UNIVERSITI TEKNOLOGI MARA

HULL DESIGN AND STABILITY OF CATAMARAN FOR SPORT FISHING APPLICATIONS

MUHAMMAD AZWAR IKRAM BIN ANWAR FARID

(2022468854)

Dissertation submitted in partial fulfilment

of the requirement of the degree of

Diploma in Mechanical Engineering

College of Engineering

February 2025

ABSTRACT

This research investigates about the design and stability of catamaran for sport fishing applications, in order to address such crucial challenges like stability, safety, and sustainability in marine vessels. Traditional boats like monohull often bring issues in terms of pitching, rolling and poor stability in rough water conditions that can increase the safety risk and discomfort for anglers. The main objective is to build up an optimized catamaran hull design with better stability, hydrodynamics performance, and sustainability to ensure a safe and comfortable fishing platform.

The use of advanced computational tools like PolyCAD, Rhinoceros 3D, and theoretical frameworks, like Archimedes' principle and metacentric height analysis to evaluate the study of hull's performance. The results specify that catamaran design greatly improves the stability and reduces wave resistance, with the peak of buoyancy at the centre of the hull. The GZ curve analysis focus on an improved righting moment, to confirm the resistance of the resistance to the heel. Nonetheless, trade-offs were found, involving increased drag and cost construction. Sustainability considerations such as using lightweight materials, like fiberglass, can increase fuel efficiency and decrease the impact on environment.

By demonstrating that catamaran hulls can achieve better performance in terms of stability, efficiency, and comfortability for sport fishing compared to monohulls and SWATH designs, this finding contributes to naval architecture. Limited access to data and physical testing shows that this study needs an advanced simulations tools for further investigation. The study highlights the practical solutions for anglers, indicating the importance of innovative and environmentally safe hull design for the future of marine industry and its application.

ACKNOWLEDGEMENT

Firstly, I wish to thank God for giving me the opportunity to embark on my diploma and for completing this long and challenging journey successfully. My gratitude and thanks go to my supervisor, Mr. Mohd Azahari Bin Johan for always helping me with my project. His advisement, encouragement, support, and knowledge were invaluable and has played a major role in succeeding the ending of this project.

Finally, I would also like to thank my parents Anwar Farid bin Haji Mohd Radzi and Aziah Binti Md Zin for their continued support and encouragement and always praying for my success. Without their help, I may not be able to overcome the obstacles in finishing this project. Their faith in my abilities is the factor that makes this trip smooth.

TABLE OF CONTENTS

UNIVERSITI TEKNOLOGI MARA i

UNIVERSITI TEKNOLOGI MARA ii

CONFIRMATION BY SUPERVISOR iii

AUTHOR'S DECLARATION iv

ABSTRACT v

ACKNOWLEDGEMENT vi

TABLE OF CONTENTS vii

LIST OF FIGURES x

LIST OF ABBREVIATIONS xi

CHAPTER 1 1

1.1 BACKGROUND OF STUDY 1

1.2 PROBLEM STATEMENT 2

1.2.1 STABILITY 2

1.2.2 COMFORTABILITY 3

1.3 RESEARCH OBJECTIVES 3

1.4 RESEARCH QUESTIONS 4

1.5 SIGNIFICANCE OF THE STUDY 5

1.6 SCOPE AND LIMITATIONS 7

CHAPTER 2 8

2.1 HULL SHAPES AND TYPES 8

2.2 PRINCIPLE OF VESSEL STABILITY 10

2.3 HYDRODYNAMIC PERFORMANCE 12

2.4 TOOLS FOR HULL STABILITY ANALYSIS 14

2.5 SUSTAINABILITY CONSIDERATIONS 15

CHAPTER 3 16

3.1 RESEARCH DESIGN 16

Research design refer to overall framework used throughout the implementation of this project from start fo finish. It shows how the data is collected and analysed to determine the problem within it. A well design framework ensures that accuracy, validity, and reliablity of study align with the project objectives. 16

3.2 HULL SELECTION AND MODELING 18

3.3 PRELIMINARY DETERMINATION OF MAIN DIMENSIONS 19

3.4 MORPHOLOGCAL METHOD AND PUGH CHART FOR GENERAL ARRANGEMENT (GA) SELECTION 21

3.5 WEIGHT ESTIMATION 25
3.6 STABILITY ANALYSIS PROCEDURE 27
3.7 DATA COLLECTION 28
3.8 ANALYSIS OF RESULTS 29
CHAPTER 4 31
4.1 HULL SHAPES MODELS 31
4.2 SIMULATION RESULTS 32
4.3 DISCUSSION 38
CHAPTER 5 39
5.1 SUMMARY OF FINDINGS 39
5.2 CONCLUSION 39
5.3 RECOMMENDATION 40
REFERENCES 41
APPENDICES 42