GUIDELINES FOR MOTORCYCLE FACILITIES

ISBN 978-967-5957-57-4

Cawangan Jalan
Jabatan Kerja Raya

NTJ 33/2015

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NTJ 33/2015
JKR 20401-0063-15

KERAJAAN MALAYSIA

GUIDELINES FOR MOTORCYCLE FACILITIES

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ACKNOWLEDGEMENTS

It is hereby acknowledged that the following officers have provided time, effort, support, guidance and materials for the production of this document:

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FOREWORD

Through the cooperation and support of various road authorities and engineering institutions in Malaysia, the manual on GUIDELINES FOR MOTORCYCLE FACILITIES is updated towards the latest motorcycles facilities requirement. The aim of this publication is to achieve quality and consistency in road and highway construction.

The cooperating bodies are:

Public Works Department, Malaysia (JKR)

Malaysia Highway Authority (LLM)

Malaysian Institute of Road Safety Research (MIROS)

Royal Malaysia Police (PDRM)

Road Transport Department Malaysia (JPJ)

The productions of this document are carried out through several stages. The documents are initially compiled/drafted by the relevant Technical Committee and finally endorsed by Technical Committee and road authorities at the workshop before publication. The Technical Committee welcomes feedback and suggestions, which can update and improve these documents.

This manual on GUIDELINES FOR MOTORCYCLE FACILITIES is a document produced for use by planners and engineers in Malaysia. It is hoped that this guide will address the issues on planning and designing for motorcycle facilities and will be accepted by the highway engineering fraternity in the country. In keeping with the intent of these guidelines, practitioners should apply their engineering experience and judgment for the benefit of all road users.

CHAPTER 1 – INTRODUCTION

1.1 General Introduction

Motorcycles are an accepted part of traffic and their safety deserves the same attention in the design and management of roads in Malaysia as does that of other road users (pedestrians, bicyclist, etc). While accepted as part of traffic, motorcycles have particular needs and problems which may not be widely recognized by those responsible for road planning, road design and traffic engineering and management.

While the needs of some other "special" road user groups, especially pedestrians, bicyclists, trucks and buses are gradually being acknowledged and their needs reflected in mainstream traffic engineering and management guidelines (e.g Austroads, 1995 a, b: Ogden and Tylor, 1996), this has not yet been the case for motorcyclists. These guidelines are designed to provide engineering practitioners with a better understanding of motorcyclists' safety needs and incorporate these needs in the upgrading and maintenance of existing roads and the planning, design and construction of new roads.

1.2 Motorcycles Across The World

Motorcycles are one of the most affordable forms of motorized transport in many parts of the world. According to WHO (2013), there were around 455 million motorcycles in use worldwide in 2010, or about 69 motorcycles per 1,000 people and around 782 million cars, or about 118 per 1000 people as shown in Table 1.1.

Table 1.1: The World's Registered Motorcycles and Cars (2002, 2006 and 2010)
(Data source: Haworth, 2012; WHO, 2013)

Items	2002 (Million)	2006 (Million)	2010 (Million)
The World's registered motorcycles	200	313	455
Number of motorcycles per 1000 population	33	50	69
The World's registered cars and 4-wheel light vehicles	590	686	782
Number of cars per 1000 population	91	109	118

Of the total motorcycle population in the world in 2010, about 79% were registered in Asia (Table 1.2). Within Asia, China has the most motorcycles (110 million), followed by India (82 million), Indonesia (60 million) and Vietnam (31million) (WHO, 2013). In terms of motorcycles per 1,000 population, Vietnam, Malaysia, Indonesia and Thailand have the highest number of motorcycles per 1,000 population. This is shown by Figure 1.1.

Table 1.2: The Overall Total of Registered Motorcycles in the World - 2010
(Data source: Global Status Report on Road Safety, WHO 2013)

No.	Continent / Region	Registered Motorcycles (2010)	Percentage of Total Motorcycles (%)	Motorcycles per 1000 population	Percentage of MCs of all vehicles (%)
1	Asia	359,567,713	78.94	100.80	59.35
2	Middle East	13,240,634	2.91	28.35	25.21
3	Europe	38,767,389	8.51	43.90	9.56
4	Africa	7,938,939	1.74	10.35	22.88
5	South America	22,801,731	5.01	58.12	22.54
6	North America	12,395,764	2.72	23.82	3.86
7	Oceania	778,936	0.17	21.80	4.01
Total		455,490,566	100	World's rate = 69	30% of all vehicles

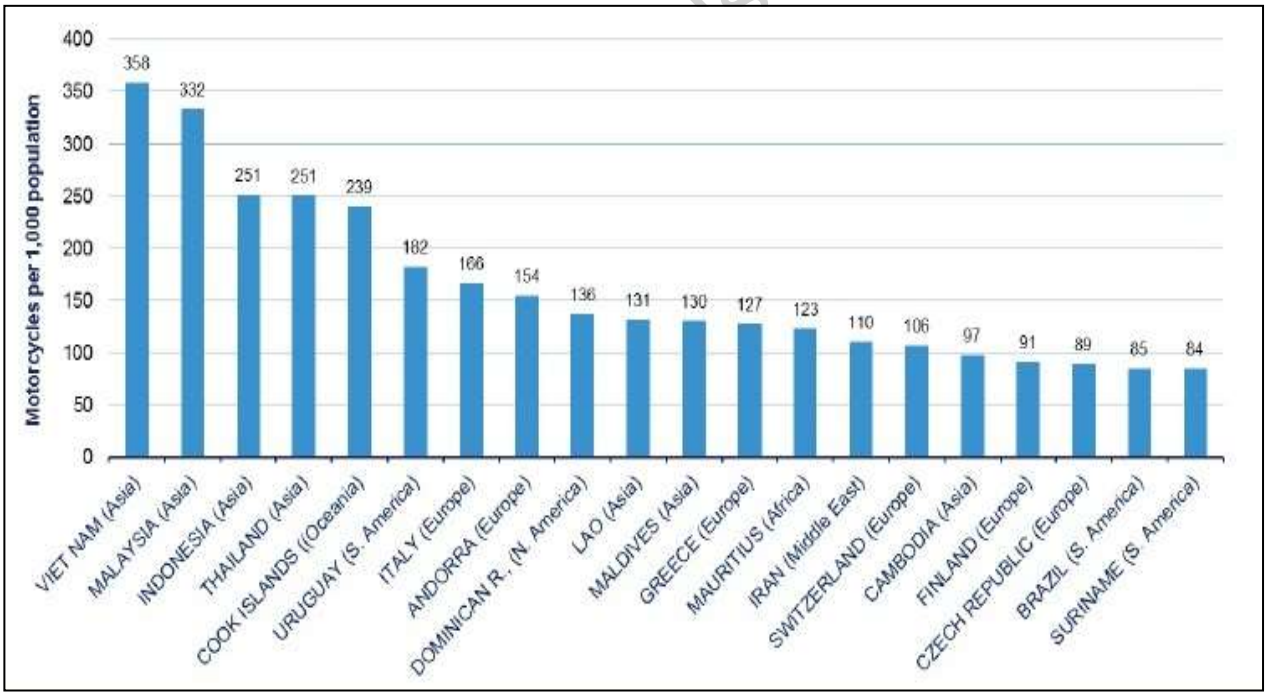

Figure 1.1: The 20 Countries with the Greatest Number of Motorcycles per 1,000 Population
(Data source: Global Status Report on Road Safety, WHO 2013)

1.3 Motorcycle Use and Fatalities

The high number of motorcycles was found corresponding with high accident occurrence. In Asian countries, motorcyclists make up a large proportion of those injured or killed on the roads (Haworth, 2012). Most of the motorcycle deaths happened in Asia, accounting for a percentage of 78% as shown in the Figure 1.2. Five Asian countries (Thailand, Laos, Vietnam, Malaysia, and Cambodia) are among the top ten countries with greatest motorcycle deaths per 100,000 population in which Thailand has the highest death rate per 100,000 people as shown in the Figure 1.3.

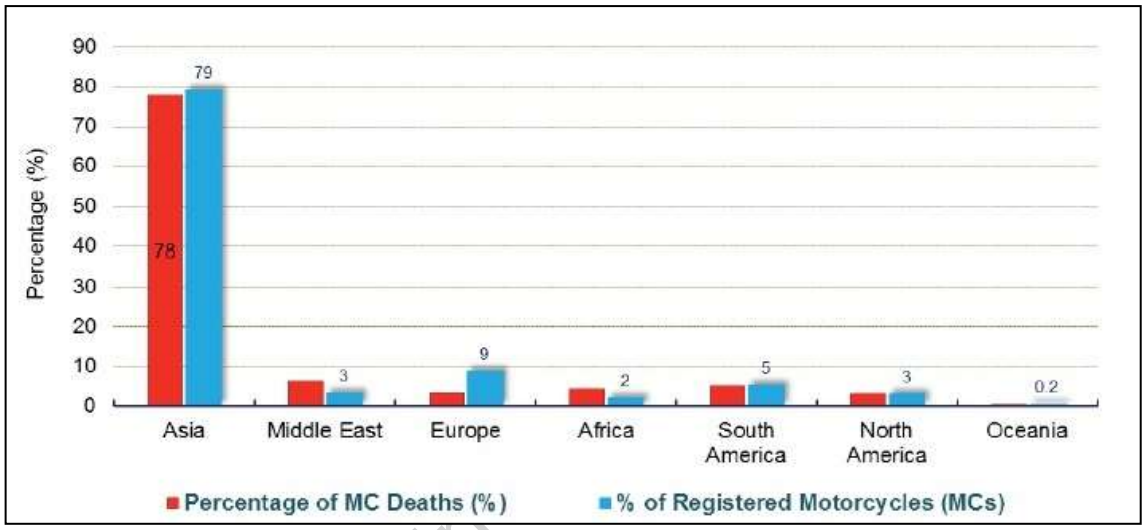

Figure 1.2: Percentage of Motorcycle Use and Fatalities by Continents
(Data source: Global Status Report on Road Safety, WHO 2013)

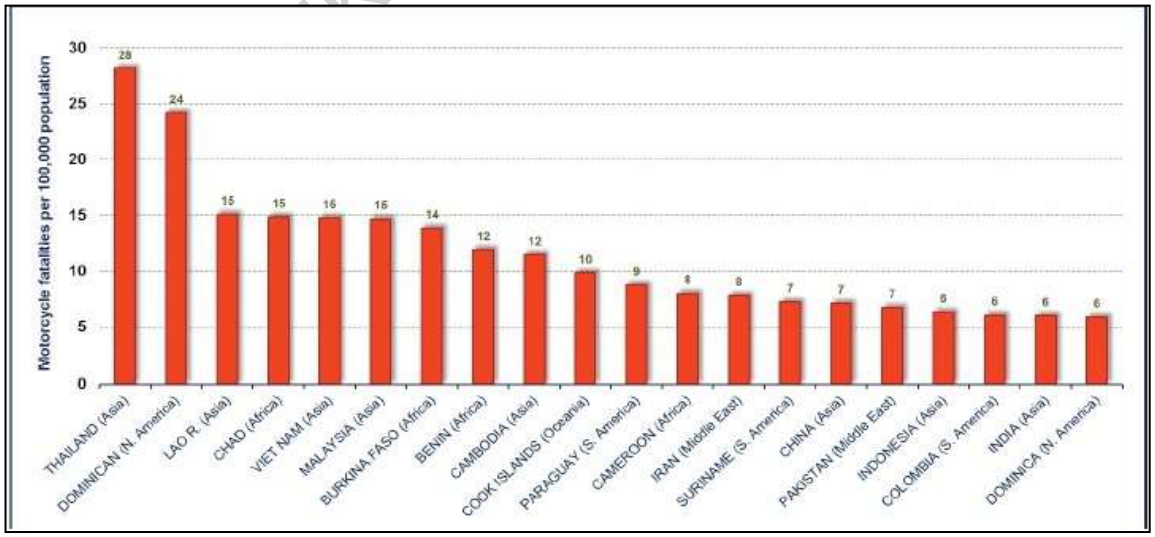

Figure 1.3: The 20 Countries with Greatest Rate of Motorcycle Deaths per 100,000 Populations
(Data source: Global Status Report on Road Safety, WHO 2013)

1.4 Motorcycle Registration and Accident In Malaysia

Motorcycles comprise of 48% of the total registered vehicles in Malaysia with average annual growth rate about 3% (RTD, 2013). Table 1.3 shows the registered vehicles from 2004 to 2013.

Table 1.3 – Number of Registered Vehicles in Malaysia (2004 to 2013)
(Source: Road Transport Department (RTD), 2013)

Year	Registered Vehicles				
	Private Vehicles	Private Motorcycles	Lorries / Vans	Buses	Taxis
2004	5,911,752	6,572,366	772,218	54,997	65,008
2005	6,426,457	6,977,469	802,913	57,071	67,154
2006	6,941,996	7,458,128	836,579	59,991	70,409
2007	7,419,643	7,943,364	871,234	62,308	72,374
2008	7,966,525	8,487,451	1,363,401	64,050	90,474
2009	8,461,334	8,905,854	934,044	66,201	78,841
2010	9,017,613	9,368,454	961,839	68,666	83,712
2011	9,675,397	9,947,189	994,770	71,628	89,815
2012	10,294,024	10,544,578	1,028,861	73,277	92,819
2013	10,480,977	11,035,204	1,112,480	62,672	99,532

Consistent with other countries in the world, motorcycle involved accidents were also alarming. Radin et al. (1995) found that the accident risk faced by motorcyclists is 20 times greater than car users in Malaysia.

In 2013, although motorcycles are involved in sixteen per cent (16%) of all road accidents in Malaysia, motorcycle riders and pillion riders account for thirty four percent (34%) of motor accident deaths in Malaysia (PDRM, 2013). Figure 1.4 and Table 1.4 show the accidents by types of vehicles and motorcyclist casualties from 2004 to 2013.

Table 1.4: Vehicles Involved In Road Accident in Malaysia (2004 to 2013)
(Source: Statistical Report Road Accidents Malaysia, PDRM, 2013)

Year	Vehicles Involved In Road Accident				
	Private Vehicles	Private Motorcycles	Lorries / Vans	Buses	Taxis
2004	380,589	99,227	64,986	12,165	7,111
2005	376,061	97,072	61,147	8,594	7,043
2006	411,976	104,302	65,280	9,711	7,754
2007	428,475	111,958	68,982	10,296	8,816
2008	399,393	103,690	44,683	18,942	8,056
2009	472,307	113,962	65,944	9,380	8,669
2010	511,861	120,156	69,226	9,580	9,899
2011	546,702	129,017	70,994	9,986	11,197
2012	655,813	130,080	70,378	10,617	11,680
2013	632, 602	121,700	56,424	10,123	11,651

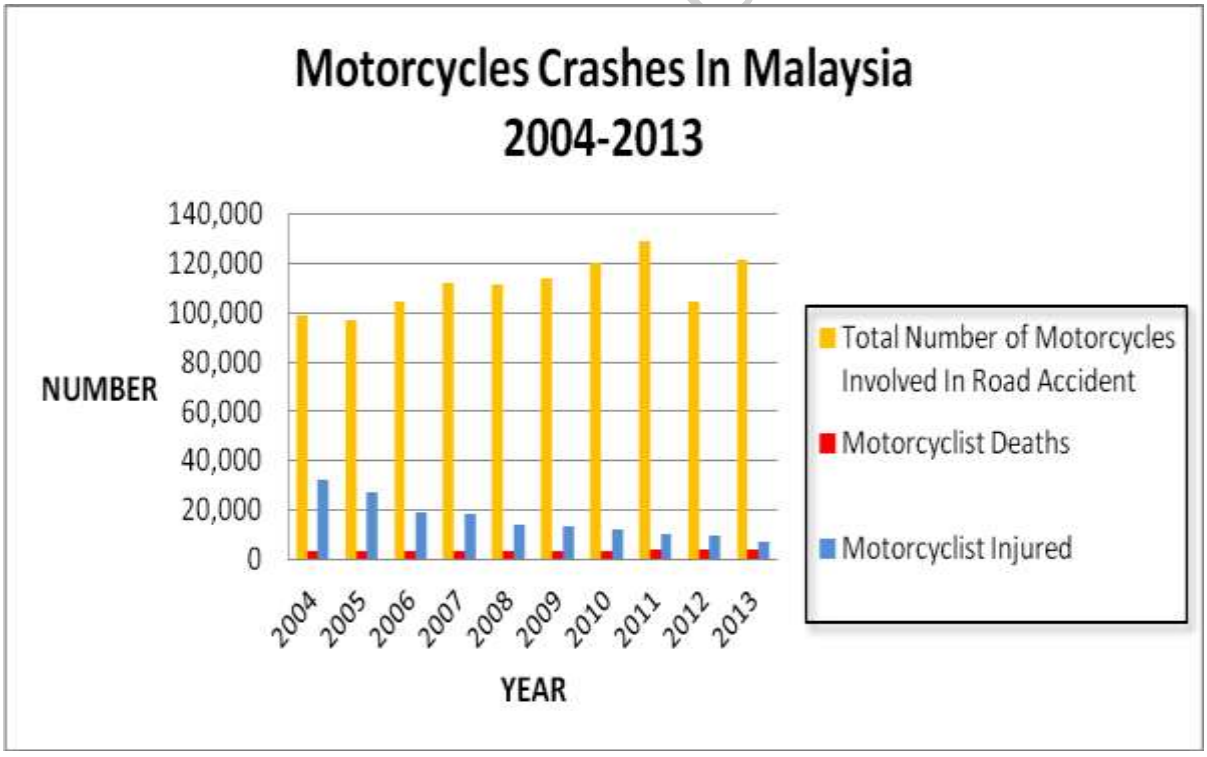

Figure 1.4: Motorcycle Crashes in Malaysia, 2013
(Source: Statistical Report Road Accidents Malaysia, PDRM, 2013)

Breakdown and analysis of accidents revealed that:

- 25% of motorcycle accidents are single vehicle accidents.
- The majority motorcycle accidents are more likely at State Roads (34%) and Federal roads (32%). Motorcycle accidents tend to occur along the high speed high volume Federal and State roads with little control of access.
- The majority of motorcycle casualty accidents involve injuries to the head (30%), legs (25%), hands (9%) and chest (4%).
- Motorcycle accidents are more likely to occur at the approach to or at junctions.
- The majority of motorcycle riders involved in accidents are males and the 16 to 25-year age group is the most predominant.
- The majority of motorcycle casualty accidents involve angular collision (30%), head on collision (19%), right angle side collision (8%) and rear end collision (12%).

