



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**DESIGN NEW MECHANISM OF SAFETY TRIANGLE FOR
MOTORCYCLE UNDER 150 CC**

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

By

NORHAZWANI BINTI ABDUL NAJIB

B071610704

950125146230

FACULTY OF MECHANICAL AND MANUFACTURING ENGINEERING
TECHNOLOGY

2019

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

Tajuk: DESIGN NEW MECHANISM OF SAFETY TRIANGLE FOR MOTORCYCLE
UNDER 150 CC

Sesi Pengajian: 2019

Saya **NORHAZWANI BINTI ABDUL NAJIB** 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:

.....
NORHAZWANI BINTI ABDUL NAJIB

.....
Ts. Dr. MOHD ZAKARIA BIN
MOHAMMAD NASIR

Alamat Tetap:

No 4, Lorong 29

Jalan Taman Tasik Utama, Ayer Keroh

Melaka.

Cop Rasmi Penyelia

Tarikh: 14 January 2020

Tarikh:

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

DECLARATION

I hereby, declared this report entitled DESIGN NEW MECHANISM OF SAFETY TRIANGLE FOR MOTORCYCLE UNDER 150 CC is the results of my own research except as cited in references.

Signature:

Author : NORHAZWANI BINTI ABDUL NAJIB

Date: 14 January 2020

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 of Mechanical Engineering Technology (Maintenance Technology) with Honours. The member of the supervisory is as follow:

Signature:

Supervisor : Ts. Dr. MOHD ZAKARIA BIN
MOHAMMAD NASIR

Date: 14 January 2020

ABSTRAK

Risiko kemalangan jalan raya semakin meningkat setiap tahun terutamanya melibatkan penunggang motorsikal. Pelbagai usaha dilaksanakan untuk mengurangkan kadar kemalangan jalan raya yang melibatkan nyawa. Projek ini dihasilkan sebagai satu cara bagi mengurangkan kemalangan jalan raya khususnya melibatkan perlanggaran kenderaan dengan motorsikal rosak yang berhenti di bahu jalan raya. Hal ini terjadi, disebabkan pemandu yang sedang bergerak tidak dapat melihat dengan jelas apabila motorsikal berhenti di bahu jalan atau tidak sempat untuk bertindak dari mengelak dari berlanggar. Penghasilan segi tiga kecemasan mudah alih direka bentuk menggunakan perisian inventor dan solidwork. Reka bentuk akhir selepas analisa akan dicetak menggunakan 3D prototaip untuk ujian dan kajian lanjut. Berdasarkan data yang diambil daripada beberapa responden adalah untuk memberikan komen dan penarafan pada prototaip dan segi tiga yang sedia ada di pasaran. Penarafan telah diambil dalam beberapa kondisi iaitu pada waktu siang, malam dengan adanya lampu jalan dan tanpa lampu jalan. Oleh itu, telah membuktikan prototaip boleh dilihat dengan lebih jelas jika dibandingkan dengan segi tiga yang ada terutama pada waktu malam yang tiada jalan lampu kerana mudah dilihat dengan jelas disebabkan sistem pencahayaan LED dan ketinggian prototaip. Kesimpulannya, reka bentuk segitiga kecemasan khas untuk motorsikal dapat membantu pengguna motorsikal menggunakannya untuk memberi amaran awal kepada pengguna jalan raya yang lain pada jarak sehingga 100 meter berbanding reka bentuk sedia ada dan ditambahkan dengan ciri-ciri LED dan boleh dilipat.

ABSTRACT

The risk of road accidents is increasing every year especially involving motorcyclists. Various efforts have been made to reduce the rate of fatal road accidents. The project was created as a way to reduce road accidents, especially involving collisions with damaged motorcycles that stopped at the shoulder of the road. This is because the driver is not able to see clearly when the motorcycle is stopped on the road or is unable to act on the collision. The produced of portable safety triangles is designed using Inventor and Solidwork software. The final design after the analysis will be printed using 3D prototypes for testing and further study. Based on data taken from several respondents were to provide comments and ratings on the prototype and safety triangles that are available in the market. Ratings have been taken in several of conditions, during the day and night with street lights and no street lights. Therefore, it has been shown that the prototype can be seen more clearly compared to the current safety triangle especially at night with no street lights as it is easily visible due to the LED lighting system and the height of the prototype. In conclusion, the design of a portable safety triangle for motorcycles can help motorists use it to alert other road users at distances up to 100 meters compared to the existing design and added with LED and foldable features.

