special appreciation this study to my family,

My supervisor, En Mahasan bin Mat Ali,

My lecturer and my superb friends

that always believe in me and giving me cooperation, support and encouragement also understandings to complete this report.

Thank you so much.

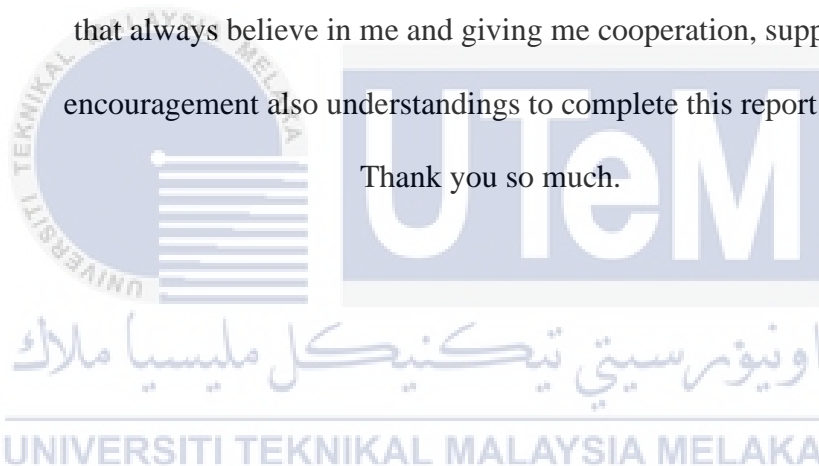


TABLE OF CONTENTS

	PAGE
DECLARATION	i
APPROVAL	ii
ABSTRAK	iii
ABSTRACT	iv
ACKNOWLEDGEMENTS	v
DEDICATION	vi
TABLE OF CONTENTS	vii
LIST OF TABLES	xiii
LIST OF FIGURES	xiv
LIST OF APPENDICES	xiv
LIST OF SYMBOLS	xx



اونيورسيتي تيكنيكل مليسيا ملاك
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

LIST OF ABBREVIATIONS	xxi
CHAPTER 1	1
INTRODUCTION	1
1.1 Project Background	1
1.2 Problem Statement	3
1.3 Research Objectives	4
1.4 Scope of Research	5
1.5 Significant of Study	6
CHAPTER 2	7
LITERATURE REVIEW	7
2.1 Hobie Mirage Kayak	7
2.2 Mirage Drive Propulsion System	10
2.3 Geometry of Surf Fins	11
2.4 Aerodynamics	12
2.5 Introduction Aerofoil	15
2.6 Theoretical Background	17
2.6.1 Lift Force	18
2.6.2 Drag Force	20
2.7 Parametric construction model Aerofoil / Hydrofoil	21
2.8 Hydrodynamic Modelling for Active Fins	23

2.9	Design of Aeroplane using Principle of Aerofoil Shape	24
2.10	Design of Aerofoil Based on Turtle's Fin	26
2.11	Design of Aerofoil Based on Dolphin's Fin	27
2.12	Naca Airfoil	28
CHAPTER 3		31
METHODOLOGY		31
3.1	Project Flow Chart	32
3.2	Investigate different type of aerofoil design that can be apply to paddle fin drive	33
3.2.1	Collection Data	33
3.2.2	Primary Sources	33
3.2.2.1	Observation	34
3.2.3	Secondary Sources	34
3.2.3.1	Journal/ Articles	34
3.2.3.2	Books	35
3.2.3.3	Internet	36
3.3	Develop viable prototype of paddle fin drive that integrates with different type of aerofoils	36
3.3.1	Design of product using 3D CAD software (SOLIDWORKS)	36
3.3.2	Analyse the type of aerofoil with an optimum forward thrust for fishing kayak	37

3.3.3	Model Analysis Design and Simulation using ANSYS Software	38
3.3.4	Modelling and meshing analysis	38
3.3.5	Pressure and Velocity Analysis	39
CHAPTER 4		41
RESULT AND DISCUSSION		41
4.1	Design of Fin with Different Type of Airfoil Using Solidwork Software	41
4.1.1	Design of fin with NACA 0015 (Symmetrical) Airfoil	42
4.1.2	Design of fin with NACA 2414 (Semi Symmetrical) Airfoil	44
4.1.3	Design of fin with NACA 4415 (Chambered) Airfoil	47
4.2	Analysis of Naca 0015 Airfoil Design	50
4.2.1	Process of Modelling and Meshing generation	51
4.2.2	Static pressure NACA 0015	53
4.2.3	Velocity magnitude NACA 0015	55
4.2.4	Variation of lift and drag coefficient with Angle of attack (AOA)	57
4.3	Analysis of Naca 2414 Airfoil Design	61
4.3.1	Process of Modelling and Meshing generation	61
4.3.2	Static pressure NACA 2414	64
4.3.3	Velocity magnitude NACA 2414	66
4.3.4	Variation of lift and drag coefficient with Angle of attack (AOA)	67
4.4	Analysis of Naca 4415 Airfoil Design	71