The main causes of motorcycle accidents / motorcycle injuries:

i. Mixing of motorcycles with other vehicles along high speed high volume roads with limited control of access.

ii. Poor design of junctions causing multiple conflicts for motorcyclists.
   a. Absence of right turn lane
   b. Improper design of right turn lane
   c. Inadequate channelization due to improper design of painted island treatment

iii. Street Light
   a. Absence of street lights
   b. Inadequate level of lighting

iv. High volume of traffic
   a. Inadequate gaps in main stream of traffic
   b. Inadequate overtaking opportunities along 2-lane 2-way roads

v. High speed traffic
   a. Absence of speed limit signs
   b. Absence of transition speed limit signs

vi. Roadside furniture placed too close to edge of travel way

vii. Absence of facilities for motorcyclists to shelter during wet weather conditions

1.5 Design Considerations for Motorcycle Facilities

Looking at the high number of motorcycle population and accidents, it is important to provide proper facilities for the motorcyclists. Road planner and road designer must understand that it is their duty and responsibility to provide a safe, secure and comfortable facility for use by motorcyclists taking into account the diverse range of motorcycles, motorcyclists, riding behavior, road environment and weather conditions by:

a) Understanding motorcyclists behaviour, height & built of the average motorcyclists

b) Looking at historical accident data involving motorcyclists in Malaysia

c) Motorcycles design, characteristic and capabilities (ranging from small 70 cc engine to the larger super bikes with engines of more than 1000 cc)

d) Willingness of motorcyclists to use the road as planned and designed by the engineers, taking into account local culture and weather conditions (e.g. beating red lights, taking shelter under flyovers, etc.)

e) Practicing/adopting sound engineering judgment in line with world's best practice

Road planners and highway engineers should not adopt typical cross section in the design of facilities for motorcycles without taking into account travel speed, number of lane, lane widths, traffic composition, adjacent land uses and other critical factors. The direct adoption of standard typical cross section can lead to inadequate provision along the major roads and over provision along the local and neighboring streets (e.g. providing motorcycle lanes on low volume local road) and leaving little room for engineering judgment.

Motorcycles are small and mobile machines, hence their riders will take every possible opportunity to be at the head of a queue (e.g. at signalized intersections and roundabout). Road planners and road designers need to take cognizance of this peculiarity and make provisions for this in the planning and design of intersections, taking into account the needs of other road users such as pedestrians and bicyclists. This will require a divergence/revamp of the planning and design philosophies adopted from western countries such as USA, Europe or Australia which has a very small motorcycle population (less than 3%).

1.6 Summary

This chapter has provided some information on the characteristics of motorcycle accidents. The following chapters of these guidelines describe how such accidents may be prevented during the planning, design, construction and maintenance of roads and traffic facilities. This prevention starts with an appreciation of what makes a road 'safe' and the specific safety needs of motorcyclists.

It is imperative for road planners and designers to incorporate the guidelines specified in this document in the planning, design and construction and maintenance of roads as there are more than six million registered motorcycles in Malaysia (and the number is increasing every year) and motorcyclists account for about 50-56% (year 2004-2013) of the annual road accident fatalities. The planning and design of roads need to incorporate the need for motorcyclists to reduce fatalities involving this group of road users if the Government's objective of reducing road accident fatalities to two deaths per ten thousand registered vehicles is to be achieved by the year 2020.

To address an existing road accident problem involving motorcyclists on a section of road, accident investigation and remedial treatment procedures should be used. These are described in detail in another document, Interim Guide on Identifying, Prioritizing and Treating Hazardous Location on Roads in Malaysia produced by IKRAM in 1995. When these remedial treatment procedures reach the stage of design and construction of new works, the section of these guidelines dealing with 'good practice' can be used to cater for the safety needs of motorcyclists.

It has to be highlighted that the engineers involved in the planning, design, construction and maintenance of road facilities related to the safety and well-being of motorcyclists is expected to use their discretion and engineering judgment to determine the most appropriate design for the specific project / road. This guideline is intended to lead them to the best engineering practice / solution for that specific road / project.

CHAPTER 2 - WARRANTS FOR MOTORCYCLE FACILITIES

2.1 Types of Roads

Motorcycle facilities are provided along two (2) types of roads:-

i. Expressways

Defined as a multi-lane high speed high volume road with full/partial control of access and grade separated interchanges all along the road.

ii. Non Expressways

a) Urban Roads

Defined as roads other than expressways which include Federal Roads, State Roads, Municipal Roads and other major roads.

b) Rural Roads

Defined as roads other than expressways which include 'jalan kampung', unpaved roads and other minor roads.

2.2 Types of Facilities

There are two (2) types of facilities provided for motorcycles;-

i. Exclusive Motorcycle Lane

Defined as a roadway meant exclusively for use by motorcycles (motorcyclists are compelled) by law to use it and other vehicles are prohibited by law from using it). It is physically separated from the main carriageway and is grade separated from the main carriageway at intersections/interchanges/points of conflicts. Details of the design of exclusive motorcycle lane are elaborated in Chapter 3 of this Guideline.

ii. Non-exclusive Motorcycle Lane

Defined as the extra lane or verge or marginal strip on the left hand side of the road where motorcycles are encouraged/required to use while riding along a road. Details of the design of paved shoulder for use by motorcycles are elaborated in Chapter 4 of this Guideline.

2.3 Warrants Analysis

2.3.1 Warrants for Expressways

Exclusive motorcycle lanes are recommended to be provided along all expressways, in particular new expressways with grade separated facilities provided at all points of conflicts such as at interchanges, rest and recreation areas, toll plazas, etc. Table 2.1 can be used as a guide to determine the warrants for expressway.

2.3.2 Warrants for Non-Expressways

Generally, the following numerical warrants should be considered for the provision of motorcycle facilities:-

i. Warrant 1 - Total Volume of Traffic or
ii. Warrant 2 - Percentage of Motorcycles or
iii. Warrant 3 - Total Number of Motorcycle Accidents or
iv. Warrant 4 - Side Friction Scores
v. Warrant 5 - Combination of i, ii, iii and/or iv above

Warrant 1: Total Volume of Traffic

The total volume of traffic along a road would affect the efficiency and level of service along a road and the number of accidents involving motorcycles. High volume of traffic, especially during the peak period would invariably affect the smooth flow of traffic resulting in a reduced level of service and higher probability of road accidents. The requirements are satisfied when there are more than:

a. 15,000 vehicles per day along a 2-lane 2-way road
b. 10,000 vehicles per day per lane along a multi-lane road.

Warrant 2: Percentage of Motorcycles

The percentage of motorcycles along a road would affect the efficiency and level of service along a road and the number of accidents involving motorcycles. High percentage of motorcycles, especially during the peak period would invariably affect the smooth flow of traffic resulting in a reduced level of service and higher probability of road accidents. The requirements are satisfied when motorcycles form more than thirty (30) percent of main stream traffic.

Warrant 3: Total Number of Motorcycle Accidents

Accident prone areas involving motorcycle accidents which are correctable by engineering measures warrants the provision of motorcycle facilities. This claim should be substantiated by accident records for a period of two to three years. The requirements are satisfied when there are more than five (5) motorcycle accidents per km per year.

Warrant 4: Side Friction Scores

The safety at motorcycle lane along non-expressway depends largely on the continuity of the facility. The lesser the number of junctions per km. along the motorcycle facility the higher the safety of motorcyclists using that facility.

The non-expressway road with a number of junctions per km along it can be summarized as a road with low or high side friction. A non-expressway road with low side friction is suitable for the provision of motorcycle lane, whereas a road with high side friction is not suitable for a motorcycle lane facility. A road defined with low side friction has side friction scores of less than 30 and a road with high side friction scores of more than 30.

Motorcycle lane facilities are only suitable in an environment with side friction less than 30. The definition of low and high side friction and the method of calculating side friction scores are as shown in Appendix 2.0.

Warrant 5: Combination of i, ii, iii and/or iv above

Motorcycle facilities can be provided even if does not fulfill any of the criteria specified in i, ii, iii or iv above if, in the opinion of the engineer, its absence would be detrimental to the safety of the motorcyclists and the well being of other road users. The requirements under this warrant are satisfied if there is a high likelihood of warrant i, ii, iii and/or iv being met within the first five (5) years of the design life of the project. Table 2.1 shows the summary of the warrants for motorcycle lane facilities for both types of roads, expressway and non-expressway.

Table 2.1: Summary of Warrant Analysis Table

<table>
<tr><th colspan="2" rowspan="2">Numerical Warrants</th><th colspan="3">Type of Roads</th></tr>
<tr><th>Expressways</th><th>Non-Expressways</th><th>Section of Expressways and Non-Expressways</th></tr>
<tr><td colspan="2">Type of Motorcycle Facilities</td><td>Exclusive motorcycle lane</td><td></td><td></td></tr>
<tr><td>1.</td><td>Total Volume of Traffic</td><td>> 15,000 vehicle per day</td><td>> 15,000 vehicle per day along a 2-lane 2-way road
OR
> 10,000 vehicle per day per lane along a multi-lane road</td><td rowspan="5">• For Section with Expressway Road Conditions, Warrant for Expressways shall apply.

OR
• For Section with Non-Expressway Road Conditions, Warrant for Non Expressways shall apply.

OR
• For combination of Expressway and Non- Expressways along the road, the engineer's experience and engineering judgment is required to decide the most appropriate</td></tr>
<tr><td>2.</td><td>Percentage of motorcycles</td><td>> 30% of main stream traffic</td><td>> 30% of main stream traffic</td></tr>
<tr><td>3.</td><td>Total number of Motorcycle Accidents</td><td>> 5 accidents per km per year</td><td>> 5 accidents per km per year</td></tr>
<tr><td>4.</td><td>Side Friction Scores</td><td>Not Applicable</td><td>< 30 friction scores (refer Appendix 2.0 for details)</td></tr>
<tr><td>5.</td><td>Combination of 1,2,3 and/or 4</td><td colspan="2">• Can be provided even if not fulfilling criteria 1, 2,3 or 4 if its absence would be detrimental to the safety of motorist/other road user.

• Warrants if there is a high likelihood of warrants 1, 2,3 and/or 4 being met within</td></tr>
</table>

		5 years of design life of the project.	form of motorcycle facilities.

2.3.3 Warrants for Roads with Sections of Expressways and Non-Expressways

For roads having sections of expressways and non-expressways road conditions along it, the following warrants shall apply:

Sections with Expressway Road Conditions

The warrants as specified in 2.3.1 (Warrants for Expressways) shall apply.

Sections with Non-Expressways Road Conditions

The warrants as specified in 2.3.2 (Warrants for Non-Expressways) shall apply. For long sections of roads with expressway and non-expressway conditions along it, the engineer is required to use his experience and engineering judgment to decide on the most appropriate form of motorcycle facilities for the safety and wellbeing of motorcyclist.

2.4 Minimum Length of Motorcycle Lanes

Length of motorcycle lane to be constructed shall be at least more than 5km long, taking into consideration the site conditions, cost and the usage of the motorcycle lane after completion.

Although the warrant in Table 2.1 shows the need for motorcycle lanes, but if the length is less than 5km, it is not practical to construct motorcycle lanes.

CHAPTER 3 – EXCLUSIVE MOTORCYCLE LANE

3.1 Definition of Motorcycle

According to the Road Transport Act 1987 (Act 333), Motorcycle; that is to say, motor vehicles with less than four wheels, and the unladen weight of which does not exceed four hundred and fifty kilograms (< 450kg). Further references related to motor vehicles as listed below:

1. Road Transport Act 1987 (Act 333)
2. Construction and Use Rules 1959
3. Vehicle Type Approval (VTA) (Amend 2013) Guideline

3.2 Design of Motorcycle

The design of motorcycle is represented by the biggest motorcycles which were commonly found in Malaysia. The side and front views of this design motorcycle vehicle are shown in Figure 3.1 and Figure 3.2, respectively.

Figure 3.1: Design of Motorcycle (less than 250 c.c.) – Side Front view

Figure 3.2: Design of Motorcycle (less than 250 c.c.) – Front view

3.3 Static Space of Motorcycle –Single Operating Space

Figures 3.3 and 3.4 show the simplified outline and dimensions for a single motorcycle. The physical breadth is 1.0 m while the length is 2.60 m. The total area of 2.6 m2 (1.0 m x 2.60m) is the physical space on the road surface being occupied by a static motorcycle. Note that these figures represent a typical motorcycle with side mirrors on both sides.

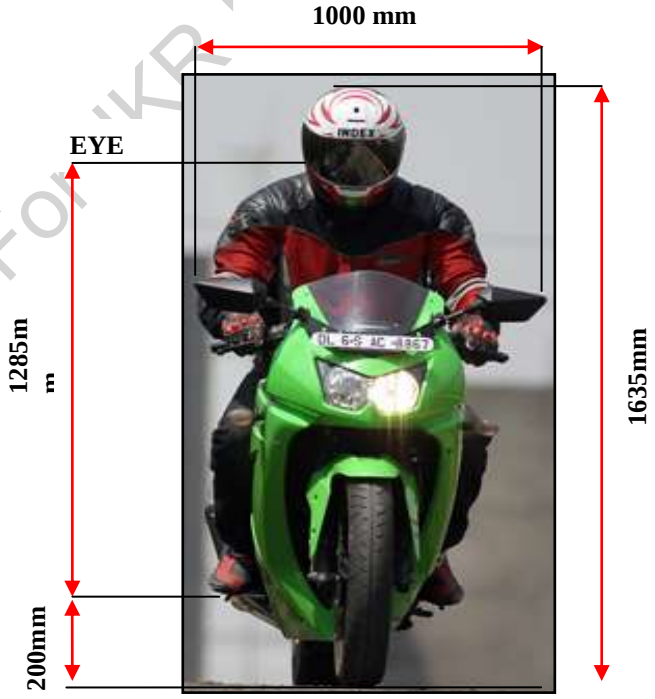

Figure 3.3: Front Outline of a Static Motorcyclist – Breadth of 1.0 m Mean Operating Width of 1.3 m Required by a Motorcyclist

Figure 3.4: Side Outline of a Static Motorcyclist – Length of 2.60 m

3.4 Static Space of Motorcycle - Side-by-Side Operating Space

The design values of the separation distance of side by side are based on the following values:

- 60 km/hr; and
- 1200 mc/hr/lane is 0.5 m as shown in Figure 3.5 below.

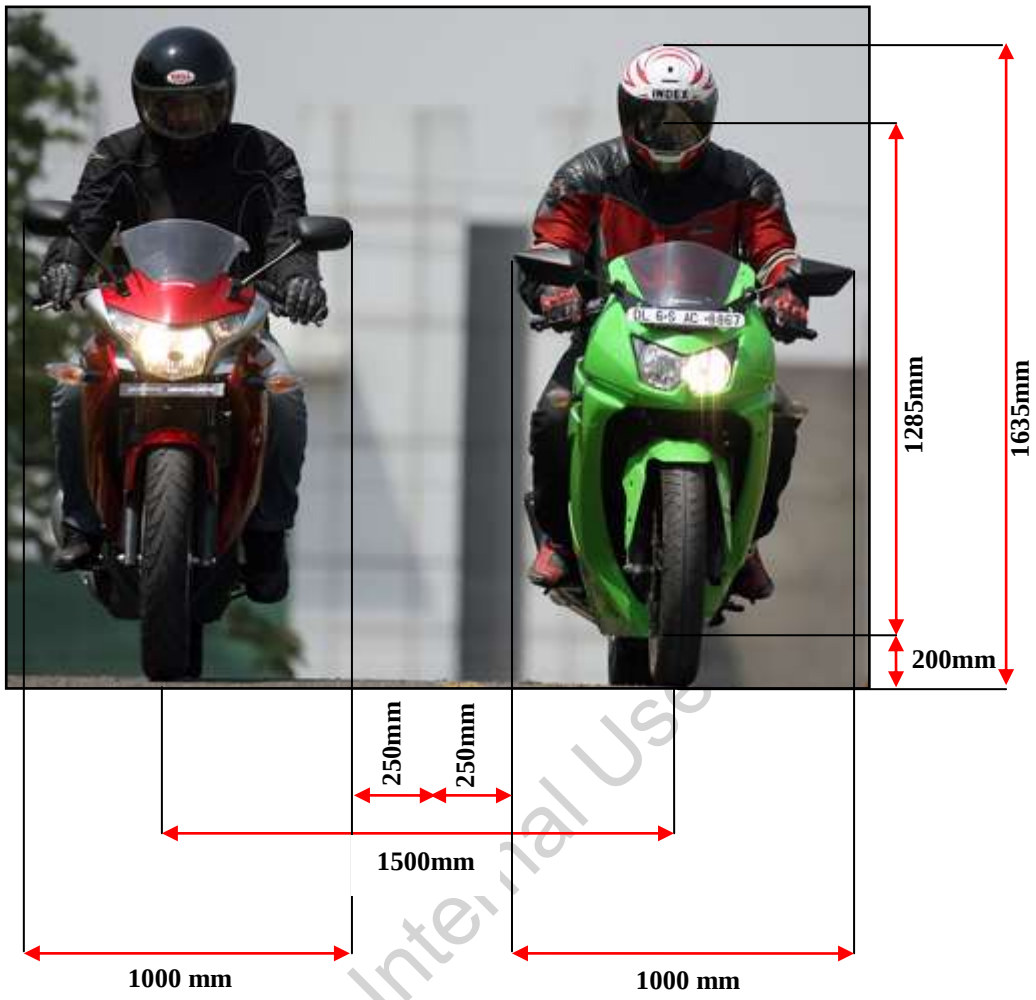

Figure 3.5: Side-by-side Motorcyclist Separation Distance of 0.50 m

3.5 Riding Manner Along The Exclusive Motorcycle Lanes Of Various Widths

Within motorcycle lane widths of 1.7m and narrower, the motorcyclist's riding manner follows the headway concept (i.e., they travel in one line) under both low and high volume conditions. On the contrary, their riding manner follows the space concept (i.e., they travel in more than one line) when they ride along motorcycle lanes wider than 1.7m, either under low volume or high volume conditions. Thus, unless the availability of space is very much a constraint, one should avoid providing a 1.7m wide motorcycle lane.