DEDICATION

I would like to dedicate for this project especially to my beloved parents and my family which gives strength and spirit as well as also supporting for the whole time to completing this project. I would like to dedicate to my supervisor which always assist and provide guidance in implementing this project and always monitor my development of this project. To my entire lecturer I would like to say thank you to be always encouraging to complete this project idea. Besides, do not forget to say a big thank you to my entire friend will always calmly, supporting and reducing stress while preparing this prototype.

ACKNOWLEDGEMENTS

The first step, I would like to say thanks to ALLAH S.W.T for giving me the opportunity to implement this project idea and letting me to finish my Final Year Project 2 and give me patience and strength that I need in order to fulfill my duty as a bachelor student. This opportunity I am able to gain knowledge and experience with more and more during completing it report and this idea project.

Here, I also want to lifting gratitude for having supervisors Ts. Dr. Mohd Zakaria Bin Mohammad Nasir for his support, suggestions and teach me on how to do this report and idea of project by followed step by step. Thank you for always being reminded to give progress every week, giving advices at the same time, encouragements and guidance to help in this report and idea of this project.

Besides, a special thank you to my family with their supports and give the strength through the whole my process study and my Bachelor Degree Project. Other than that, not forgotten to all my friend for encouraging me to finish this project.

Lastly, with humbleness I am using this opportunity for say thank you to everyone who supported me all the time for done my final project. I am thankful for their aspiring, advice and guidance during preparing the report and project.

TABLE OF CONTENTS

	PAGE
DECLARATION	iii
APPROVAL	iv
ABSTRAK	v
ABSTRACT	vi
DEDICATION	vii
ACKNOWLEDGEMENTS	viii
TABLE OF CONTENTS	ix
LIST OF TABLES	xii
LIST OF FIGURES	xiv
LIST OF APPENDICES	xviii
LIST OF SYMBOLS	xix
LIST OF ABBREVIATIONS	xx
CHAPTER 1 INTRODUCTION	1
1.1 Background of study	1
1.2 Problem Statement	4
1.3 Objectives	8
1.4 Work scope	8
1.5 Expected Result	9
CHAPTER 2 LITERATURE REVIEW	10
2.1 Motorcycle	10
2.1.1 Accident Statistic in World	11
2.1.2 Accident Statistic in Malaysia	17
2.2 Safety Triangle Emergency	23
2.2.1 Current Safety Triangle Being Used Widely	27
2.2.2 Safety Triangle Placement	30
2.3 Vision of the Driver	38
2.3.1 Diagnostic of Speed and Time as a Factor of a Collision	42
2.3.2 Visual Distance for Day And Night Time	44

2.3.3	Reflective Material	47
CHAPTER 3	METHODOLOGY	48
3.1	Project Flowchart	48
3.2	Product Design Specification	50
3.2.1	Performance	50
3.2.2	Ease of maintenance and installation	50
3.2.3	Safety	51
3.2.4	Weight	51
3.2.5	Cost	51
3.2.6	Manufacturability	51
3.2.7	Materials	52
3.2.8	Specification	52
3.3	Summary of Survey Form	52
3.4	Concept Design Development	57
3.4.1	First Concept Design	58
3.4.2	Second Concept Design	59
3.4.3	Third Concept Design	60
3.4.4	Selected Design	61
3.5	Material	62
3.5.1	Reflecting Material	63
3.5.2	LED Light	64
3.5.3	Screw and Washer	63
3.5.4	Tripod Stand	64
3.5.5	LED “STOP” Sign	66
3.5.6	Battery	65
3.6	Gantt Chart	67
CHAPTER 4	RESULT AND DISCUSSION	68
4.1	Overview	68
4.2	Prototype of Portable Safety Triangle	69
4.3	Fabrication Process	69
4.3.1	Design a Product Using Software	70
4.3.2	Print of the Design	72
4.3.3	Conducting Electrical Circuit and Fabricating Process	74
4.3.4	Finishing process	76

4.3.5	Final product	76
4.4	Prototype Testing	78
4.4.1	The rating of first candidate for distances visibility at straight road	80
4.4.2	The rating of first candidate for distances visibility at curve road	83
4.4.3	The rating of second candidate for distances visibility at straight road	86
4.4.4	The rating of second candidate for distances visibility at curve road	89
4.5	New size of safety triangle for motorcycle user	92
4.6	Analysis Finate Element Method (FEM)	92
4.6.1	Material selection	93
4.6.2	Load and fixtures	94
4.6.3	Mesh information	95
4.7	Production Cost	96
CHAPTER 5 CONCLUSION		98
5.1	Conclusion	98
5.2	Recommendation	99
5.3	Project Potential	99
REFERENCES		100
APPENDIX		104