4.4.1	Process of Modelling and Meshing generation	71
4.4.2	Static pressure NACA 4415	74
4.4.3	Velocity magnitude NACA 4415	76
4.4.4	Variation of lift and drag coefficient with Angle of attack (AOA)	77
4.5	Comparison Result of NACA 0015, NACA 2414 and NACA 4415	81
4.5.1	Comparison Result of NACA 0015, NACA 2414 and NACA 4415 Based on Coefficient of Lift (CL)	82
4.5.2	Comparison Result of NACA 0015, NACA 2414 and NACA 4415 Based on Coefficient of Drag (CD)	83
4.5.3	Comparison Result of NACA 0015, NACA 2414 and NACA 4415 Based on Lift Force	84
CHAPTER 5		86
CONCLUSION & RECOMMENDATION		86
5.1	Introduction	86
5.2	Conclusion	86
5.3	Recommendation	88
5.4	Sustainable Design and Development	89
5.5	Complexity	89
5.6	Life Long Learning	90
REFERENCE		91



LIST OF TABLES

TABLE	TITLE	PAGE
Table 4.1.1-1:	Database NACA 0015	42
Table 4.1.2-1:	Database NACA 2414	45
Table 4.1.3-1:	Database NACA 4415	48
Table 4.2.4-1:	Result Coefficient of Lift (CL), Coefficient of Drag (CD) and Lift Force with different angle of attack for NACA 0015	58
Table 4.3.4-1:	Result Coefficient of Lift (CL), Coefficient of Drag (CD) and Lift Force with different angle of attack for NACA 2414	68
Table 4.4.4-1:	Result Coefficient of Lift (CL), Coefficient of Drag (CD) and Lift Force with different angle of attack for NACA 4415	78

اونيورسيتي تيكنيكل مليسيا ملاك

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

LIST OF FIGURES

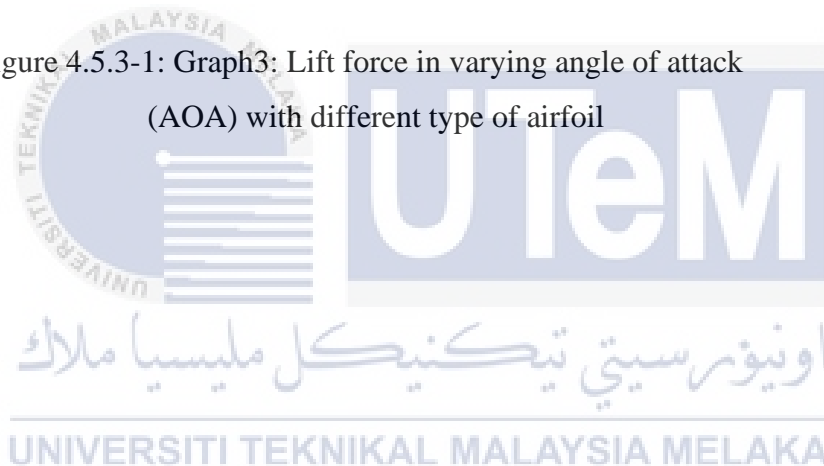
FIGURE	TITLE	PAGE
Figure 1.1-1:	Fishing Kayak	2
Figure 1.1-2:	Fin Drive System	3
Figure 1.2-1:	Paddle Fin	4
Figure 2.1-1:	Hobie Mirage Kayak	8
Figure 2.1-2:	Original Concept Sketch Mirage	9
Figure 2.1-3:	Technology of Mirage	9
Figure 2.2-1:	Design and placement of the Gauges Mirage Drive Propulsion System	10
Figure 2.2-2:	Mirage Drive Propulsion System Instrumented kayak equipment	11
Figure 2.3-1:	Diagram of Surf Fin with Key Geometries	12
Figure 2.4-1:	General Section of An Airfoil	14
Figure 2.5-1:	Aerodynamics Characteristics on Bird	17
Figure 2.6-1:	Hydrofoil physics diagram immersed on a free surface	18
Figure 2.6-2:	Hydrofoil Lifting and Drag Vectors	19
Figure 2.6-3:	Breakdown of Drag Components	21
Figure 2.7-1:	Parameters Definition of Foil	23