The acceptable and practical width for the motorcycle lane is recommended to be 3.0 m, inclusive of marginal strip. A wider lane may improve comfort but it is also expected that the average motorcycle speed will increase which may bring about speed management problems.

3.6 Act, Rules and Regulation

The motorcycle facility is not required to be gazetted for its specific use as it is clearly stated in Clause 79(2) of the Road Transport Act 1987 (Act 333) under penalties for neglect of traffic directions and signs.

> ***Penalties for neglect of traffic directions and signs***
>
> *Subject to subsection (1) and section 76$_A$, where any traffic sign has been lawfully placed on or near any road, any pedestrian or any person driving or propelling any vehicle, who fails or neglects to conform to the indication given by the sign, shall be guilty of an offence and shall on conviction be liable to a fine of not less than three hundred ringgit and not more than two thousand ringgit.*

The traffic signs and directions can be referred to in the Mandatory Signs of the Traffic Signs (Size, Colour and Type) Rules 1959, ATJ 2E/87 (Pindaan 2011) – Guide Signs Design and Application and Guidelines & Design Application (T1/07) – Expressway Signing System by LLM.

3.7 Capacity and Level-of-Service for Uninterrupted Exclusive Motorcycle Lanes

Note that while the selection of these breakpoints is arbitrary, they have been chosen to reflect the full range of site speeds, flows and lane width conditions, and motorcycling experience along the uninterrupted exclusive motorcycle lanes.

3.7.1 LOS Designation for Motorcycle Lane (Headway Concept)

For the headway concept as per Table 3.1 and Figure 3.6, the motorcycle density is measured in mc/km/lane while the motorcycle density is measured in mc/m2 in the space concept.

Table 3.1: LOS Criteria for One-Way Exclusive Motorcycle Lane (Headway Concept)*

Level of Service	Density (mc/km/lane)	Expected Flows and Speed		
		Average Speed (km/hr)	Flow Rate (mc/hr/ln)	*v/c* Ratio
A	6	53	306	0.10
B	21	45	918	0.30
C	44	35	1530	0.50
D	68	29	1989	0.65
E	235	13	3060	1.00
F	>235	<13	Variable	Variable

*Average conditions for one (1) minute

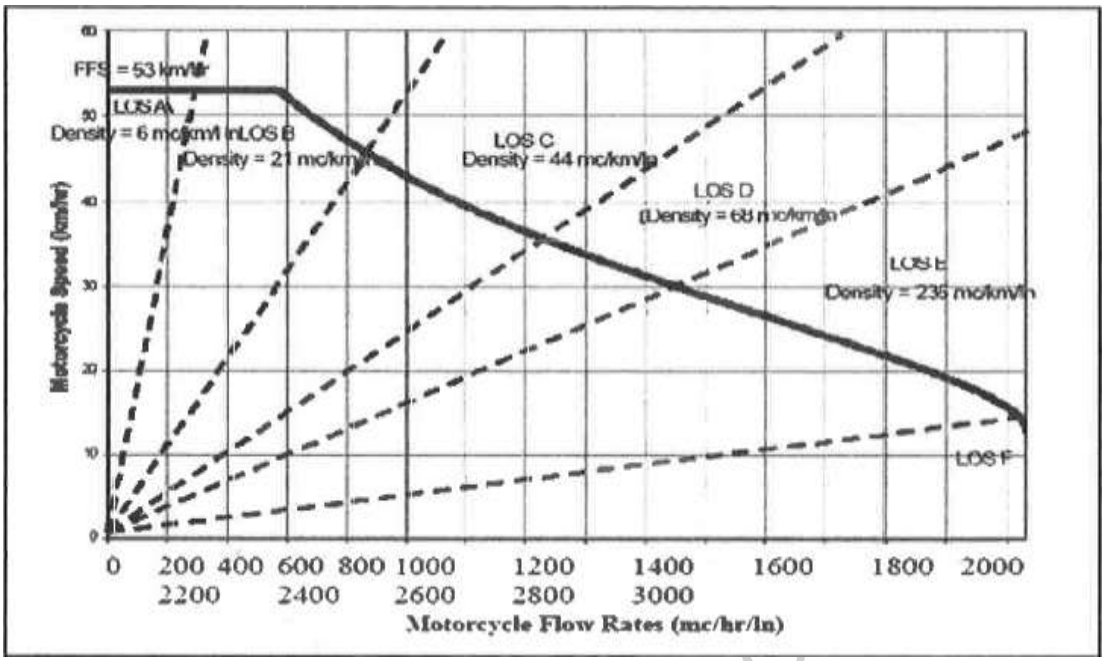

Figure 3.6: Motorcycle Speed-Flow Curve and LOS Boundaries for Uninterrupted Motorcycle Facility (Headway Concept)
(Source: Hussain Hamid, PhD., Development of Capacity and Level-Of-Service for Uninterrupted Exclusive Motorcycle Lanes in Malaysia, 2006)

3.7.2 LOS Designation for Motorcycle Lane (Space Concept)

The LOS criteria for the uninterrupted exclusive motorcycle lanes (space concept) are presented in Table 3.2 and the chart of the speed-flow curve and LOS boundaries for an uninterrupted exclusive motorcycle lane (space concept) is shown in Figure 3.7.

Table 3.2: LOS Criteria for One-Way Exclusive Motorcycle Lane (Space Concept)*

Level of Service	Space (m^2/mc)	Expected Flows and Speed		
		Average Speed (km/hr)	Flow Rate (mc/hr/ln)	*v/c* Ratio
A	295	65	221	0.10
B	69	46	662	0.30
C	33	36	1104	0.50
D	21	30	1435	0.65
E	6	13	2207	1.00
F	<6	<13	Variable	Variable

*Average conditions for one (1) minute

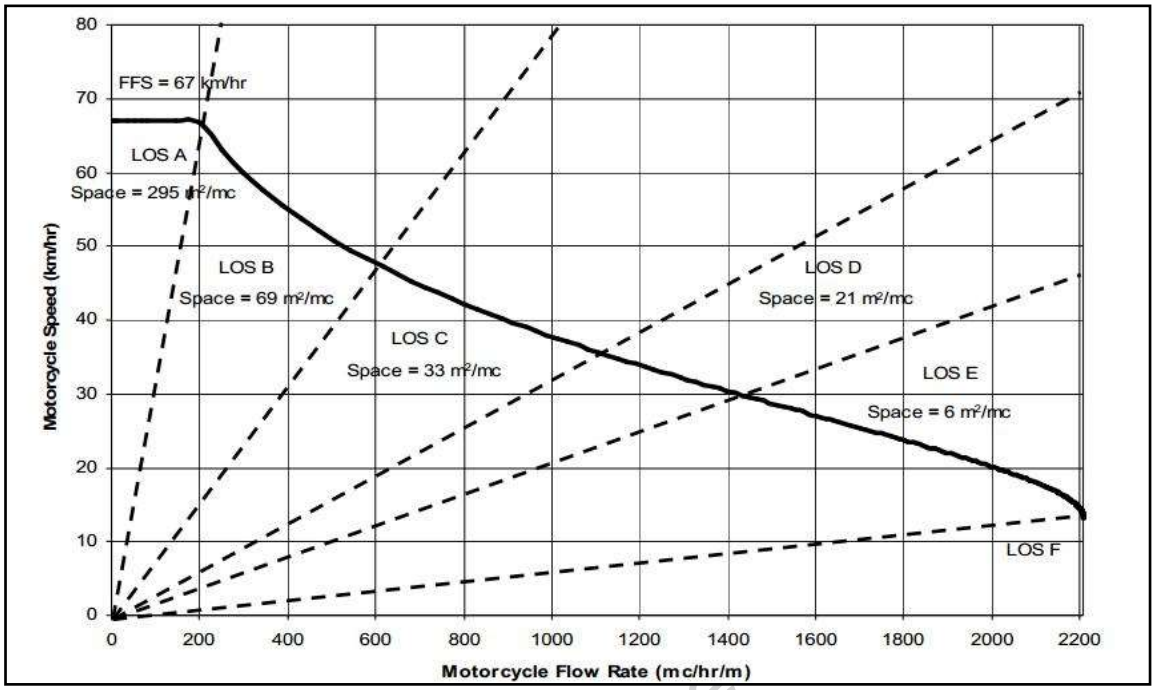

Figure 3.7: Motorcycle Speed-Flow Curve and LOS Boundaries for Uninterrupted Motorcycle Facility (Space Concept)
(Source: Motorcycle Lane Programs in Malaysia, Professor Dr. Ir. Radin Umar)

3.7.3 Maximum Motorcycle Flow Rates at Various LOS for Ranges of Motorcycle Lane Widths

Based from the LOS values of the headway and space concepts, the computed maximum service motorcycle flow rates for a range of motorcycle lane widths are presented in Table 3.3 and graphically in Figure 3.8.

Table 3.3: Maximum Motorcycle Flow Rates for Various LOS and Lane Widths

Motorcycle Lane Width (m)	Maximum Service Motorcycle Flow Rates (mc/hr/ln)*				
	LOS A	LOS B	LOS C	LOS D	LOS E
1.4	306	918	1530	1989	3060
1.5	306	918	1530	1989	3060
1.6	306	918	1530	1989	3060
1.7	306	918	1530	1989	3060
1.8	398	1192	1987	2583	3973
1.9	420	1258	2098	2727	4193
2.0	442	1324	2208	2870	4414
2.1	464	1390	2318	3014	4635
2.2	486	1456	2429	3157	4855
2.3	508	1523	2539	3301	5076
2.4	530	1589	2650	3444	5297

2.5	553	1655	2760	3588	5518
2.6	575	1721	2870	3731	5738
2.7	597	1787	2981	3875	5959
2.8	612	1836	3060	3978	6120
2.9	612	1836	3060	3978	6120
3.0	612	1836	3060	3978	6120
3.1	612	1836	3060	3978	6120
3.2	612	1836	3060	3978	6120
3.3	612	1836	3060	3978	6120
3.4	612	1836	3060	3978	6120

*Average conditions for one (1) minute

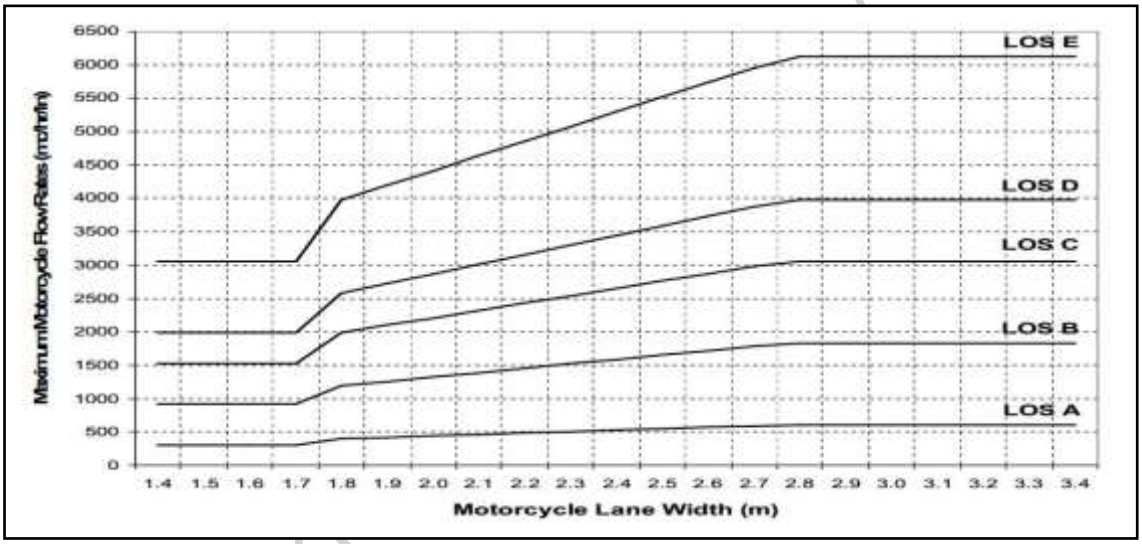

Figure 3.8: Chart of Maximum Motorcycle Flow Rates for Various LOS and Lane Widths

(Source: Motorcycle Lane Programs in Malaysia, Professor Dr. Ir. Radin Umar)

Based on the above, it is recommended that the exclusive motorcycle lane width of 3.0m is to be considered. Pavement design for exclusive motorcycle lane is to be 100 mm sub-base of sand blanket, 150 mm base course of crusher run and a 20 mm of asphalt surfacing. Typical plan view for an exclusive motorcycle lane dual carriageway with full access control as illustrated in Appendix 3.0.

CHAPTER 4 - NON-EXCLUSIVE MOTORCYCLE LANE

4.1 Definition

A non-exclusive motorcycle lane (NEML) refers to the part of the road that is adjacent to the regularly traveled portion of the road and is on the same level as the road. Ideally, non-exclusive motorcycle lane with suitable width should be included in the construction of the new roads or the upgrade of existing roads where there is a significant level of current / potential motorcycle travel. The normal practice of JKR Malaysia, is to provide 2.0m non-exclusive motorcycle lane width (non-exclusive motorcycle lane refers to the extra pavement width added to an existing roadway). The lane provides a safer riding environment for the motorcyclists.

Figure 4.1: Example of Non-Exclusive Motorcycle Lane
(Location: Federal Route 5, Jalan Abdul Rahman - Parit Jawa, Muar, Johor, JKR Malaysia)

Roads with non-exclusive motorcycle lanes have reduced accident rates (Department of Transport, Federal Highway Administration), as non-exclusive motorcycle lanes:

• Provide space for motorcycle lane and disabled vehicles.

• Reduce passing conflicts between motor vehicles, motorcyclists and pedestrians.

• Make the crossing pedestrians more visible to motorists.

• Provide space to make maneuvers.

• Accommodate potential driver error.

• Add a recovery area to regain control of vehicle.

• Increase sight distance for through vehicles and for vehicles entering the roadway.

• Provide lateral clearance to roadside objects such as guardrail, signs and poles.

• Contribute to driving ease and reduced driver strain.

Figure 4.2: Example of Non-Exclusive Motorcycle Lane to be added onto Existing Roadways
(Location: FT 007 Alor Janggus, Kedah, JKR Malaysia)

4.2 Design Requirement

- Material and structure of non-exclusive motorcycle lane should be the same as mainline pavement
- The lane width of the non-exclusive motorcycle lane is 2.0 m (not more than 2.5m as this may encourage other bigger vehicle to use the motorcycle lane)
- Red coloured separator to be provided
- Road stud to be provided along the non-exclusive motorcycle lane at 6.0m interval
- Minimum distance of 0.5m marginal strip is desirable.

The Typical Plan View and Typical Road Cross Section with NEML are as illustrated in Appendix 4.0.

The symbol and pavement word marking shall be yellow in colour and placed alternately along the motorcycle lane at 250 m intervals as illustrated in Appendix 4.1.

The various treatment designs for non-exclusive motorcycle lane at points of conflict are elaborated in Chapter 5 of this guideline.

CHAPTER 5 - TREATMENT OF NON-EXCLUSIVE MOTORCYCLE LANE AT POINT OF CONFLICT

5.1 Introduction

This chapter provides information on the methods of treatment which should be considered for adoption, to improve the safety and convenience of motorcyclists particularly at points of conflict. Point of conflict is defined as an area where motor vehicles (including motorcycles) cut across the path of other vehicles traveling along the main line. Particular attention is to be given to points of conflicts since accident investigation and countermeasures carried out by JKR Malaysia have shown that these locations have a high rate of accidents especially involving motorcycles.

The treatments proposed in this chapter are not exhaustive and should only be used as a guide for designers. When implementing any of the treatment specified in this chapter, the designer must always consider the road and traffic environment including ensuring conformance with the existing road traffic rules and regulations. The application of sound engineering judgment based on road safety principles are highly encouraged.

5.2 Treatment at Four-Legged Major Junctions

For these junctions, it is recommended that the non-exclusive motorcycle lane be terminated before the start of the deceleration lane and commences after the acceleration lane. In other words, motorcyclists will have to share the same space with other vehicles at the junction approaches. However, adequate lane width need to be provided to enable motorcyclists to pass through the junction without being squeezed or cause an impediment to the movement of other vehicles. Typical treatment of non-exclusive motorcycle lane at signalized four-legged major junction is as shown in Appendix 5.0.

A 'head start' storage area before the stop line should be provided for motorcyclists so that they are 'stored' in front of other vehicles. This treatment formalizes the common practice adopted by most motorcyclists, who wait in front of other vehicles so that they can be seen and lead other vehicles when the directional green phase starts. If the number of motorcyclists is very large then consideration may be given to providing motorcyclists with a larger store area.