LIST OF TABLES

TABLE	TITLE	PAGE
Table 1.1	Number of Accident by State of 2007 – 2018 (Road Safety Department of Malaysia, 2018)	6
Table 1.2	Fatalities By Category For Use Of The Road For 10 Years (2008 To 2017) (Road Safety Department of Malaysia, 2018)	7
Table 2.1	General Road Accident Statistics in Malaysia in 1997-2017 (Road Safety Department of Malaysia, 2018)	18
Table 2.2	Status of Safety Road for Asean Countries In 2013 For Malaysia (Road Safety Department of Malaysia, 2018)	19
Table 2.3	Number of Vehicles In Malaysia By State in 2003 to 2018 (September) (Road Safety Department of Malaysia, 2018)	20
Table 2.4	The Number of Death Caused by Accident of Road User for 10 Years, 2008 -2018 (Road Safety Department of Malaysia, 2018)	21
Table 2.5	Road Safety Plan for Strategies of Malaysia 2006-2010 (Road Safety Department and Malaysian Institute of Road Safety Research, 2014)	22
Table 2.6	Road Safety Plan of Malaysia in 2006-2010 : Target and Result (Road Safety Department and Malaysian Institute of Road Safety Research, 2014)	23
Table 2.7	Assembled Symmetrically Of Safety Triangle (‘red warning triangle’, 1977)	29
Table 2.8	Based On Way of California Department of Motor Vehicle (DMV) For Placing Safety Triangle (‘Are You Placing Your Warning Triangles Properly’, 2017)	33
Table 2.9	Use of Safety Triangle in Countries in North America (M. S. Abdul Khalid <i>et al.</i> , 2018)	36

Table 2.10	Use of Safety Triangle in European countries (M. S. Abdul Khalid <i>et al.</i> , 2018)	37
Table 2.11	Use of Safety Triangle in Australia (M. S. Abdul Khalid <i>et al.</i> , 2018)	37
Table 2.12	SWT usage in Japan, Singapore and Malaysia Countries (M. S. Abdul Khalid <i>et al.</i> , 2018)	38
Table 2.13	Levels of Impact Factors with Three Brake System (Li <i>et al.</i> , 2014)	41
Table 3.1	The Answer from Survey Form	53
Table 3.2	Product Design Specification	62
Table 4.1	Rating number	79
Table 4.2	Data of rating for straight road for candidate 1	80
Table 4.3	Curve Road for Candidate 1	83
Table 4.4	Straight Road for Candidate 2	86
Table 4.5	Curve Road for Candidate 2	89
Table 4.6	Result material selection	94
Table 4.7	Result fixture information	94
Table 4.8	Result of load	95
Table 4.9	Result of mesh	95
Table 4.10	List of material and cost used	96

LIST OF FIGURES

FIGURE	TITLE	PAGE
Figure 1.1	Hierarchy of control (Ramesh and Armstrong, 2019)	3
Figure 2.1	Number and Rate of Road Traffic Death per 100 000 population in 2000-2016 (WHO, 2018)	12
Figure 2.2	The Percent of Deaths by Road User Type by WHO Region (WHO, 2018)	13
Figure 2.3	Motorcyclist Fatalities , 1994-2016 (Safety, 2017)	15
Figure 2.4	Motorist killed in 2010-2016 ('Road Safety Annual Report', 2018)	16
Figure 2.5	Example Warning Design Standard ('The Emergency Triangle and Safety on the Road - Arrive Alive', 2019)	26
Figure 2.6	Respondents Who Owned and Kept VEK In Their Vehicles (M. S. Abdul Khalid <i>et al.</i> , 2018)	27
Figure 2.7	Open and A Closed Triangle ('red warning triangle', 1977)	28
Figure 2.8	Bike Sight of Motorcycle Warning Triangle ('Bike Sight - Motorcycle Warning Triangle')	30
Figure 2.9	Type of Emergency Situations (M. S. Abdul Khalid <i>et al.</i> , 2018)	31
Figure 2.10	The Example Emergency Warning Sign Shall Be Displayed ('The Emergency Triangle and Safety on the Road - Arrive Alive', 2019)	32
Figure 2.11	Guideline for placing safety triangle	33
Figure 2.12	How Far Driver Can Look Ahead (Covers et al., 2011)	39
Figure 2.13	Vision on The Speed ('Adjusting Your Speed When Riding a Motorcycle - SAAQ', 2019)	41
Figure 2.14	Stopping Distance ('Adjusting Your Speed When Riding a Motorcycle - SAAQ', 2019)	42