Figure 2.8-1: Concept Model of fin active stabilizer used at 0 Speed	24
Figure 2.9-1: Modern Aeroplane	25
Figure 2.9-2: 10 Types of Airfoil	25
Figure 2.10-1: Diagram Force and Moment Turtle	26
Figure 2.10-2: Hydrofoil Turtle	27
Figure 2.11-1: Original Dolphin Airfoil	28
Figure 2.12-1: NACA 0015	29
Figure 2.12-2: NACA 2414	29
Figure 2.12-3: NACA 4415	30
Figure 3.1-1: Flow Chart Project	32
Figure 3.3.1-1: Drawing Paddle Fin Drive	37
Figure 3.3.3-1: Corresponding analysis model	38
Figure 3.3.4-1: Meshing Analysis Model	39
Figure 3.3.5-1: Static Pressure for 0°	40
Figure 3.3.5-1: Contours velocity magnitude	40
Figure 4.1.1-1: Coordinate airfoil after import Database NACA 0015	43
Figure 4.1.1-2: Generate model NACA 0015	44
Figure 4.1.2-3: Full design fin with airfoil NACA 0015	44
Figure 4.1.2-1: Coordinate airfoil after import Database NACA 2414	46
Figure 4.1.2-2: Generate model NACA 2414	47
Figure 4.1.2-3: Full design fin with airfoil NACA 2414	47

Figure 4.1.3-1: Coordinate airfoil after import Database NACA 4415	49
Figure 4.1.3-2: Generate model NACA 4415	50
Figure 4.1.3-3: Full design fin with airfoil NACA 4415	50
Figure 4.2.1-1: Coordinates of NACA 0015	51
Figure 4.2.1-2: Grid generation of NACA 0015	52
Figure 4.2.1-3: Geometry of the NACA 0015 airfoil section	52
Figure 4.2.1-4: Meshing of air profile around the NACA 0015 airfoil	53
Figure 4.2.2-1: Static pressure contour distribution around the NACA 0015 at 0° Angle of attack (AOA)	54
Figure 4.2.2-2: Streamline of static pressure NACA 0015	55
Figure 4.2.3-1: Contours of velocity magnitude in m/s of NACA 0015 at 0° Angle of attack (AOA)	56
Figure 4.2.3-2: Streamline of velocity magnitude NACA 0015	57
Figure 4.2.4-1: Graph 1: Coefficient of lift (CL) in varying angle of attack (AOA) for NACA 0015	59
Figure 4.2.4-2: Graph 2: Coefficient of drag (CD) in varying angle of attack (AOA) for NACA 0015	60
Figure 4.2.4-3: Graph 3: Lift force in varying angle of attack (AOA) for NACA 0015	61
Figure 4.3.1-1: Coordinates of NACA 2414	62
Figure 4.3.1-2: Grid generation of NACA 2414	63
Figure 4.3.1-3: Geometry of the NACA 2414 airfoil section	63

Figure 4.3.1-4: Meshing of air profile around the NACA 2414 airfoil	64
Figure 4.3.2-1: Static pressure contour distribution around the NACA 2414 at 0° Angle of attack (AOA)	65
Figure 4.3.2-2: Streamline of static pressure NACA 2414	65
Figure 4.3.3-1: Contours of velocity magnitude in m/s of NACA 2414 at 0° Angle of attack (AOA)	66
Figure 4.3.2-2: Streamline of velocity magnitude NACA 2414	67
Figure 4.3.4-1: Graph 1: Coefficient of lift (CL) in varying angle of attack (AOA) for NACA 2414	69
Figure 4.3.4-2: Graph 2: Coefficient of drag (CD) in varying angle of attack (AOA) for NACA 2414	70
Figure 4.3.4-3: Graph 3: Lift force in varying angle of attack (AOA) for NACA 2414	71
Figure 4.4.1-1: Coordinates of NACA 4415	72
Figure 4.4.1-2: Grid generation of NACA 4415	73
Figure 4.4.1-3: Geometry of the NACA 4415 airfoil section	73
Figure 4.4.1-4: Meshing of air profile around the NACA 2414 airfoil	74
Figure 4.4.2-1: Static pressure contour distribution around the NACA 4415 at 0° Angle of attack (AOA)	75
Figure 4.4.2-2: Streamline of static pressure NACA 4415	75
Figure 4.4.3-1: Contours of velocity magnitude in m/s of NACA 4415 at 0° Angle of attack (AOA)	76
Figure 4.4.3-2: Streamline of velocity magnitude NACA 4415	77