This storage area shall be clearly marked for motorcyclists by having it painted with yellow coloured symbol of motorcyclist on red coloured background. It is also important that these coloured surfacings have high skid resistance properties to reduce the risk of skidding. Alternatively, only symbol of the yellow coloured motorcyclist may be used as a minimum requirement.

5.3 Treatment at Three Legged Major Junctions

In this type of junction, motorcycles turning into/from the junction must share the same space with other vehicles at the junction approaches of the main road. However, a continuous travel path is provided for straight through motorcycles on the opposite side of the junction. Therefore, adequate merging length needs to be provided upstream to allow right turning motorcycles to merge safely into the main carriageway. Similarly, adequate length must also be provided downstream to allow safe merging for motorcycles entering the non-exclusive motorcycle lane. Typical treatment of non-exclusive motorcycle lane at major three-legged junctions is as shown in Appendix 5.1.

5.4 Treatment of Non-Exclusive Motorcycle Lanes with Series of Minor Junctions

Where the non-exclusive motorcycle lane passes in front of a series of minor junctions, it is recommended that the non-exclusive motorcycle lane be carried across these junctions. This treatment (as shown in Appendix 5.2) allows the motorcyclists to maintain their travel path unimpeded and without having to change their lane.

Continuity lines painted in front of the minor junctions are used to define the length or area where any vehicles can use to cross the non-exclusive motorcycle lane. This is also the area where high frequency of conflicts exists and extra caution is necessary.

This potential conflict area is to be further supplemented with traffic signs to give prominence to the existence of the non-exclusive motorcycle lane.

5.5 Treatment through Interchange Areas

Conflicts may arise between straight through motorcycles and other vehicles exiting or entering the ramps. Hence, it is appropriate that a grade separated crossing and/or vehicular box culvert be provided for straight through motorcycles to avoid any conflict.

At instances where this cannot be provided, the non-exclusive motorcycle lane needs to be terminated before the start of the exit taper and commences after the entering taper at the downstream. Straight through motorcycles crossing the diverging and merging sections are exposed to being hit by vehicles entering and exiting the ramps. However, the gore area can be used by motorcyclists as it helps to minimize the crossing length. Therefore, the gore area must be clear from any obstruction.

5.6 Treatment at Bus Stop and Taxi Stand

The treatment at other points of conflict (e.g. bus stop, taxi stand etc.) varies depending on the road environment. Appendix 5.3 outlines some form of treatments that can be used for non-exclusive motorcycle lane at bus stops. However, the designer must carefully study the suitability of any of these treatments and their safety implications.

5.7 Road Signs and Markings

Road signs need to be provided along the vicinity of motorcycle lanes. These signs can either be in the form of post mounted or on-pavement painting. Appendices 5.4 and 5.5 show some typical signs that can be used with the provision of non-exclusive motorcycle lanes.

CHAPTER 6 - MOTORCYCLE SHELTER

6.1 Introduction

Motorcycle shelter is one of the facilities that should be built along the highways in Malaysia to cater for motorcyclists. The purpose of these shelters is to allow motorcyclists to stop and take a rest during wet weather conditions and/or when they are tired and are in need of rest. Road authorities in Malaysia, such as the Public Works Department, Malaysian Highway Authority and local municipalities have been providing these shelters as and where they are necessary.

Of late, there has been a number of road accidents involving motorcycles taking shelter underneath flyovers or interchanges during wet weather conditions. The huge number of motorcyclists taking shelter underneath these structures has resulted in some of them being placed on the travelled way, leading to collisions with other vehicles (drivers unable to stop in time due to poor visibility during wet weather conditions).

Due to the severity of these incidents, the Malaysian Government has decided to concentrate on providing more shelters to prevent the occurrence of such incidents. Accident statistics in Malaysia indicate that more of these accidents occur in the major urban centres, with a high volume of traffic and a correspondingly high composition of motorcycles. As such, the focus of this chapter is more on the urban highway where the volume of the motorcyclists is higher. Based on a survey of the existing shelters, the response from the motorcyclists on the shelters is good as they now have a proper place to take shelter during wet weather conditions.

The total construction cost to build the shelters depends on the types, sizes, material used and the locations.

Objectives and Advantages of Motorcycle Shelters:

- To minimize traffic disruption from motorcyclist during wet weather conditions
- Create safer environments for motorcyclist by preventing them taking shelter or stopping on the travelled way
- Deliver a safer route for travelling purpose
- Create parking and rest area for fatigued motorcyclist and to allow motorcyclist take shelter during wet weather condition

6.2 Warrant for Motorcycle Shelter

Motorcycle shelter warrants are decision criteria that identify sites along road network needing shelter installations and takes into account the geometry and location of roadside features.

- Shelters are located at selected locations along the route, wherever practicable, and shall be constructed to increase safety and security for motorcyclists taking refuge under adverse weather conditions.

- Motorcycle shelter is only recommended at a fully or partially access control roads where accessibility is regulated / controlled by the number of motorcycles using that section of road which exceeds 500 motorcycles/day.

- Motorcycle shelter should be placed to match the flow line of motorcyclist traffic (road left side). Motorcycle shelter located at the right side of road would invite unexpected hazard to the motorcyclist.

- Motorcycle shelter shall be placed where the motorcyclists have a clear and unobstructed view of it from afar (at least 150m).

- Design of motorcycle shelter should be subjected to Stage 3 Safety Audit in accordance with the Road Safety Audit Guidelines produced by JKR Malaysia in 1997. Stage 5 Audit should be carried out when necessary on all completed works. This includes road sign markings and shelters as well as any physical road improvements.

6.3 Types of Motorcycle Shelter

A motorcycle shelter should be understood as a street space mechanism where motorcyclist merge, stop then diverge. It is made up of a secure stop area with compatible platforms for motorcyclist. Shelter and platforms can be arranged in various layouts to cope with motorcyclists' demand and traffic flows.

The design of a motorcycle shelter is not a trivial matter. Each shelter is a particular case of demand structure and external conditions governing it. Different motorcycle shelter may be appropriate under different circumstances, depending on what the issues are. Therefore, there is a need to understand the phenomena that occurs at a particular motorcycle shelter and to forecast performance of alternative layouts and operations.
However, for motorcycle shelter particularly in urban areas, aesthetic value in the design can be considered by the designer to meet requirement by the relevant authorities.

This Motorcycle Facilities Guideline attempts to identify a common "identifier" that could be used on every unique motorcycle shelter to blend it as part of the road network system.

6.3.1 Stand Alone Shelter

Figure 6.1: Stand Alone Motorcycle Shelter

General characteristics:

- Provide safe and convenient place for motorcyclists to stop by during bad weather conditions.
- Attractive shelters attract motorcyclists to stop by even during good weather.
- The construction of the stand alone shelter is more expensive compared to under bridge shelter types.
- Higher maintenance cost.
- Need exclusive land for shelter booth and drive path.
- If located too far from the mainline, there is a possibility of motorcyclists riding by the shelter without noticing it.

The layout plan drawing for Motorcycle Shelter (Type 1 – Stand Alone) is as illustrated in Appendix 6.0.

6.3.2 Under Bridge Shelter

Figure 6.2: Under Bridge Motorcycle Shelter

General characteristics:

- Cost effective type of motorcycle shelter
- Easy access and provide convenience to motorcyclists
- Fulfil the Malaysian motorcyclist culture, where motorcyclists prefer to take cover below bridge during bad weather conditions
- Low maintenance work required
- The designer shall calculate the required length for ease of manoeuvre and ensure safety of motorcyclist.

The layout plan drawing for Motorcycle Shelter (Type 2 – Under Bridge) is as illustrated in Appendix 6.1.

6.4 Design Criteria / Quality Standard

The shelter designs have a relationship to site issues such as specific to weather as well as the prevalent factors affecting its design, number and behaviour of the arriving motorcyclists.

The proposed motorcycle shelter design includes the following:

- Provides for maximum weather protection
- Provides for several benches and one garbage bin
- Has a ceiling in white to permit maximum light
- Is wired for electricity to permit night lighting (depending on location)

- Provides for convenient accessibility
- Provide proper drainage on the mainline
- Lightning protection shall be installed.
- Provides proper signs indicating there are motorcycle shelter facilities ahead to prevent overflowing motorcycles into the traffic lane and to protect motorcyclists' safety. The next shelter facilities should be placed within 5km with a proper provision of approaching and confirmation signs.

The drawings for motorcycle shelter facilities signs are as illustrated in Appendix 6.2 and Appendix 6.3.

6.4.1 Motorcyclist Waiting Areas

The recommended procedures for computing the size of motorcyclist waiting areas at motorcycle shelter is based on maintaining a desirable level of service. The level of service for a motorcyclist waiting area is based not only on space but also the degree of mobility allowed. The proposed size of Stand Alone Type of Motorcycle Shelter is shown in Table 6.1.

Table 6.1: Proposed Size of Stand Alone Type of Motorcycle Shelter

CRITERIA / TYPE	LOCATION	VOLUME OF MOTORCYCLE	MINIMUM SIZE AREAS
Type A	Urban & Intra-urban highways / roads	More than 1500 motorcycle/dir/day	$32m^2$ (8m x 4m)
Type B		More than 500 motorcycle/dir/day but less than 1500 motorcycle/dir/day	$21m^2$ (7m x 3m)
Type C	Inter-urban highways / roads	Less than 500 motorcycle/dir/day	$12m^2$ (4m x 3m)

Whereas for under bridge type of shelter, the recommended minimum width shall be 3.5m and the length varies, based on bridge dimension / location.

In order to provide a better utilisation of motorcycle shelter occupied only by the motorcyclists, it is suggested that a 175mm platform be raised to prevent motorcyclist from parking their motorcycle inside the shelter.

Figure 6.3: Raised Platform for Better Occupancy and Utilisation by Motorcyclist

6.5 Impact of Motorcyclist Amenities

Motorcyclist amenities are those elements provided at a motorcycle shelter to enhance comfort, convenience and security for the transit patrons. Amenities include such items as shelters, benches, vending machines, trash receptacles, phone booths / emergency telephone booth, information signs, motorcycle racks, lighting and landscaping. The effect that particular amenities have on motorcyclist waiting area is unclear. Amenities at most motorcycle shelters are placed in response to human needs in addressing an environmental condition. The advantages and disadvantages of different motorcyclist amenities at motorcycle shelters are summarized in Table 6.2.

Overall required motorcyclist waiting areas at motorcycle shelter should account for space taken up by shelters, benches, information signs and other amenities, with appropriate shy distances.

Table 6.2: Example of Motorcyclists Amenities at Motorcycle Shelter

Amenity	Advantages	Disadvantages
Shelters	• Provide comfort for waiting motorcyclist • Provide protection from climate-related elements (sun, glare, wind and rain)	• Require maintenance trash collection • May be used by graffiti artists
Benches	• Provide comfort for waiting	• Require maintenance

	motorcyclist	• May be used by graffiti artists • May be used by illegal advertiser.
Lighting	• Increase visibility • Increase perceptions of comfort and security • Prevent misuse of motorcycle facilities for any immoral activities during “dark hours”.	• Require routine maintenance • Can be costly
Trash Receptacles	• Provide place to discard trash • Keep shelter clean	• May be costly to maintain • May have bad odour

CHAPTER 7 – ROAD LIGHTING

7.1 General

The primary purpose of road lighting is to provide safe and comfortable vision during the night on motorcycle lanes. The benefits of such lighting include reduction of accidents and facilitation of traffic flow.

7.2 Warrants

The intent of the motorcycle lane road lighting warrants is to provide guidelines for levels of road lighting consistent with the national standards, while recognising the unique needs of the motorcyclist travelling on the motorcycle lane.

7.2.1 Exclusive Motorcycle Lane

For new motorcycle lanes, road lighting should be considered at:

a) Sharp bends with horizontal radius < 115m
b) Tunnels
c) Merging & diverging gores
d) Junctions
e) Overpasses

When the forecasted motorcycle traffic volume at the opening year is likely to exceed 1000 mc/hr/ln, road lighting should be considered for the entire stretch of exclusive motorcycle lane.

For existing exclusive motorcycle lanes, road lighting should be provided when:

a) Motorcycle volume > 1500 mc/hr/ln or
b) Night time accidents is 30% higher than day time accidents

7.2.2 Non-exclusive Motorcycle Lane

For shared motorcycle lane, the provision of lighting will depend on warrant for mainline traffic and night time accident (30% more than day time accidents).

7.3 Minimum Average Motorcycle Lane Luminance

The road lighting values expressed in Table 7.1 below are to be used as a general guideline in the design of road lighting system for motorcycle lanes. The guidelines are intended to establish the level of road lighting which covers the various sections of motorcycle lanes. The lighting layout should provide a uniformly bright carriageway to the desired levels. Nevertheless it should also be designed to prohibit glare, and to minimise glare and adverse impacts on all road users. The example of road lighting layout for motorcycle lanes are as illustrated in Appendices 7.0, 7.1 and 7.2.

Table 7.1*:* Minimum Average Motorcycle Lane Luminance

Area	Minimum Average Motorcycle Lane Luminance, cd/m2
Merging & Diverging Gore Areas	2.0
Junction	1.5
Overpass	1.0
Underpass (> 30m)	1.5
Others	1.0

At tunnel or underpass which is longer than 10m, it is recommended that the full length of the structure be lit at all times. The designer shall take into account in his design the transition lighting requirements at the entrance and exit to these tunnel/underpass so that minimum vision adjustment is experienced by the motorcycle riders.

The relevant Guidelines, Codes of Practice and Standards such a MS 825: 2007, BS EN 13201, BS 5489, L-S20, etc. should be referred to when designing road lighting. Among some other factors that should be considered in the design of road lighting are as follows:

i) Glare
ii) Reflection (asphalt surface)
iii) Lighting arrangement (spacing)
iv) Mounting height
v) Luminance Maintenance Factor

CHAPTER 8 - TRAFFIC BARRIER

8.1 General

A traffic barrier is an obstacle and a hazard in itself. The decision to install it should only be taken if other means of removing the obstacle it protects are impossible or prohibitively expensive, and that the barrier itself is not a greater danger than the obstacle it is intended to protect. If a traffic barrier not fulfills its purpose of installation, then it should be changed to a different type of traffic barrier (i.e, traffic barrier with Additional Rub Rail or Special Impact Attenuators).

8.2 Traffic Barriers for Motorcycle Lane

Generally, Semi-Rigid Barriers minimum Type TL-3 and with end treatment Type 2 are recommended to be used and installed for motorcycle lane with some improvement to the traffic barrier performance for motorcyclists. Two methods are recommended,,i.e. the first method is by covering the existing guardrail posts with additional rub rail on the lower section of the guardrail system and the second method is covering exposed posts with special impact attenuators.

8.2.1 Method 1: Additional Rub Rail

The addition of rub rail to the lower section W-beam barrier systems is recommended to be used. Figure 8.1 illustrate the example of rub rail fitted to an existing W-beam.

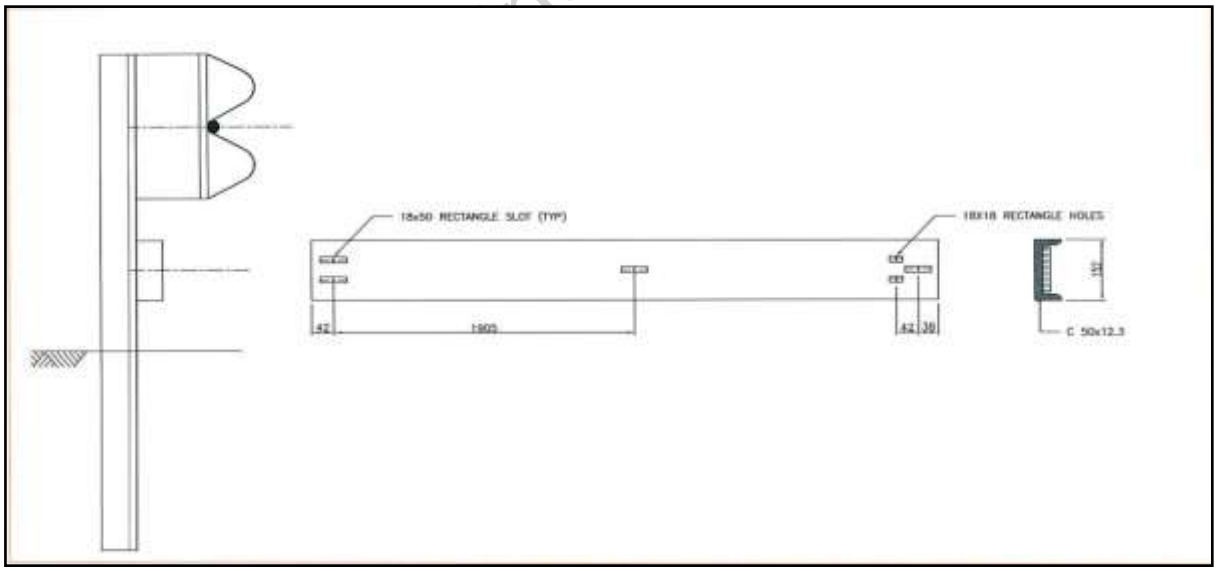

Figure 8.1: Schematic Drawing Of Rub Rail Fitted To An Existing W-Beam (Source: REAM - GL 11/2011)

Figure 8.2: Photograph of Rub Rail Fitted To an Existing W-Beam
(Source: Safe Direction)

8.2.2 Method 2: Special Impact Attenuators

This method focuses on the ways to reduce consequences of a crash against a metal barrier. Impact attenuators, or dampers, that are fitted to existing guardrail posts, also serve to increase the impact surface and, due to their deformation properties, increase energy absorption on impact.

a) Plastirail

The device consists of a soft plastic fence covering barrier posts that can be fitted to existing barrier systems. It aims to combine both energy absorption properties and impact spreading properties. The photograph of plastirail fitted to existing barrier is shown in Figure 8.3.