Figure 2.15	Distance to Stop = Distance to React + Distance to Brake ('Safe Stopping Following Distance, Reaction Distance and Braking Distance - Monroe Drive Safe', 2016)	43
Figure 2.16	The Factors Influencing Motorcycle Detection, Discrimination And Valuation (Crundall <i>et al.</i> , 2008)	45
Figure 2.17	Testing Driving Simulation Day Time (Left) And Night Time (Right) (Bella, Calvi and D'Amico, 2014)	45
Figure 2.18	Passenger Vehicle Occupant Fatalities In 2005 By Time Of Day And Restraint Use (Shankar, 2008)	46
Figure 3.1	Flowchart of the Project	49
Figure 3.2	First Concept Design	58
Figure 3.3	Second Concept Design	59
Figure 3.4	Third Concept Design	60
Figure 3.5	Reflective Strip Tape	63
Figure 3.6	LED Light	64
Figure 3.7	Screw and washer	64
Figure 3.8	Tripod Stand	65
Figure 3.9	LED "STOP" Sign	66
Figure 3.10	Battery	66
Figure 4.1	Prototype of Safety Triangle	69
Figure 4.2	Part of Safety Triangle	70
Figure 4.3	Part of Safety Triangle	70
Figure 4.4	Part of Safety Triangle	71
Figure 4.5	Base of safety triangle	71
Figure 4.6	Triangle inside the base	71
Figure 4.7	Nylon	72
Figure 4.8	Data of design	73
Figure 4.9	The small particle of powder	73
Figure 4.10	Product run in machine	74

Figure 4.11	Finished product and cleaning session to take parts	74
Figure 4.12	Soldering component	75
Figure 4.13	Covering the prototype with reflective strap	76
Figure 4.14	Presentation of the prototype safety triangle	76
Figure 4.15	Presentation of the prototype safety triangle	77
Figure 4.16	Presentation of the prototype safety triangle	77
Figure 4.17	Presentation of the prototype safety triangle	77
Figure 4.18	Presentation of the prototype safety triangle	78
Figure 4.19	Graph of distance (m) versus rating of visibilities of straight road for daylight and picture during day	81
Figure 4.20	Graph of distance (m) versus rating of visibilities of straight road for night with street light and picture during night	81
Figure 4.21	Graph of distance (m) versus rating of visibilities of straight road for night without street light and picture during night	82
Figure 4.22	Graph of distance (m) versus rating of visibilities of curve road for daylight and picture during day	84
Figure 4.23	Graph of distance (m) versus rating of visibilities of curve road for night with street light and picture during night	84
Figure 4.24	Graph of distance (m) versus rating of visibilities of curve road for night without street light and picture during night	85
Figure 4.25	Graph of distance (m) versus rating of visibilities of straight road for daylight and picture during day	87
Figure 4.26	Graph of distance (m) versus rating of visibilities of straight road for night with street light and picture during night	87
Figure 4.27	Graph of distance (m) versus rating of visibilities of straight road for night without street light and picture during night	88
Figure 4.28	Graph of distance (m) versus rating of visibilities of curve road for daylight and picture during day	90
Figure 4.29	Graph of distance (m) versus rating of visibilities of curve road for night with street light	90
Figure 4.30	Graph of distance (m) versus rating of visibilities of curve road for night without street light	91

LIST OF APPENDICES

APPENDIX	TITLE	PAGE
Appendix 1	Survey of Safety Warning Triangle	104
Appendix 2	Gantt Chart PSM 1	105
Appendix 3	Gantt Chart PSM 2	106
Appendix 4	Form Rating of Distance Visibility of Safety Triangle	107

LIST OF SYMBOLS

d/°	-	Degree
F	-	Feet
G	-	Gram
K	-	Kilometer
Km/h	-	Kilometer per hour
M	-	Million
M	-	Meter
m/h	-	Mile per hour
S	-	Second
yr.	-	Years
%	-	Percent
V	-	Voltage
mAh	-	Milliamp hour
N	-	Newton
Cm	-	Centimeters
Mpa	-	Megapascal

