

FLOW STRAIGHTENING ANALYSIS IN AN OPEN CHANNELS FLUME

IRWAN BIN MISALAM

A report submitted in partial fulfilment of the requirements
for the award of the degree of
Bachelors of Mechanical Engineering

Faculty of Mechanical Engineering
UNIVERSITI MALAYSIA PAHANG

JUNE 2013

TABLE OF CONTENTS

	Page
SUPERVISOR’S DECLARATION	ii
STUDENT’S DECLARATION	iii
ACKNOWLEDGEMENTS	iv
ABSTRACT	v
ABSTRAK	vi
TABLE OF CONTENTS	vii
LIST OF TABLES	x
LIST OF FIGURES	xi
LIST OF SYMBOLS	xiii
LIST OF ABBREVIATIONS	xiv
CHAPTER 1 INTRODUCTION	
1.1 Introduction	1
1.2 Overview of Energy Extraction From Tidal Energy	1
1.3 Tidal Energy Testing Facility	2
1.4 Problem Statement	2
1.5 Project Objectives	2
1.6 Scopes of Project	3
CHAPTER 2 LITERATURE REVIEW	
2.1 Introduction	4
2.2 Flume	4
2.3 Open Channel Flow	4
2.4 General Flume Design Data	5
2.5 Reynolds Number	6
2.6 The Entrance Region	7
2.6.1 Entry Lengths	8

2.7	Flow Straightener	10
2.8	Losses in Flow Straightener	12
2.9	Current Research In Flow Straightener	13
2.10	Material	14
2.11	Analysis	14
2.11.1	Definition of CFD	14
2.11.2	Application of CFD	15

CHAPTER 3 METHODOLOGY

3.1	Introduction	16
3.2	Flow of The Project	17
3.3	Flow Straightener Design	18
3.3.1	Honeycomb Design	18
3.3.2	Vane Tube Design	19
3.3.3	Rectangular Design	21
3.3.4	Design Justification	22
3.4	Hydraulic Radius and Reynolds Number for Non Circular Cross Section	22
3.5	Design Simulation	24
3.5	Boundary Condition	25
3.5.1	Inlet	26
3.5.2	Outlet	26
3.5.3	Top Opening	26

CHAPTER 4 RESULT AND DISCUSSION

4.1	Introduction	27
4.2	Honeycomb Design	28
4.2.1	Pressure Drop of Honeycomb Design	29
4.3	Vane Tube Design	30
4.3.1	Pressure Drop of Vane Tube design	31
4.4	Rectangular Design	33

4.4.1 Pressure Drop Rectangular Design	34
4.5 Comparison Between Design	35
4.6 Relation Between contact Surface and Ratio of Length Over Diameter	40

CHAPTER 5 CONCLUSION AND RECOMMENDATION

5.1 Introduction	43
5.2 Conclusion	43
5.3 Recommendation for Future Research	44

REFERENCES

APPENDIX A

LIST OF TABLES

Table No.		Page
3.1	Dimension for Hexagonal Shape	19
3.2	Dimension for Rectangular Shape	22
4.1	Design Ratio (L/D)	27
4.2	Number of Cells and the Wall Thickness	28
4.3	Pressure Drop of Honeycomb Design (Pa)	26
4.4	Number of Cells and the Wall Thickness	31
4.5	Pressure Drop of Vane Tube Design (Pa)	28
4.6	Number of Cells and the Wall Thickness	33
4.7	Pressure Drop of Rectangular Design (Pa)	31
4.8	Vane Tube surface contact area for every design (m ²)	41

LIST OF FIGURES

Figure No.		Page
2.1	Natural open channel flow	5
2.2	Test section facility for open channel flow	6
2.3	Entrance region analysis diagram	8
2.4	Hydrodynamic of entry length	9
2.5	Several types of flow straightener	11
2.6	Example analysis of flow straightener	13
3.1	Flow chart of the project	17
3.2	Honeycomb straightener	18
3.3	Honeycomb straightener entrance	18
3.4	Vane tube straightener	19
3.5	Vane tube straightener entrance	20
3.6	Rectangular straightener	21
3.7	Rectangular straightener entrance	21
3.8	Area and wetted parameter for different shapes	23
3.9	Few of simulation result	25
3.10	Boundary condition regulation	25
4.1	Honeycomb flow straightener	28
4.2	Pressure drop graph for honeycomb flow straightener design	29

4.3	vane tube flow straightener	30
4.4	Pressure drop graph for vane tube flow straightener design	32
4.5	Rectangular flow straightener	33
4.6	Pressure drop graph for rectangular flow straightener design	34
4.7	Pressure drop graph comparison for 6 inch diameter	36
4.8	Pressure drop graph comparison for 8 inch diameter	37
4.9	Pressure drop graph comparison for 10 inch diameter	38
4.10	Pressure drop graph comparison for 12 inch diameter	39
4.11	Surface contact graph comparison between all three designs	42

LIST OF SYMBOLS

Pa	Pascal
m	meter
ρ	Density
m/s^2	Meter / Second ²
ΔP	Pressure loss
A	Area (m ²)
f	Friction Factor
V	Velocity
L	Length
g	Gravity
D	Diameter
Re	Reynolds Number
μ	Dynamic Viscosity
Q	Volume flow rate
R	Hydraulic Radius
L_h	Hydrodynamic entry length
H_L	Head Loss

LIST OF ABBREVIATIONS

I.D Internal diameter
O.D Outer diameter