# HEAT EXPOSURE AND ITS HEALTH EFFECTS AMONG CONSTRUCTION SITE WORKERS

# SITI NOR IZZATI BINTI MAT YAACOB

# BACHELOR OF OCCUPATIONAL SAFETY AND HEALTH WITH HONOURS

UNIVERSITI MALAYSIA PAHANG



#### SUPERVISOR'S DECLARATION

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Bachelor of Occupational Safety and Health with Honours.

(Supervisor's Signature)

Full Name : DR. NORAZURA BINTI ISMAIL

Position : SENIOR LECTURER

Date : 7 DECEMBER 2017



#### STUDENT'S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

\_\_\_\_\_

(Student's Signature)

Full Name : SITI NOR IZZATI BINTI MAT YAACOB

ID Number : PA14018

Date : 7 DECEMBER 2017

# HEAT EXPOSURE AND ITS HEALTH EFFECTS AMONG CONSTRUCTION SITE WORKERS

#### SITI NOR IZZATI BINTI MAT YAACOB

Thesis submitted in fulfillment of the requirements

for the award of the degree of

Bachelor of Occupational Safety and Health with Honours

Faculty of Engineering Technology
UNIVERSITI MALAYSIA PAHANG

DECEMBER 2017

#### **ACKNOWLEDGEMENTS**

First and foremost, my deepest thanks to The Almighty, Allah SWT for giving me a healthy body and strong spiritual to complete this final year project. Next, with my greatest honour and full of appreciation, I would like to express my external gratitude to my supervisor, Dr. Norazura Binti Ismail for her germinal idea, invaluable guidance and advice, continuous encouragement and patience throughout this final year project. She has always encouraged and impressed me with her outstanding professional experience and strong conviction. I appreciate her consistent support for me. I am truly grateful to my supervisor for her progressive vision, tolerance of my naive mistakes and thanks for the time spent proofreading and correcting my mistakes.

Besides that, I would like to thank, Mr. Mohammad Rizal Bin Razali, Safety and Health Officer (SHO) in the construction site for giving me the valuable information and helping me in getting the approval to conduct my study. I also want to express thousands thanks to the Site Supervisor, Mr. Mohammad Shazimi Bin Saleh for spending their taking me viewing the project site while explaining the progress of the whole project and show the layout plan of the site.

Furthermore, I would like to thanks our university's Science Officer, Madam Mimi Nabila Binti Mohd Noordin and Science Officer Assistant, Mr. Mohamad Hafizi Bin Che Mat for teaching me on the procedure to use the instruments. I would like express my appreciation to my friend who did support and helping me a lot.

Lastly, I would like to acknowledge my deepest feeling of gratitude to my parents for their love, understanding, prayer and support for me. I am so thankful to them for supporting the financial aspect and the sharing of the hard times and difficulty with them. Also, always give me motivation to continue my hard work in completing this thesis.

## TABLE OF CONTENT

# **DECLARATION**

ACKNOWLEDGEMENTS		ii	
ABST	<b>TRAK</b>	iii	
ABST	TRACT	iv	
TABLE OF CONTENT			
LIST OF TABLES			
LIST OF FIGURES			
LIST OF SYMBOLS		xi	
LIST	LIST OF ABBREVIATIONS xii		
CHAI	PTER 1 INTRODUCTION	1	
1.1	Introduction	1	
1.2	Research Background	1	
1.3	Problem Statements	3	
1.4	Research Objectives	4	
1.5	Research Questions	5	
1.6	Reseach Hypothesis	5	
1.7	Scope and Limitations of Research	5	
1.8	Significance of Research	6	
1.9	Conceptual Framework	7	
1.10	Definition of Variables	9	

CHA	PTER 2 LITERATURE REVIEW	11
2.1	Introduction	11
2.2	Heat Stress	11
2.3	Heat Stress in Construction Site	12
2.4	Factor Associated with Heat Stress	12
	2.4.1 Environmental Factors	12
	2.4.2 Personal Factors	17
	2.4.3 Occupational Factors	20
2.5	Heat-Related Illnesses	23
	2.5.1 Heat Stroke	23
	2.5.2 Heat Exhaustion	24
	2.5.3 Heat Cramps	24
	2.5.4 Heat Rahes	25
2.6	Summary	25
СНА	PTER 3 METHODOLOGY	27
3.1	Introduction	27
3.2	Research Design	27
3.3	Research Area	28
3.4	Population of Study	28
3.5	Sample Size	28
3.6	Inclusion and Exclusion Criteria	30
3.7	Sample Strategy	30
3.8	Data Collection	33
	3.8.1 Walkthrough Observation	33
	3.8.2 Research Instrument	33