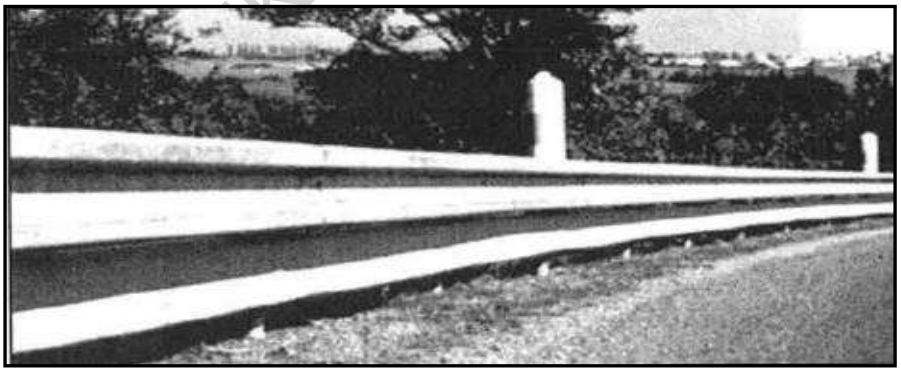

Figure 8.3: Photograph of the "Plastirail" Fitted to Existing Barrier System
(Source: REAM - GL 11/2011)

b) Mototub

The “Mototub” is similar to the Plastirail except that it is made from 70% recycled material. It is currently used in a number of European countries. The photograph of “Mototub” fitted to existing barrier is shown in Figure 8.4.

Figure 8.4: Photograph Of "Mototub "Fitted To Existing Barrier System
(Source: Sodirel)

c) The Basyc Motorcyclist Protection System (MPS)

The Basyc MPS is a unique concept which controls and absorbs bodily impact against safety barriers, thereby affording motorcyclist greater protection. This innovative high-tensile mesh guardrail protection system reduces motorcyclist injuries and fatalities. The photograph of Basic Motorcyclist Protection System (MPS) fitted to existing barrier is shown in Figure 8.5.

Figure 8.5: Photograph of Basyc Motorcyclist Protection System (MPS) Fitted to the Existing Barrier System
(Source: Cegasa Internacional)

CHAPTER 9 - TRAFFIC MANAGEMENT PLAN AT MOTORCYCLE LANE FOR MAINTENANCE AND CONSTRUCTION WORKS

9.1 Introduction

There are more than six million registered motorcycles in Malaysia and as they constitute more than fifty percent of registered vehicles nationwide, it is important that consideration be given to them during maintenance and construction works.

9.2 General Consideration

- It is important to appreciate that surface changes can be critical to motorcycle stability and many changes cannot be seen until it is too late. Road works or maintenance activities should not result in surprises which require rapid or unexpected evasive actions.
- It is important to note that motorcycles have a different behaviour / response to sudden maneuvers (such as sudden / heavy braking) compared to cars. They tend to slip off the carriageway, resulting in the motorcyclists being thrown off the motorcycles and impacting other objects and/or be impacted by other vehicles.
- Motorcyclists riding at night and/or in wet weather condition will not be as fully aware of construction works compared to car drivers driving in the comfort of the vehicle's enclosure. As such, additional signs, reflectors and pavement markings need to be provided for motorcyclists.
- Potholes are a significant factor for motorcycle accidents that can result in death or serious injury. Their prompt identification and repair has significant benefit for motorcyclists.
- Any changes in surface friction, due to a different surface texture from maintenance or road works is a potential hazard to motorcyclists. Gravel and road aggregate is very difficult to differentiate from the sealed surface. Advanced warning should be provided in all cases.
- Heavy patching results in an uneven surface which can destabilize a motorcycle.
- The presence of humps, which is intended to reduce vehicle speeds in the vicinity of construction, can be a major hazard to motorcyclists, particularly during wet weather condition (When the motorcyclist is partially 'blinded' by the rain and/or oncoming headlight glare).

9.3 Issues, Effects and Treatments

Table 9.1 below indicates the issues, effects and treatments during maintenance and construction works of motorcycle lane.

Table 9.1: Issues, Effects and Treatments

No.	Issue & Effect	Treatment
1	Closure of motorcycle lane or paved shoulder for use by motorcycles: i. Motorcycles have to travel / encroach onto mainline travel way	Preparation of Traffic Management Plan (TMP) is required.
2	Potholes: i. Motorcycles easily destabilized	Organize a system for prompt identification and repair.
3	Loose Gravel from resealing or patching: i. Motorcycles easily destabilized	Immediate cleaning is required.
4	Road surface condition throughout roadworks: i. Avoid sudden changes	Warn of changes in road surface and temporary changes in alignment or traffic control.
5	*Pavement resurfacing: i. Warn of uneven surface, as it is very difficult to detect visually	Pavement overlay is not recommended. Treatment by milling and resurfacing are required.
6	Temporary steel plates over trenches: i. Plain steel plate susceptible to skidding	Provide textured surface with low dirt retention (e.g. chequered plate). Plates must be skid resistant comparable to that of the road.
7	Services access covers: i. Exposed open access ii. Protruding service access	Opening must be covered immediately after service is done. Ensure lid is laid flushed with road level immediately after road maintenance or resealing.

9.4 Requirement of Traffic Management Plan

Conditions that requires preparation of Traffic Management Plan:

i) Construction that requires a proper traffic management be carried out

ii) Flash flood that requires partial lane closure

iii) Regular maintenance works of road facilities that require lane closure

The preparation of Traffic Management Plan should be made in accordance to Arahan Teknik Jalan 2C/85 – Manual on Traffic Control Devices (Temporary Signs and Work Zones Control) and need to be provided for the safety and well being of motorcyclists in the vicinity of work zones.

1. Need to provide adequate number of traffic signs at the approach to the work zone

Inadequate number of advance warning signs

2. Use Diamond Grade Sheeting (or equivalent) traffic signs for enhanced night time delineation

3. Need for Clear and Definitive Signs along Routes

4. Need for Clear Directions / Demarcation at Points of Deviation / Closure

5. Need for Continuous Barriers at Points of Conflict and/or Points of Traffic Diversion

6. Need for Advance Warning Signs in Vicinity of Points of Diversion

7. No Advance Warning Signs

8. Adequate Advance Warning Signs

9. Need to Enhance Night Time Delineation by Providing Stringers, Blinkers, Temporary Road lighting, etc

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www.highwaycare.co.uk

APPENDIX 2.0: SIDE FRICTION SCORES

 Side Friction = 1 (1 junction every 1 km or more)	 Side Friction = 4 (Junction every 10-50m)
 Side Friction = 2 – Kampong (1 junction per 300-500m)	 Side Friction = 5 (No distinct junction-building fronting roadside)
 Side Friction = 3 – Commercial (1 junction every 100m)	 Side Friction = 6 (buildings and parked vehicles adjacent to roadside on both side

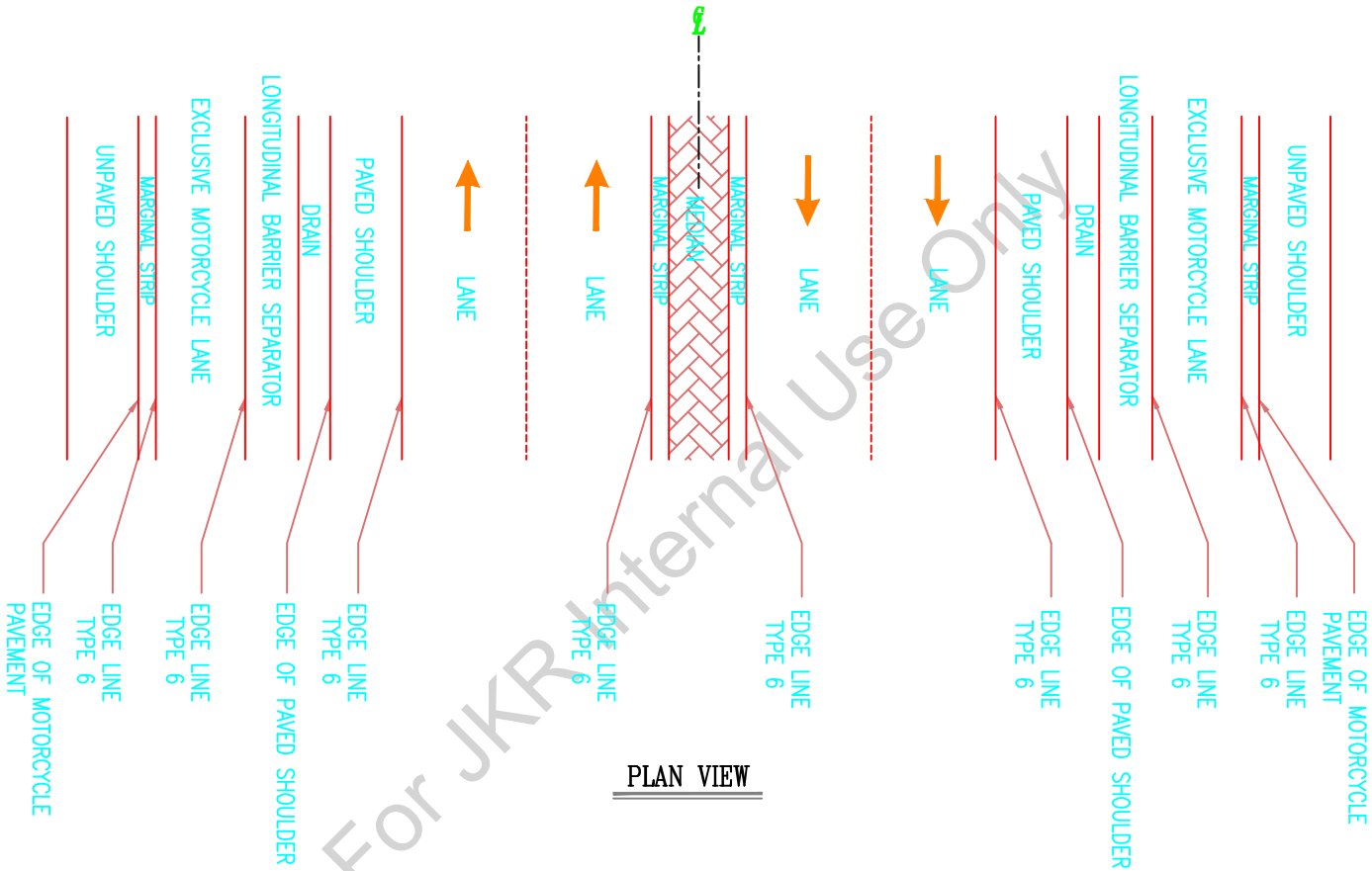
(Source: Jamilah Mohd Marjan, PhD., Modelling of Accidents on Two-Lane Single Carriageway Roads in Malaysia, 2011)

Notes:

- Side friction = 1, scores 1 (junction every 1km or more);
- Side friction = 2, scores 2 (Kampong, 1 junction per 300-500m);
- Side friction = 3, scores 3 (Commercial, 1 junction every 100m);
- Side friction = 4, scores 4 (Junction every 10-50m);
- Side friction = 5, scores 5 (No distinct junction and building fronting roadside);
- Side friction = 6, scores 6 (buildings adjacent to roadside and parked vehicles on both sides).

The scoring system was used whereby each 100m section was given scores from 1 to 6 as defined above. The scoring was done over ten, 100m sections, representing a total of 1 km section. The total score over 1 km of road section could be between a minimum of 10 points and a maximum of 60 points. However a threshold point of 30 points was chosen to demarcate between high or low side frictions. Any 1km section with points below 30 was considered having low side friction (SFRICT=0) and values higher than 30 would have a high side friction (SFRICT=1). A low side friction could mean that a 1km section has 10 sections with score 30, 3 points for each 100m section.

(Source: Jamilah Mohd Marjan, PhD., Modelling of Accidents on Two-Lane Single Carriageway Roads in Malaysia, 2011)



PLAN VIEW

TYPICAL PLAN VIEW FOR EXCLUSIVE MOTORCYCLE LANE
DUAL CARRIAGEWAY WITH FULL ACCESS CONTROL

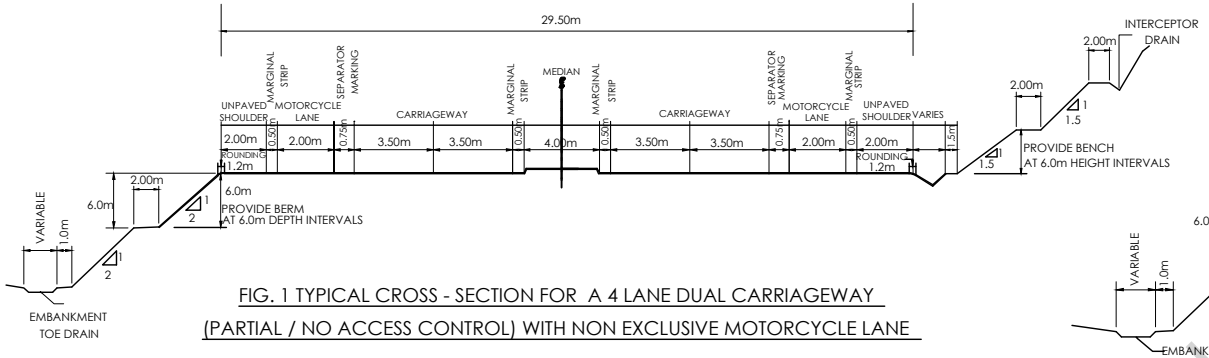


FIG. 1 TYPICAL CROSS - SECTION FOR A 4 LANE DUAL CARRIAGEWAY
(PARTIAL / NO ACCESS CONTROL) WITH NON EXCLUSIVE MOTORCYCLE LANE

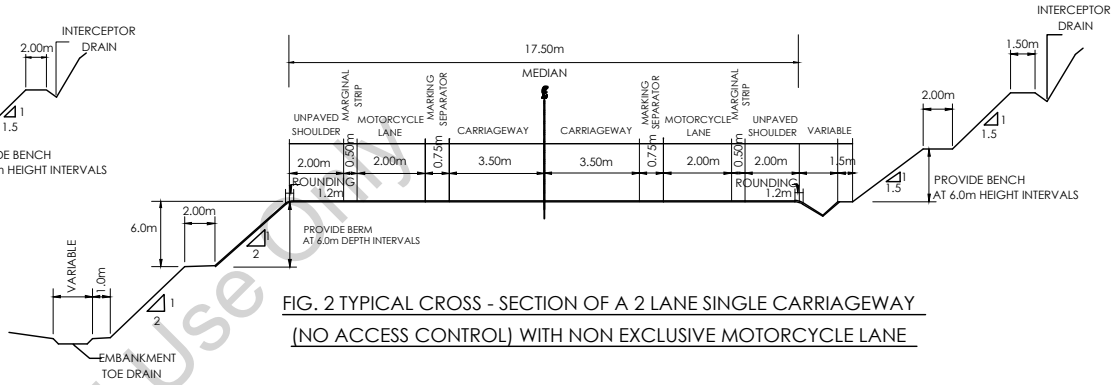
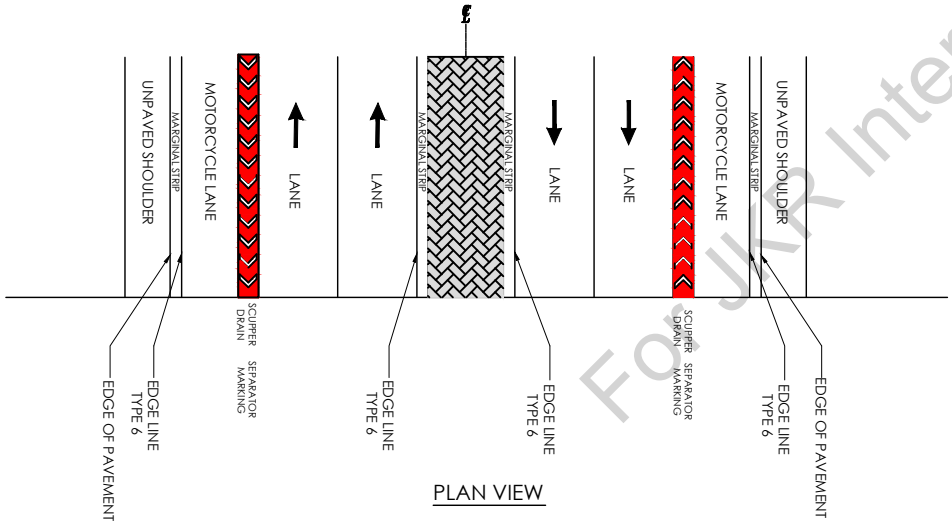
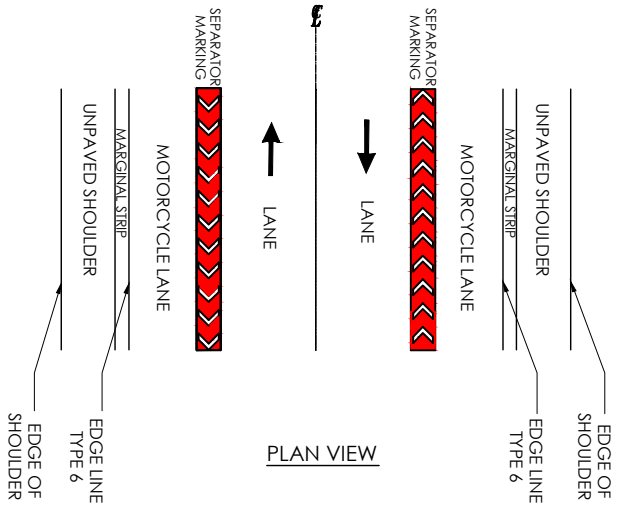