Figure 4.4.4-1: Graph 1: Coefficient of lift (CL) in varying angle of attack (AOA) for NACA 4415	79
Figure 4.4.4-2: Graph 2: Coefficient of drag (CD) in varying angle of attack (AOA) for NACA 4415	80
Figure 4.4.4-3: Graph 3: Lift force in varying angle of attack (AOA) for NACA 4415	81
Figure 4.5.1-1: Graph 1: Coefficient of lift (CL) in varying angle of attack (AOA) with different type of airfoil	82
Figure 4.5.2-1: Graph 2: Coefficient of drag (CD) in varying angle of attack (AOA) with different type of airfoil	83
Figure 4.5.3-1: Graph3: Lift force in varying angle of attack (AOA) with different type of airfoil	85



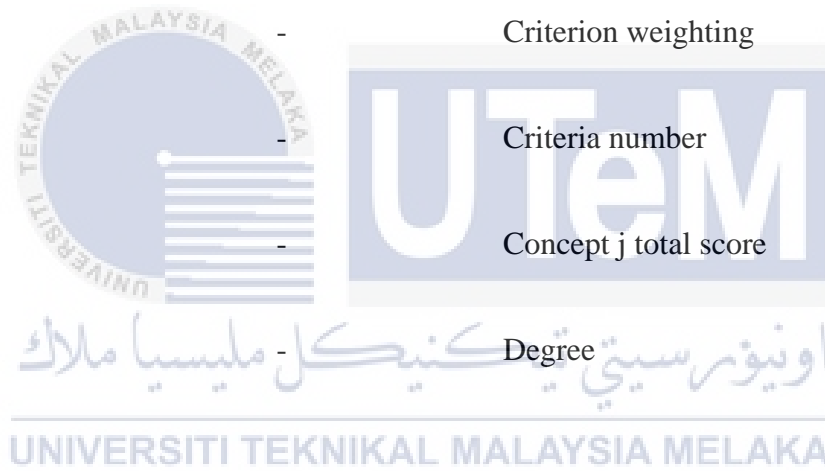
LIST OF APPENDICES

APPENDIX	TITLE	PAGE
APPENDIX 1:	GANTT CHART PSM 1	95
APPENDIX 2:	GANTT CHART PSM 2	96



LIST OF SYMBOLS

%	-	Percentage
Kg	-	Kilogram
Mm	-	Millimetre
Cm	-	Centimetre
r_{ij}	-	Concept j raw rating for the criterion
w_i	-	Criterion weighting
n	-	Criteria number
s_j	-	Concept j total score
°	-	Degree



LIST OF ABBREVIATIONS

UTeM	-	Universiti Teknikal Malaysia Melaka
PSM	-	Projek Sarjana Muda
NACA	-	National Advisory Committee for Aeronautics
CAD	-	Computer Aided Design
CAE	-	Computer Aided Engineering
FEA	-	Finite Engineering Analysis
SUP	-	Stand Up Paddle
FCS	-	Fin Control System
F _x	-	Force x اونيورسي تيكنيكل مليسيا ملاك
F _y	-	Force y UNIVERSITI TEKNIKAL MALAYSIA MELAKA
CF	-	Coefficient Force
CD	-	Coefficient of Drag
CL	-	Coefficient of Lift
LF	-	Lift Force

CHAPTER 1

INTRODUCTION

A brief introduction to the project is given in this chapter. The introduction begins with a research history which describes briefly current knowledge or previous relevant studies on the topic discussed. The problem statement subsequently provides a summary of the current problem in relation to these issues. The aim is to show the objectives that want to achieve. The scope that determines the project border or limitations is then defined. The significance of this analysis is seen at the end of this chapter in terms of project importance.

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

1.1 Project Background

Kayak manufacturers have changed their current recreational kayaks in recent years to satisfy people who are interested in fishing with their recreational kayaks. like in Figure 1.1.1. There is always a trade-off between efficiency and stability when making recreational kayaking. Recreational kayaks are often designed to provide maximum efficiency, for example speed and directional stability, for good stability or balance between the two. The type of movement carried out by the user is normally restricted to