LIST OF ABBREVIATIONS

FEM	Final Element Analysis
PPE	Personal Protective Equipment
WHO	World Health Organization
FARS	Fatality Analysis Reporting System
MOT	Ministry of Transport
MIROS	Malaysian Institute of Road Safety Research
RMP	Royal Malaysia Police
MOWs	Ministry of Works Malaysia
RSD	Road Safety Department
EU	European Union
ANSI	American National Standards Institute
FCW	Forward Collision Warning
RE	Rear-end
VEK	Vehicle Emergency Kit
UK	United Kingdom
FMCSA	Federal Motor Carrier Safety Administration
DMV	Department of Motor Vehicle
SWT	Safety Warning Triangle

GVM	Gross Vehicle Mass
AASHTO	American Association of State Highway and Transportation Officials
MVM	Million Vehicle Miles
FARS	National Highway Traffic Safety Administration's Fatality Analysis Reporting System
PDS	Product Design Specification
CC	Cylinder Capacity or Cubic Centimetres
SWOV	Institute for Road Safety Research
CRISS	Inter-University Research Center for Road Safety
LED	Light Emitting Diode
HIV	Human Immunodeficiency Virus
AIDS	Acquired Immune Deficiency Syndrome
ATV	All-Terrain Vehicle
RM	Malaysian Ringgit
MRR2	Kuala Lumpur Middle Ring Road 2 Scheme
AKLEH	Ampang-Kuala Lumpur Elevated Highway (Malaysia)

CHAPTER 1

INTRODUCTION

1.1 Background of study

The world it is towards modernity has affected and followed everything in the world also become in a more sophisticated way. A vehicle words are familiar even since before until now and also often linked with frequent of an accidents. Accident can be described in general such an unexpected and unplanned which occur suddenly without us to expected. Accident could lead fatal or severe injury at least one person or more and also can be killed. The road accident can cause of damage the vehicle such a motorcycle, car, lorry and so on and this is caused by many factors that cause of an accidents. The some factors that can be listed among accident like a hit from behind during the others vehicle a stop on the side of the road because of flat tire, damaged engine, oil run out or others factors, driving under drunkenness, drive or ride with high speed limit and driving or riding at night time so it is hard to pay of full an attention.

Accident cases from the previous until decade today are increasing more and higher statistic can be showed. Based on the newspaper '1.35 million die in road accidents worldwide every year: WHO', (December 2018) with topic 1.35 million die in road accidents worldwide every year: WHO, with every 24 seconds, has happened road accident with total 1.35 million traffic death each year around the world. In fact, 100 000 in three years the amount of fatalities it keep going increasing road accident. In 2013, at 1.25 million the amount of road traffic death was estimated. Then from this newspaper has stated that road accident more towards two wheels and pedestrian.

Roads can be described like all land transportation will use road to go to anywhere destination. Furthermore, as road users some do not know either the vehicle which are used it is in good condition or opposite. Therefore, normal thing if always seen vehicle that stops at the side of the road because of car problem, motorcycle problem, bus and lorry. In this case one of the factors can cause accident whether in day or night time because sometime the road user cannot be seen very clearly if a vehicle has stopes specially motorcycle which having a small design of transportation between other transportation.

Safety triangle is one way or best option to reduce rate of accident and injury. Nowadays, safety triangle is important item to all road user which has an own vehicle. The vehicle breakdown that has stop left at the road frequently would only use double signal to inform and caution to the other road users (Adnan *et al.*, 2012). So, their needed when convenience emergency during the vehicle make a problem with suddenly during night or day and can avoid from accident causes from the other road user. The safety triangle is a sort of warning sign to alert other road users of the risk ahead and is one of the things accessible in the vehicle emergency kits. Appropriate use of safety triangle can help alert other road user of the hazard at a distance, while would enable to react in time and prevent road crashes (Khalid *et al.*, 2018).

According to Norskov-lauritsen, Linschoten and Haverkamp (1997), system of safety triangle characteristic which is three arms extending upwardly from the base to characterize a symmetrical triangle, one of the arms expanding on a level plane on the base and the other two arms extend upwardly. Each arm has reflective and bright methods on restricted surfaces. Few benefit of safety triangle during an emergency cases such as in case of a breakdown or an impact at the roadside during daylight or during hours of darkness, this safety triangle will be inform other road users to a potential risk on the

roadway. The other road user which driving the vehicle will realize that they should slow down and be careful to maintain a strategic distance from a further impact (WHO, 2004).