FIG. 2 TYPICAL CROSS - SECTION OF A 2 LANE SINGLE CARRIAGEWAY
(NO ACCESS CONTROL) WITH NON EXCLUSIVE MOTORCYCLE LANE



PLAN VIEW



PLAN VIEW

Tarikh	Butiran	Rujukan
	LUKISAN INI DILUKIS SEMULA DARIPADA KPKR/J/R/STD/AM 501 STANDARD DRAWINGS FOR ROAD CONSTRUCTION 2006 LUKISAN INI TELAH DI PINDA PADA FEBRUARI 2014	
PINDAAN		

UKURAN

CAW. KEJURUTERAAN JALAN & GEOTEKNIK

DIREKABENTUK OLEH :

DILUKIS OLEH : CHE ESHAH BT MAT NOR

DISEMAK OLEH : MOHD IDROS BIN MOHD NOOR

DILULUSKAN OLEH : Ir. ABDUL RAHMAN BIN BAHARUDDIN

Ir. Dr. MOHAMAD NOR BIN OMAR
PENGARAH

Ir. ABDUL RAHMAN BIN BAHARUDDIN
KETUA PENOLONG PENGARAH KANAN

JABATAN KERJA RAYA MALAYSIA

TYPICAL ROAD CROSS-SECTION WITH NEML
(NON EXCLUSIVE MOTORCYCLE LANE)

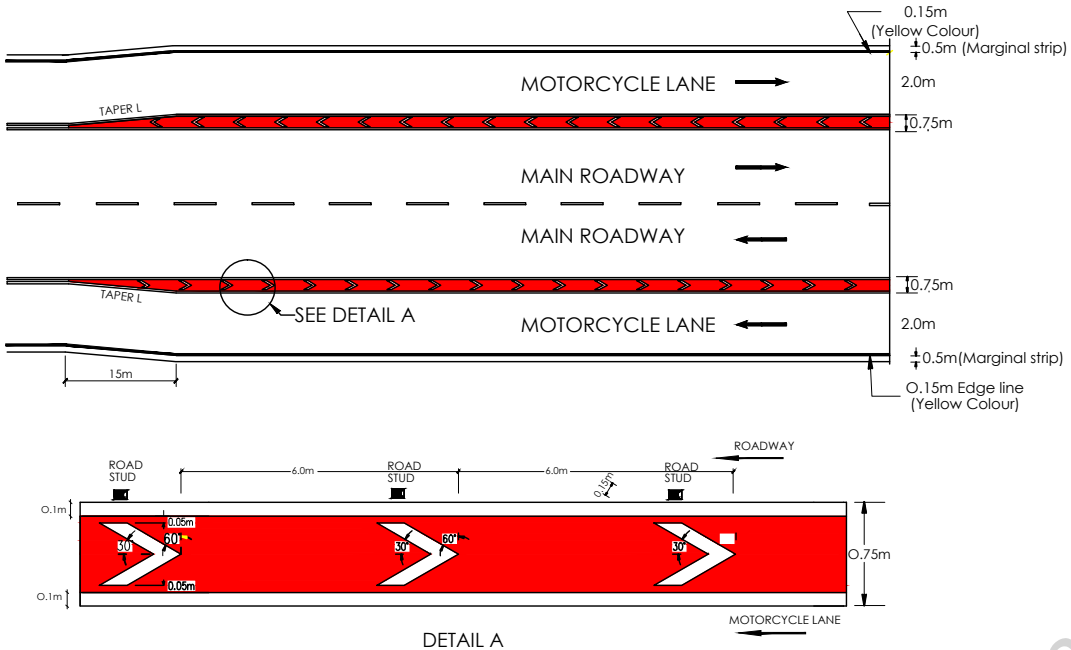
TARIKH : FEB 2014 | BIL. LUKISAN : KPKR/J/R/STD AM 901-1 | BIL. HELAIAN : 1/14

SAYA DENGAN INI TELAH MENYEMAK DAN MENGESAHKAN BAHAWA LUKISAN PIAWAI INI BOLEH DIGUNAPAKAI KE ATAS PROJEK BERKENAAN

TANDATANGAN :

NAMA :

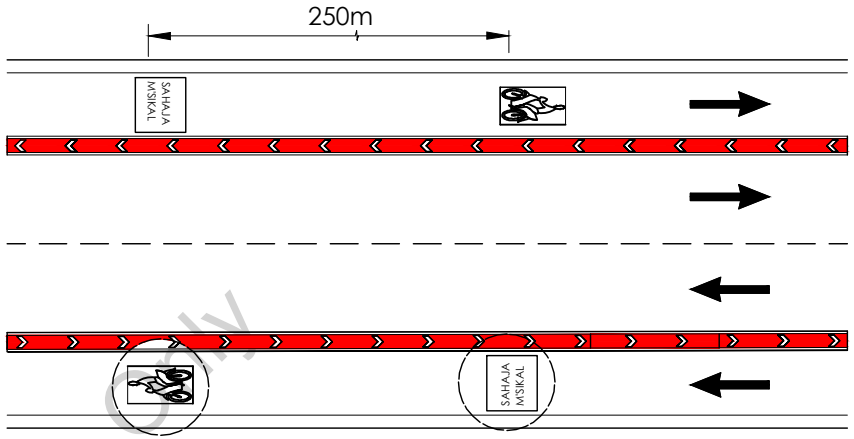
JAWATAN :



DETAIL A

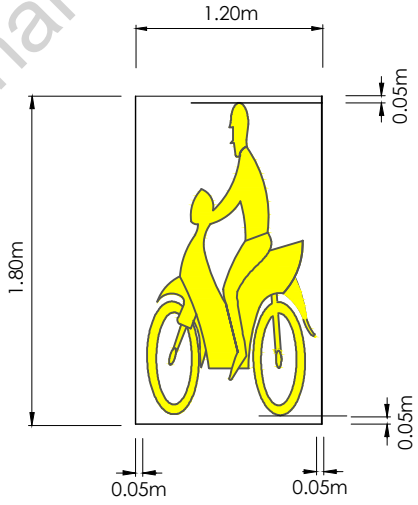
CHEVRON SEPERATOR MARKING FOR NEML

ALSO KNOWN AS LINE TYPE 16



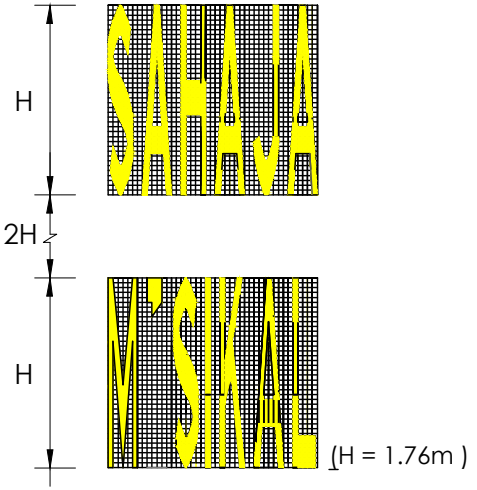
SEE DETAIL B

SEE DETAIL C



DETAIL B

MOTORCYCLE SYMBOL FOR NEML



DETAIL C

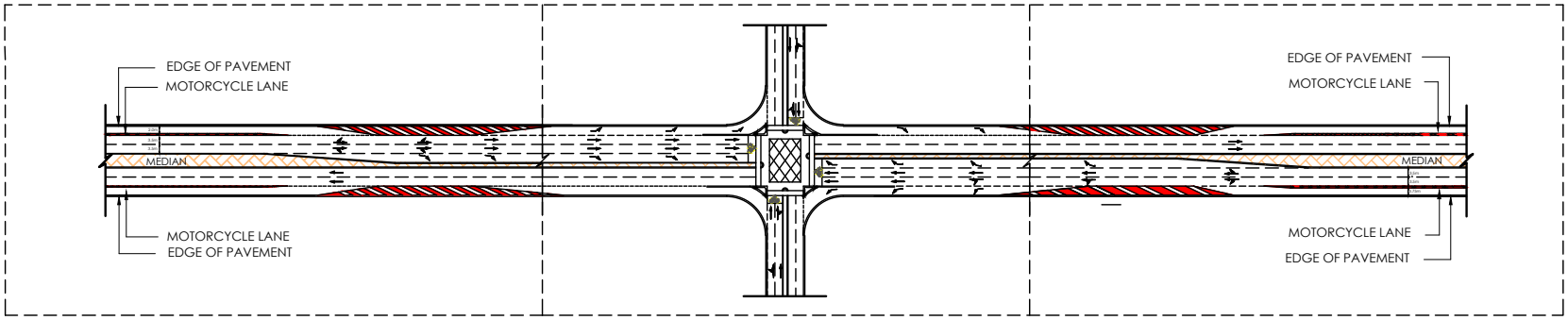
PAVEMENT WORD MARKING FOR NEML

NOTES

1. The symbol and pavement word marking shall be placed alternately along the motorcycle lane at 250m apart.
2. Symbol and pavement word marking shall be yellow (No.356 BS 381c).
3. Grid dimensions for pavement word marking is 45mm by 45mm.
4. Use WHITE UNIDIRECTIONAL RETROREFLECTIVE PAVEMENT MARKERS.
5. Use Bright Red Coloured Skid Resistance Surface Coating For background of chevron separator
6. Line type 6 should be yellow in colour.

Tarikh	Butiran	Rujukan					
	LUKISAN INI TELAH DILUKIS SEMULA DARIPADA KPKR/J/R/STD/AM 504 STANDARD DRAWINGS FOR ROAD CONSTRUCTION 2006 LUKISAN INI TELAH DI PINDA PADA FEBRUARI 2014		CAW. KEJURUTERAAN JALAN & GEOTEKNIK DIREKABENTUK OLEH : DILUKIS OLEH : HAMZAH BIN MD YASIN DISEMAK OLEH : MOHD IDROS BIN MOHD NOOR DILULUSKAN OLEH : Ir. ABDUL RAHMAN BIN BAHARUDDIN	Ir. Dr. MOHAMAD NOR BIN OMAR PENGARAH Ir. ABDUL RAHMAN BIN BAHARUDDIN KETUA PENOLONG PENGARAH KANAN	JABATAN KERJA RAYA MALAYSIA SYMBOLS AND PAVEMENT MARKINGS FOR NEML TARIKH : FEB 2014 / BIL. LUKISAN : KPKR/J/R/STD AM 904-1 / BIL. HELAIAN : 4/14	SAYA DENGAN INI TELAH MENYEMAK DAN MENGESAHKAN BAHAWA LUKISAN PIAWAI INI BOLEH DIGUNAPAKAI KE ATAS PROJEK BERKENAAN TANDATANGAN : NAMA : JAWATAN :
PINDAAN		UKURAN					

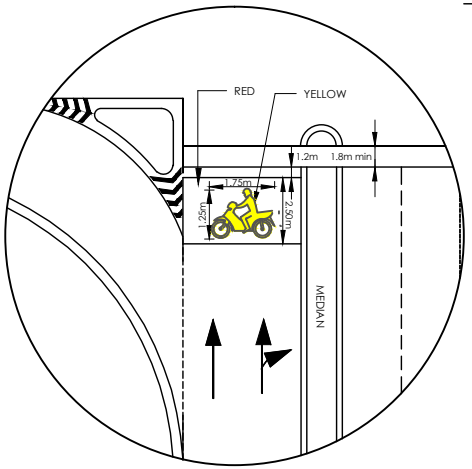
APPENDIX 5.0



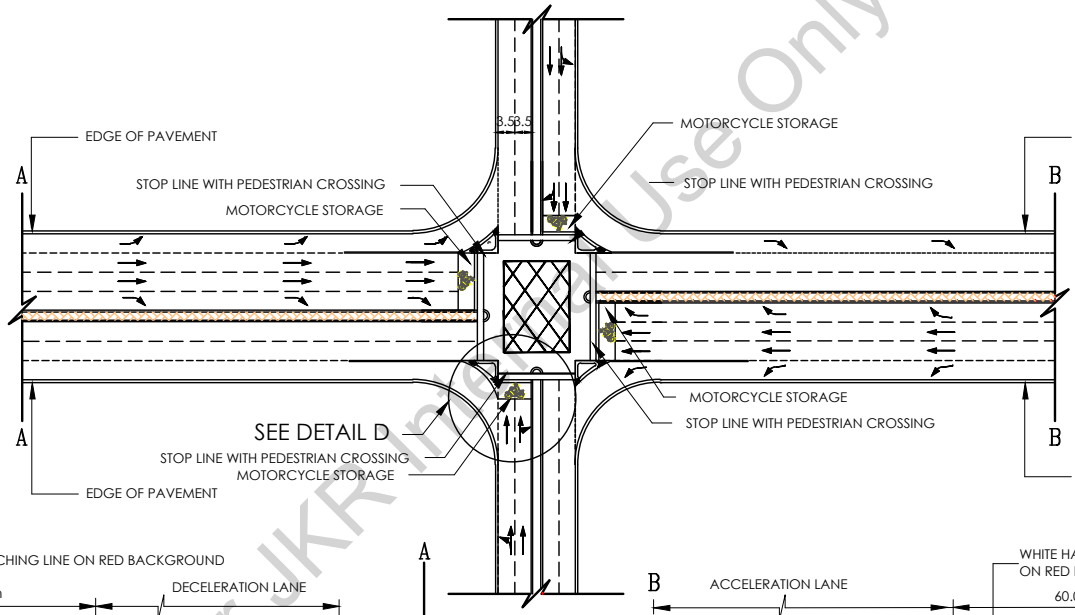
SEE DETAIL A

SEE DETAIL B

SEE DETAIL C



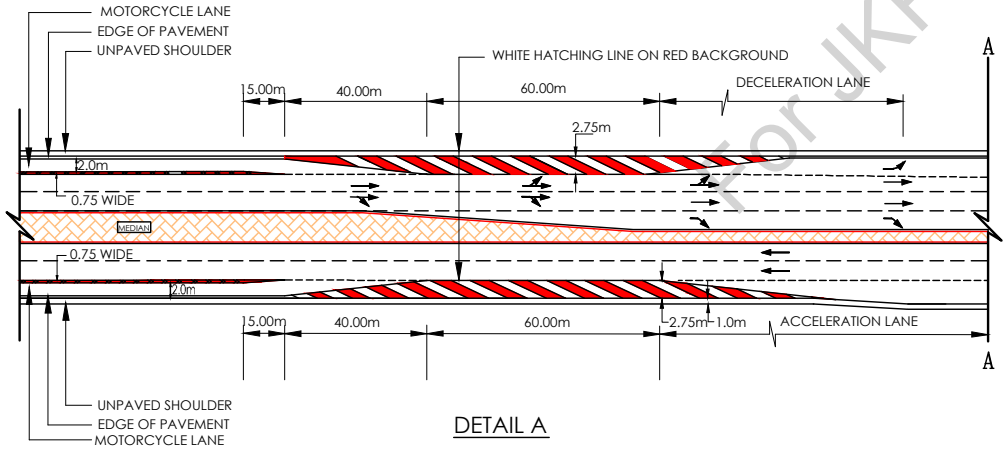
DETAIL D



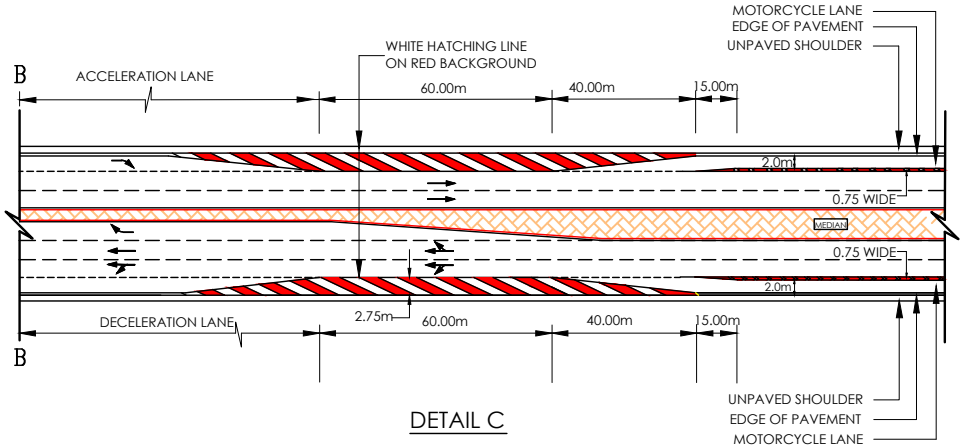
DETAIL B

NOTES:

1. THE Td = 75m AND Tm = 115m (FOR ACCELERATION AND DECELERATION LANE AT INTERSECTION) ARE CALCULATED BASED ON A SPEED OF 70km/hr.
2. THIS TYPE OF MOTORCYCLE LANE TREATMENT IS APPLICABLE FOR ANY MAJOR JUNCTIONS PROVIDED THEY ARE AT LEAST 750.0m APART.
3. ALL COLOURED SURFACING SHALL BE TREATED WITH SKID RESISTANCE TREATMENT.
4. EDGE LINE (LINE TYPE 6) SHALL BE YELLOW OR COLOUR



DETAIL A



DETAIL C

Tarikh	Butiran	Rujukan
	LUKISAN INI DILUKIS SEMULA DARIPADA KPKR/J/R/STD/AM 505 STANDARD DRAWINGS FOR ROAD CONSTRUCTION 2006 LUKISAN INI TELAH DI PINDA PADA FEBRUARI 2014	
PINDAAN		