	3.8.3 Questionnaire	38
3.9	Validity and Reliability	38
3.10	Data Analysis	39
3.11	Quality Assurance and Quality Control	40
3.12	Study Ethics	40
CHA	PTER 4 RESULTS AND DISCUSSION	41
4.1	Introduction	41
4.2	Reliability Test for Questionnaire	
4.3	Background Characteristics	41
	4.3.1 Demographic Data on Respondents	41
	4.3.2 Work Profile	43
	4.3.3 Work Environment	45
	4.3.4 Hydration	48
4.4	Environmental Heat Stress Monitoring	52
	4.4.1 WBGT Outdoor (WBGT out)	52
	4.4.2 Heat Index	53
4.5	Personal Heat Stress Monitoring	55
	4.5.1 Pre and Post Body Temperature	55
	4.5.2 Systolic and Diastolic Blood Pressure	57
	4.5.3 Pre and Post Pulse Rate	59
	4.5.4 Medical Conditions of Respondents	60
4.6	Correlation Between Environmental and Physiological Effect	61
4.7	Factors Influence Personal Heat Stress	61
4.8	Prevalence of Heat Stress	63
	4.8.1 Symptoms of Heat Stress	63

CHAI	PTER 5	5 CONCLUSION	65
5.1	Introduction		
5.2	Concl	usions	65
5.3	Recon	mmendations	66
	5.3.1	Job Rotation	67
	5.3.2	Water, Rest and Shade	67
	5.3.3	Monitor of Heat Ilness	67
	5.3.4	Future Study	68
REFE	CRENC	EES	69
APPE	NDICI	ES	
A	Gantt	Chart	75
В	Heat-R	Related Illness Questionnaire	76
C	Reliat	pility Statistic	84
D	Norma	ality Test Table	85
E	SPSS	Output	87

## LIST OF TABLES

Table No.	Title	Pages
Table 2.1	Clothing-Adjustment Factor for Some Clothing Ensembles	18
Table 2.2	Heart Rate Recovery Criteria	19
Table 2.3	ACGIH Screening Criteria for Heat Stress	12
Table 3.1	Table for Determining Sample Size of a Known Population	29
Table 3.2	List of Instrument used and its model	33
Table 4.1	Demographic Information on Respondents	42
Table 4.2	Frequencies and Percentage Type of Clothes of Respondents	46
Table 4.3	Environmental Temperature of Construction Site	47
Table 4.4	Hydration Data of Respondents	49
Table 4.5	Effect of Heat Index	55
Table 4.6	Wilcoxon Signed Rank Test	56
Table 4.7	The Results of Systolic and Diastolic Blood Pressure	59
Table 4.8	Pre and Post Pulse Rate	59
Table 4.9	Medical History of Respondents	60
Table 4.10	Correlation between the Environmental Factor and Physiological Effect	61
Table 4.11	Factor Influenced Heat Stress Level	62
Table 4.12	Frequency and Percentage of Heat Stress Symptoms	64

## LIST OF FIGURES

Figure No.	Title	Pages
Figure 1.1	Conceptual Framework	10
Figure 3.1	Research Process	32
Figure 3.2	Wet Bulb Globe Temperature	34
Figure 3.3	Digital Infrared Forehead Thermometer	35
Figure 3.4	OMRON Blood Pressure	36
Figure 3.5	Digital Body Weight Balance	37
Figure 4.1	Physically and Mentally Tired	44
Figure 4.2	Environmental Temperature of Construction Site	47
Figure 4.3	Urine Colour Chart	50
Figure 4.4	Stages of Urine Colour	51
Figure 4.5	WBGT Outdoor Temperature at KotaSAS Construction Site	53
Figure 4.6	Heat Index Reading	54
Figure 4.7	Heat Index Chart	54
Figure 4.8	Healthy and Unhealthy Blood Pressure Ranges	58

# LIST OF SYMBOLS

bpm	Beat per minute
fpm	Feet per minute
$^{\mathrm{o}}\mathrm{C}$	Degree Celcius
$^{\mathrm{o}}\mathrm{F}$	Fahrenheit

 $T_{db} \hspace{1.5cm} Dry \ Bulb \ Temperature$ 

#### LIST OF ABBREVIATIONS

ACGIH American Conference of Governmental Industrial Hygienists

AIOH Australia Institute of Occupational Hygienists

CCOHS Canadian Centre for Occupational Health and Safety

CDC Centers for Disease Control and Prevention

CIC Construction Industry Council

DB Dry Bulb

DOL The United States Department of Labor

DOSH Department of Occupational Safety and Health

FMA Factory and Machinery Act
HHS Health and Human Services

HR Heart Rate

HRI Heat-Related Illness

HSE Health and Safety Executive

IHSA Infrastructure Health and Safety Association

ILO International Labor Organization

NIOSH National Institute for Occupational Safety and Health

OSHA Occupational Safety and Health

OSHS Occupational Safety and Health Services

OTM OSHA Technical Manual
PPE Personal Protective Equipment

RH Relative Humidity

WBGT Wet Bulb Globe Temperature