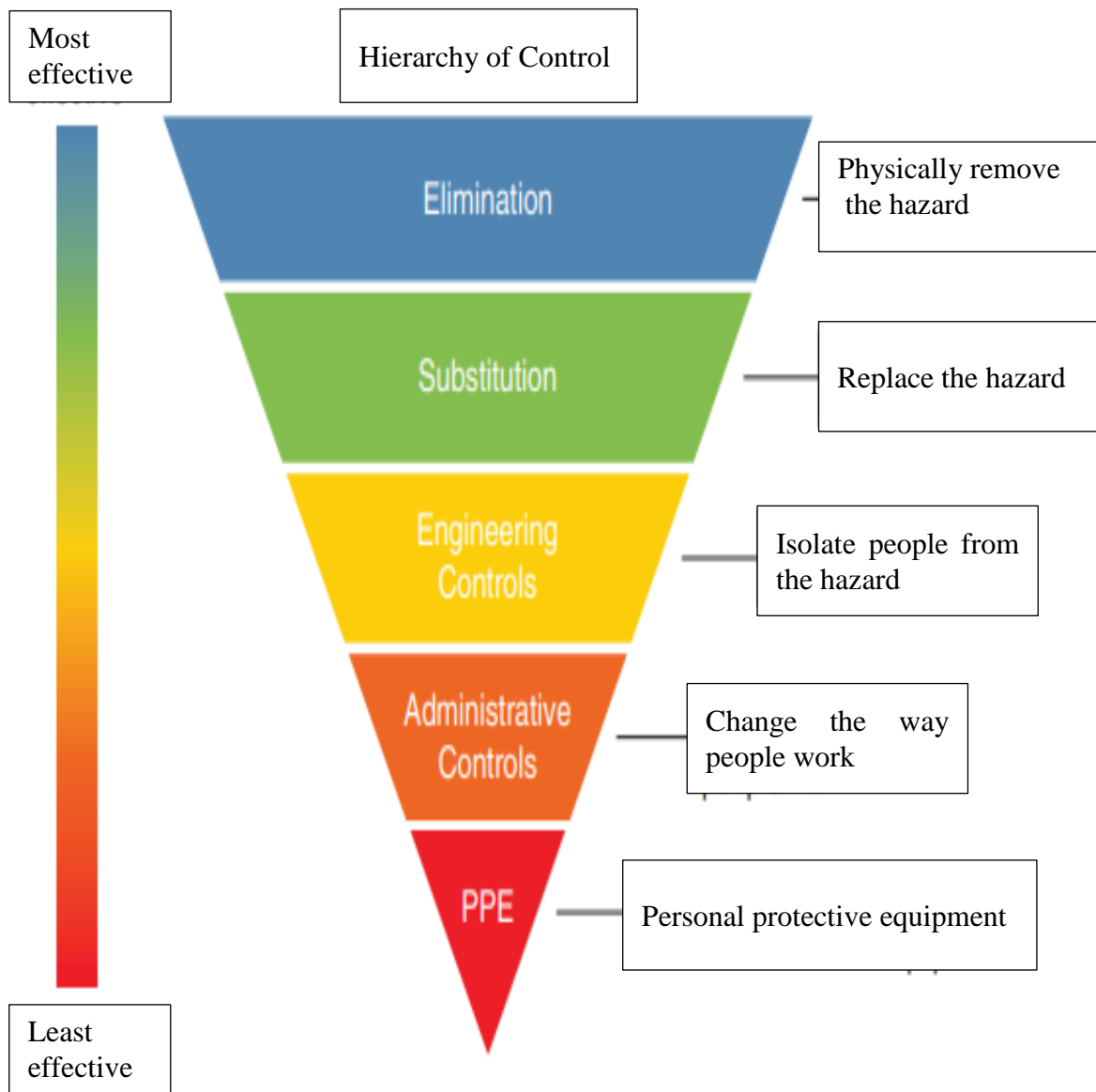


Figure 1.1: Hierarchy of control (Ramesh and Armstrong, 2019)

Based on Figure 1.1, Ramesh and Armstrong (2019) in order to control the hazard, the most important to follow the hierarchy of controls. In Personal Protective Equipment (PPE) is included the safety triangle. From the figure, that can be state the effectiveness of PPE is the lowest level compared the others. Although, in case accident PPE the first thing road user will be think for control the hazard, it should never be the first control you turn