UKURAN

CAW. KEJURUTERAAN JALAN & GEOTEKNIK

DIREKABENTUK OLEH :

DILUKIS OLEH : HAMZAH BIN MD YASIN

DISEMAK OLEH : MOHD IDROS BIN MOHD NOOR

DILULUSKAN OLEH : Ir. ABDUL RAHMAN BIN BAHARUDDIN

Ir. Dr. MOHAMAD NOR BIN OMAR
PENGARAH

Ir. ABDUL RAHMAN BIN BAHARUDDIN
KETUA PENOLONG PENGARAH KANAN

JABATAN KERJA RAYA MALAYSIA

TREATMENT OF NEML AT SIGNALISED JUNCTION (TYPICAL LAYOUT)

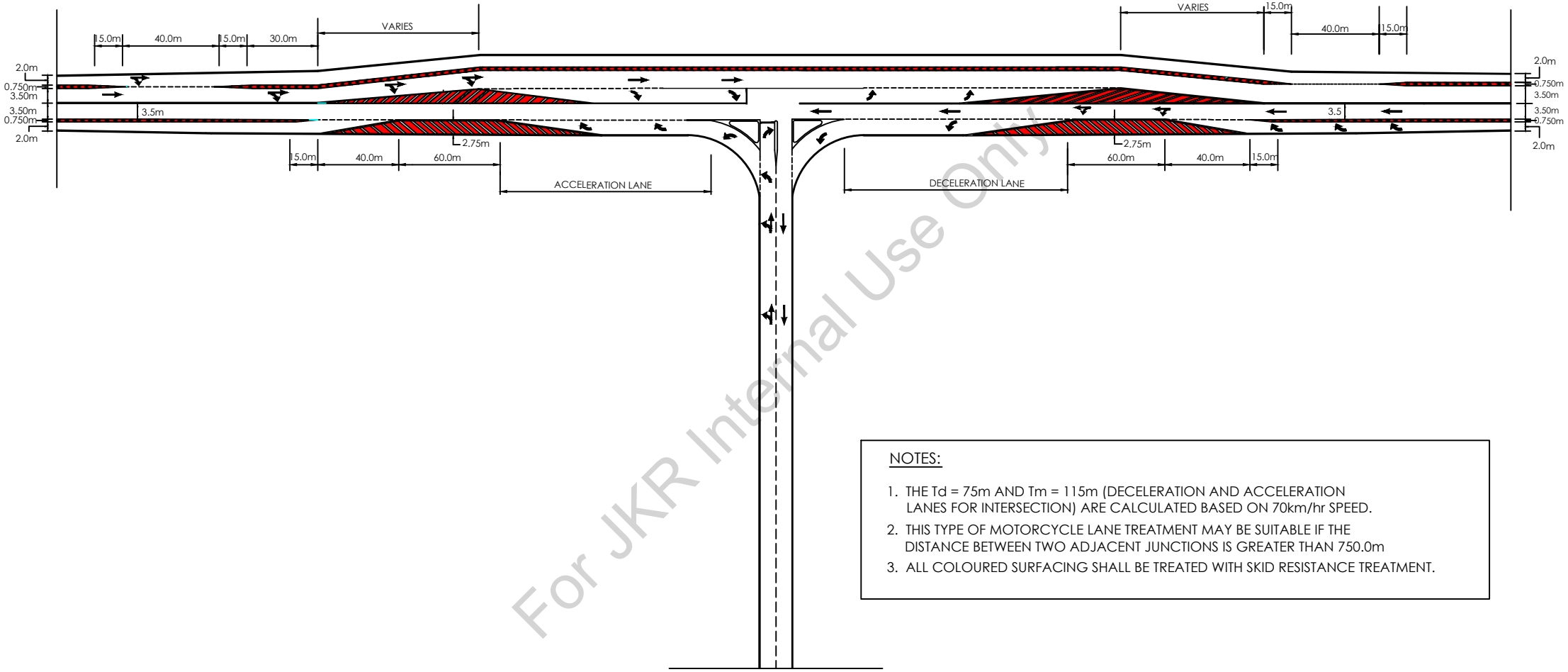
TARIKH : FEB 2014 | BIL. LUKISAN : KPKR/J/R/STD AM 905-1 | BIL. HELAIAN : 5/14

SAYA DENGAN INI TELAH MENYEMAK DAN MENGESAHKAN BAHAWA LUKISAN PIAWAI INI BOLEH DIGUNAPAKAI KE ATAS PROJEK BERKENAAN

TANDATANGAN :

NAMA :

JAWATAN :



NOTES:

1. THE Td = 75m AND Tm = 115m (DECELERATION AND ACCELERATION LANES FOR INTERSECTION) ARE CALCULATED BASED ON 70km/hr SPEED.
2. THIS TYPE OF MOTORCYCLE LANE TREATMENT MAY BE SUITABLE IF THE DISTANCE BETWEEN TWO ADJACENT JUNCTIONS IS GREATER THAN 750.0m
3. ALL COLOURED SURFACING SHALL BE TREATED WITH SKID RESISTANCE TREATMENT.

Tarikh	Butiran	Rujukan
	LUKISAN INI DILUKIS SEMULA DARIPADA KPKR/J/R/STD/AM 507 STANDARD DRAWINGS FOR ROAD CONSTRUCTION 2006 LUKISAN INI TELAH DI PINDA PADA FEBRUARI 2014	
PINDAAN		

UKURAN

CAW. KEJURUTERAAN JALAN & GEOTEKNIK

DIREKABENTUK OLEH :

DILUKIS OLEH : JAMILAH BT ATAN

DISEMAK OLEH : MOHD IDROS BIN MOHD NOOR

DILULUSKAN OLEH : Ir. ABDUL RAHMAN BIN BAHARUDDIN

Ir. Dr. MOHAMAD NOR BIN OMAR
PENGARAH

Ir. ABDUL RAHMAN BIN BAHARUDDIN
KETUA PENOLONG PENGARAH KANAN

JABATAN KERJA RAYA MALAYSIA

TREATMENT OF NEML AT UNSIGNALISED T-JUNCTION (TYPICAL LAYOUT)

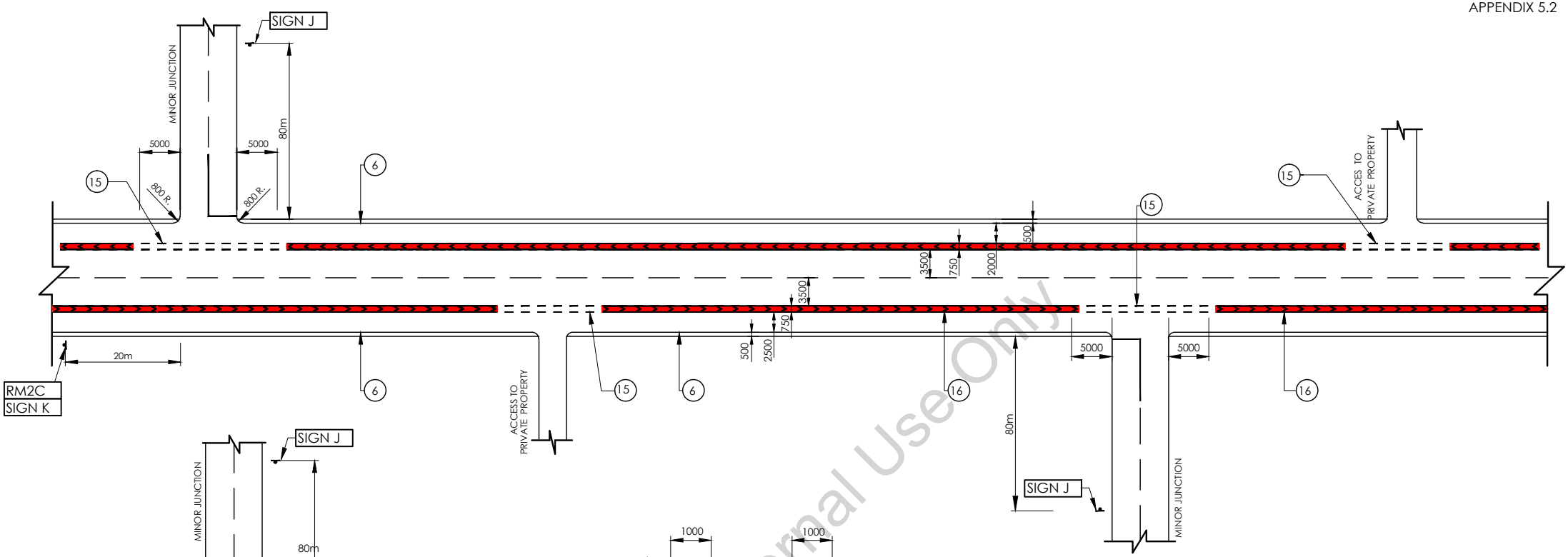
TARIKH : FEB 2014 | BIL. LUKISAN : KPKR/J/R/STD AM 907-1 | BIL. HELAIAN : 7/14

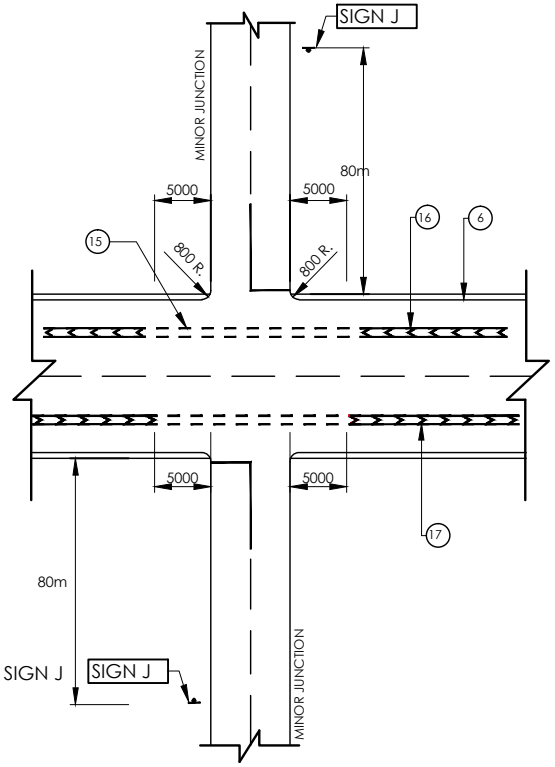
SAYA DENGAN INI TELAH MENYEMAK DAN MENGESAHKAN BAHAWA LUKISAN PIAWAI INI BOLEH DIGUNAPAKAI KE ATAS PROJEK BERKENAAN

TANDATANGAN :

NAMA :

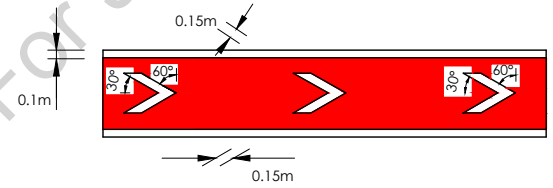
JAWATAN :





TYPE 15

ALL VEHICLE CAN CROSS OVER THIS SEPARATOR MARKING WHEN NECESSARY.



TYPE 16

ALL VEHICLES ARE PROHIBITED FROM CROSSING OVER THIS SEPARATOR MARKING.
MOTORCYCLISTS ARE REQUIRED TO RIDE WITHIN THE DESIGNATED MOTORCYCLE LANE.

LEGEND:-

(2) TYPE OF ROAD MARKING

NOTES:

1. THE TRAFFIC SIGNAGES SHOWN IN THIS DRAWING ARE ADDITIONAL WITH THE PROVISION OF MOTORCYCLE LANE
2. ALL DIMENSION ARE IN MILLIMETRES
3. LINE TYPE 6 SHOULD BE YELLOW IN COLOUR.
4. USE BRIGHT RED COLOURED SKID RESISTANCE SURFACE COATING FOR BACKGROUND OF CHEVRON SEPARATOR MARKING.

Tarikh	Butiran	Rujukan
	LUKISAN TELAH DILUKIS SEMULA DARIPADA KPKR/J/R/STD/AM 509 STANDARD DRAWINGS FOR ROAD CONSTRUCTION 2006 LUKISAN INI TELAH DI PINDA PADA FEBRUARI 2014	
PINDAAN		

UKURAN

CAW. KEJURUTERAAN JALAN & GEOTEKNIK

DIREKABENTUK OLEH :

DILUKIS OLEH : CHE ESHAH BT MAT NOR

DISEMAK OLEH : MOHD IDROS BIN MOHD NOOR

DILULUSKAN OLEH : Ir. ABDUL RAHMAN BIN BAHARUDDIN

Ir. Dr. MOHAMAD NOR BIN OMAR
PENGARAH

Ir. ABDUL RAHMAN BIN BAHARUDDIN
KETUA PENOLONG PENGARAH KANAN

JABATAN KERJA RAYA MALAYSIA

TREATMENT OF NEML IN RURAL ENVIRONMENT
FOR DISTANCE BETWEEN JUNCTIONS < 750m
(ROAD MARKINGS & TRAFFIC SIGNS)

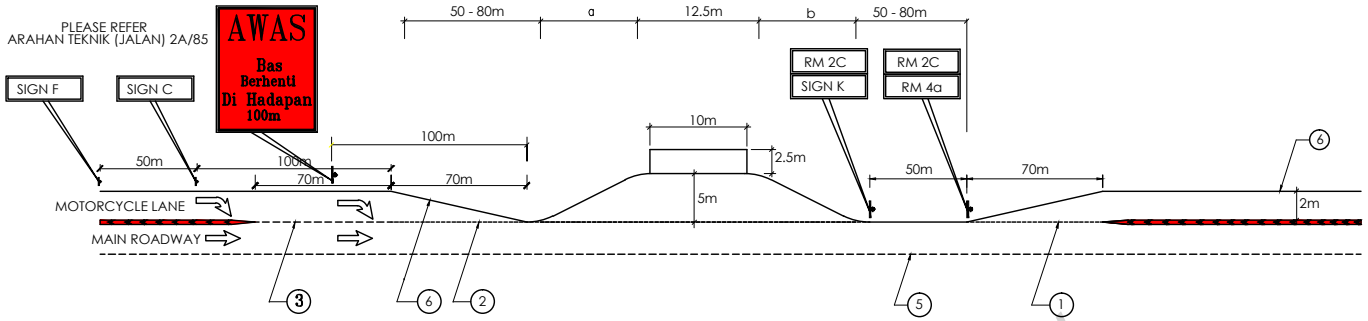
TARIKH : FEB 2014 | BIL. LUKISAN : KPKR/J/R/STD AM 909-1 | BIL. HELAIAN : 9/14

SAYA DENGAN INI TELAH MENYEMAK DAN MENGESAHKAN BAHAWA LUKISAN PIAWAI INI BOLEH DIGUNAPAKAI KE ATAS PROJEK BERKENAAN

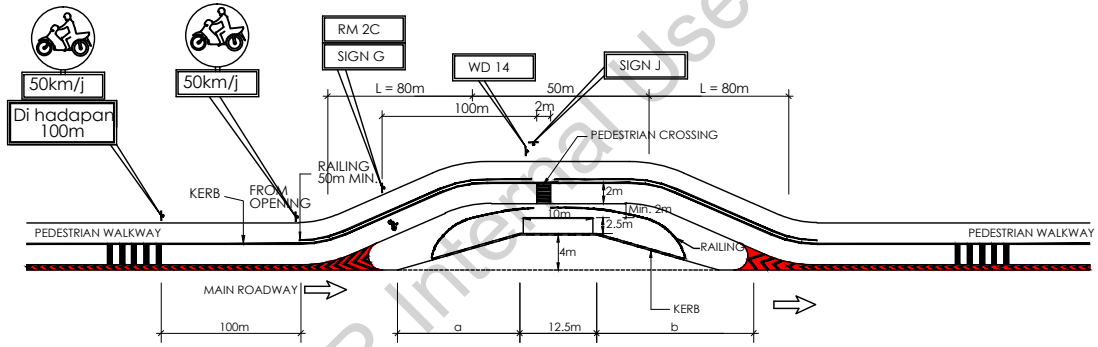
TANDATANGAN :

NAMA :

JAWATAN :



MOTORCYCLE LANE INFRONT OF BUS STOP (TYPE 2)



MOTORCYCLE LANE BEHIND BUS STOP (TYPE 1)

DESIGN STANDARD FOR BUS LAY BY	DIMENSION (m)	
	a	b
R1	10	20
R2	25	25
R3	25	35
R4	35	50
R5	35	70

NOTES:

1. $L = V \times w\sqrt{\ }$
   Where : V = speed of m/lane
   w = lateral width
2. Railing along the pedesterian walkway starts min 50m from opening to pedestrian crossing and ends min 50m after the opening.
3. Maximum superelevation to be used is 4%
4. For radius of horizontal curve for motorcycle lane, please refer to TABLE 2. Minimun radius in Arahan Teknik (Jalan) 10/86 - A Guide To The Design of Cycle Track.
5. Drainage system required as per site condition.
6. Motorcycle lane at bus stop is designed for speed of 50km/hr.

Tarikh	Butiran	Rujukan
	LUKISAN INI DI LUKIS SEMULA DARIPADA KPKR/J/R/STD/AM 512 STANDARD DRAWINGS FOR CONSTRUCTION 2006 LUKISAN INI TELAH DI PINDA PADA FEBRUARI 2014	
PINDAAN		

UKURAN

CAW. KEJURUTERAAN JALAN & GEOTEKNIK

DIREKABENTUK OLEH :

DILUKIS OLEH : HAMZAH BIN MD YASIN

DISEMAK OLEH : MOHD IDROS BIN MOHD NOOR

DILULUSKAN OLEH : Ir. ABDUL RAHMAN BIN BAHARUDDIN

Ir. Dr. MOHAMAD NOR BIN OMAR
PENGARAH

Ir. ABDUL RAHMAN BIN BAHARUDDIN
KETUA PENOLONG PENGARAH KANAN

JABATAN KERJA RAYA MALAYSIA

TREATMENT OF NEML AT BUS STOP

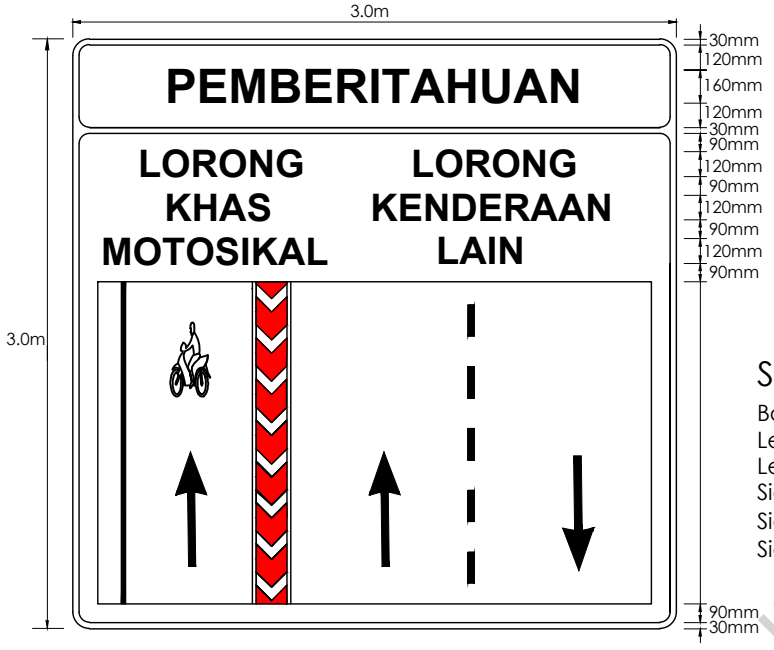
TARIKH : FEB 2014 | BIL. LUKISAN : KPKR/J/R/STD AM 912-1 | BIL. HELAIAN : 12/14

SAYA DENGAN INI TELAH MENYEMAK DAN MENGESAHKAN BAHAWA LUKISAN PIAWAI INI BOLEH DIGUNAPAKAI KE ATAS PROJEK BERKENAAN

TANDATANGAN :

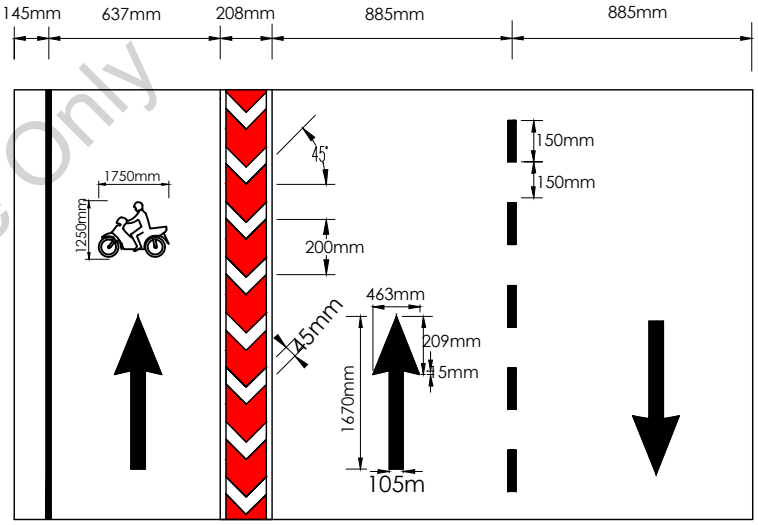
NAMA :

JAWATAN :



Sign Ref. A

Background - Blue
Letter, Symbol and Markings - White
Letter Height - 120mm/160mm
Sign Height - 3000mm
Sign Width - 3000mm
Sign Area - 9.0 sq. m



Inset Dimensions

ADVANCE NOTIFICATION SIGN FOR NON EXCLUSIVE MOTORCYCLE LANE

Tarikh	Butiran	Rujukan
	LUKISAN INI DILUKIS SEMULA DARIPADA KPKR/J/R/STD/AM 513 STANDARD DRAWINGS FOR ROAD CONSTRUCTION 2006 LUKISAN INI TELAH DI PINDA PADA FEBRUARI 2014	
PINDAAN		

UKURAN

CAW. KEJURUTERAAN JALAN & GEOTEKNIK

DIREKABENTUK OLEH :

DILUKIS OLEH : HAMZAH BIN MD YASIN

DISEMAK OLEH : MOHD IDROS BIN MOHD NOOR

DILULUSKAN OLEH : Ir. ABDUL RAHMAN BIN BAHARUDDIN

Ir. Dr. MOHAMAD NOR BIN OMAR
PENGARAH

Ir. ABDUL RAHMAN BIN BAHARUDDIN
KETUA PENOLONG PENGARAH KANAN

JABATAN KERJA RAYA MALAYSIA

ADVANCE NOTIFICATION SIGN FOR NEML

TARIKH : FEB 2014 | BIL. LUKISAN : KPKR/J/R/STD AM 914-1 | BIL. HELAIAN : 14/14

SAYA DENGAN INI TELAH MENYEMAK DAN MENGESAHKAN BAHAWA LUKISAN PIAWAI INI BOLEH DIGUNAPAKAI KE ATAS PROJEK BERKENAAN

TANDATANGAN :

NAMA :

JAWATAN :

KURANGKAN LAJU

SIGN A

Background	: Yellow
Letter	: Black
Letter Height	: 200mm
Sign Height	: 610mm
Sign Width	: 2400mm
Sign Area	: 1.46sq m

LORONG MOTOSIKAL DI HADAPAN 100 m

SIGN B

Background	: Blue
Letter	: White
Letter Height	: 150mm
Sign Height	: 1225mm
Sign Width	: 1355mm
Sign Area	: 1.66sq m

LORONG MOTOSIKAL TAMAT DI HADAPAN 100 m

SIGN C

Background	: Blue
Letter	: White
Letter Height	: 150mm
Sign Height	: 1240mm
Sign Width	: 1740mm
Sign Area	: 2.16sq m

BERI LALUAN MOTOSIKAL MELINTAS

SIGN D

Background	: Yellow
Letter	: Black
Letter Height	: 200mm
Sign Height	: 450mm
Sign Width	: 2250mm
Sign Area	: 2.14sq m

AWAS MOTOSIKAL MASUK DI HADAPAN 150 m

SIGN F

Background	: Red
Letter	: White
Letter Height	: 200mm
Sign Height	: 1655mm
Sign Width	: 2360mm
Sign Area	: 3.91sq m

PEJALAN KAKI MELINTAS DI HADAPAN 100 m

SIGN G

Background	: Yellow
Letter	: Black
Letter Height	: 150mm
Sign Height	: 1230mm
Sign Width	: 1480mm
Sign Area	: 1.82sq m

AWAS LORONG MOTOSIKAL

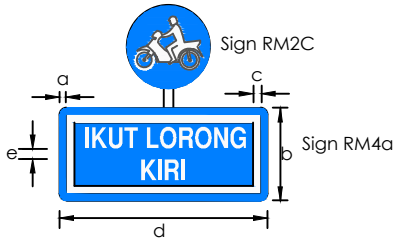
SIGN J

Background	: Red
Letter	: White
Letter Height	: 200mm
Sign Height	: 1270mm
Sign Width	: 1520mm
Sign Area	: 1.94sq m

GUNAKAN LORONG MOTOSIKAL DI HADAPAN 50 m

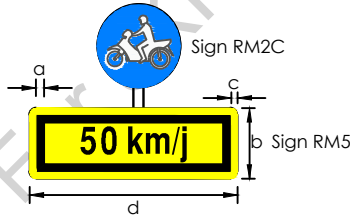
SIGN K

Background	: Blue
Letter	: White
Letter Height	: 150mm
Sign Height	: 12400mm
Sign Width	: 1770mm
Sign Area	: 2.20sq m



SIGNS	DIMENSIONS (MILLIMETRES)			
a	b	c	d	e
15	230	20	500	5

TABLE A
DIMENSION FOR RM 4a



SIGNS	DIMENSIONS (MILLIMETRES)		
a	b	c	d
15	170	20	500

TABLE B
DIMENSION FOR RM 5

NOTE:-

1. All dimension are in millimetres
2. Where applicable, all WARNING and REGULATORY signs shall be of the 750mm SIZE MINIMUM (Refer to Arahan Teknik (Jalan) 2A/85 or the Relevant Updated Document (RUD).
3. All GUIDE signs shall refer to Arahan Teknik (Jalan) 2B/87 or the RUD
4. All Lettering shall be cCridge Narrow
5. The signs shown here are examples of signages which might be relevent to the project. Reference to Arahan Teknik 2A/85 or the RUD should be made for any other signs not shown here.
6. The distances indicated on some of the signs are arbitrary. Use the actual distance as required.

Tarikh	Butiran	Rujukan
	LUKISAN INI DILUKIS SEMULA DARIPADA KPKR/J/R/STD/AM 503 STANDARD DRAWINGS FOR FOR ROAD CONSTRUCTION 2006 LUKISAN INI TELAH DI PINDA PADA FEBRUARI 2014	

PINDAAN

UKURAN

CAW. KEJURUTERAAN JALAN & GEOTEKNIK

DIREKABENTUK OLEH :

DILUKIS OLEH : CHE ESHAH BT MAT NOR

DISEMAK OLEH : MOHD IDROS BIN MOHD NOOR

DILULUSKAN OLEH : Ir. ABDUL RAHMAN BIN BAHARUDDIN

Ir. Dr. MOHAMAD NOR BIN OMAR
PENGARAH

Ir. ABDUL RAHMAN BIN BAHARUDDIN
KETUA PENOLONG PENGARAH KANAN

JABATAN KERJA RAYA MALAYSIA

STANDARD TRAFFIC SIGNS FOR NEML

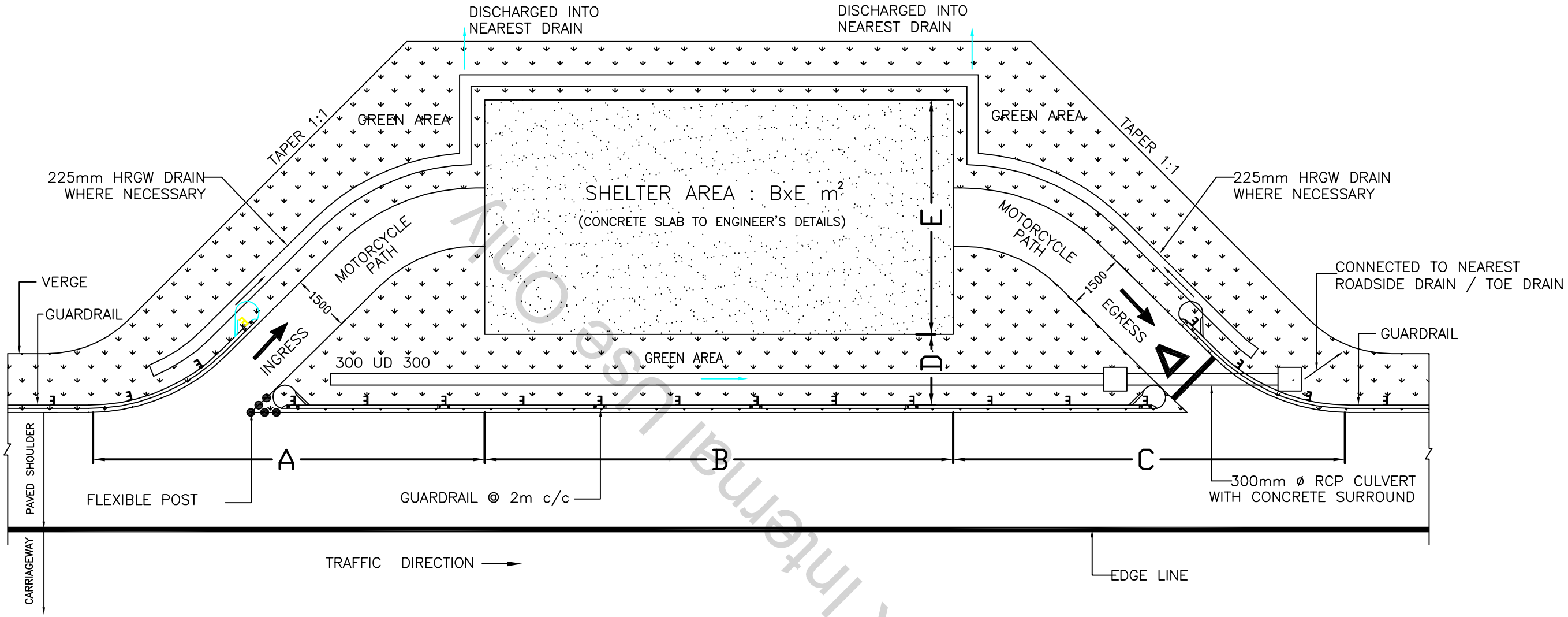
TARIKH : FEB 2014 | BIL. LUKISAN : KPKR/J/R/STD AM 903-1 | BIL. HELAIAN : 3/14

SAYA DENGAN INI TELAH MENYEMAK DAN MENGESAHKAN BAHAWA LUKISAN PIAWAI INI BOLEH DIGUNAPAKAI KE ATAS PROJEK BERKENAAN

TANDATANGAN :

NAMA :

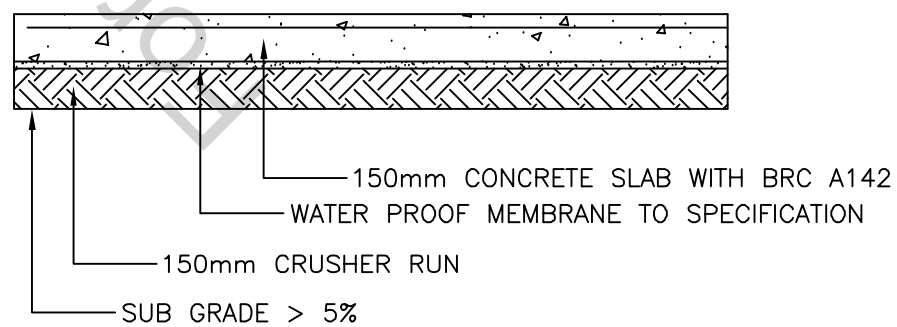
JAWATAN :



LAYOUT PLAN: MOTORCYCLE SHELTER (TYPE 1 – STAND ALONE)

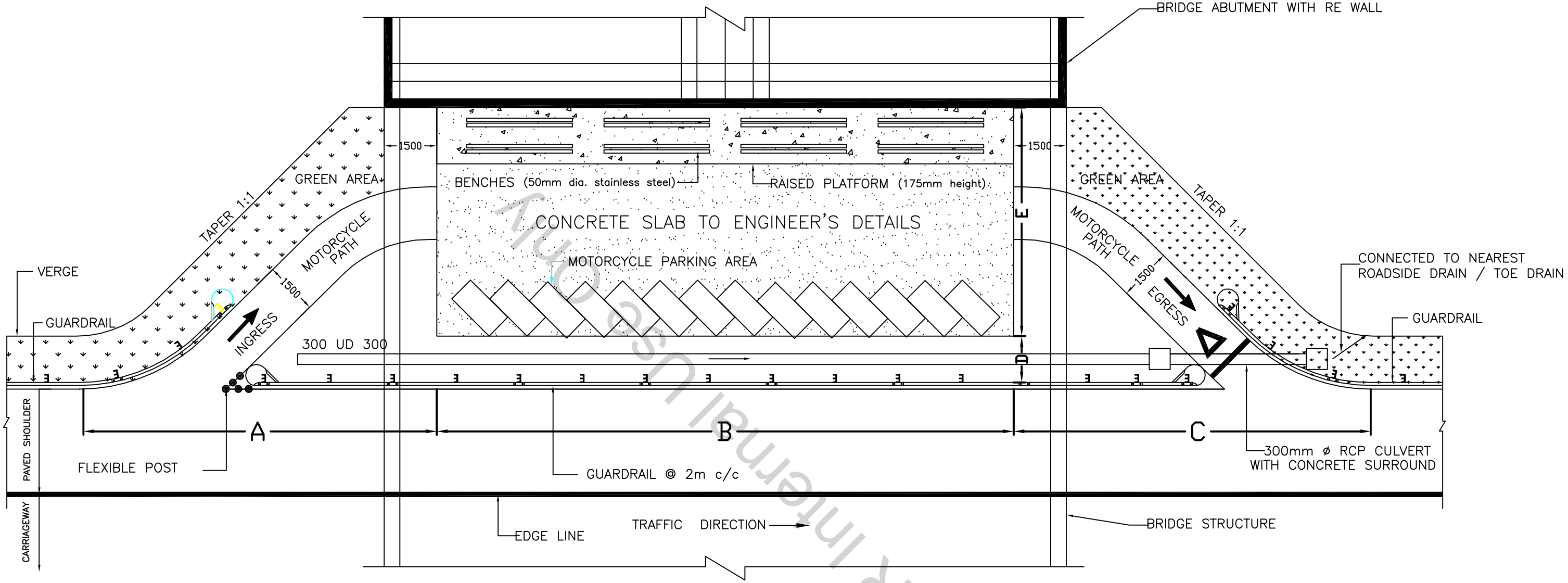
SCALE 1:100

DIMENSION	EXPRESSWAY	NON EXPRESSWAY
INGRESS/ ENTRY LENGTH (A)	BASED ON TAPER RATIO 1:1	
SHELTER LENGTH (B)	VARIES (BASED ON SHELTER AREA: TYPE A/B/C)	
EGRESS/ EXIT LENGTH (C)	BASED ON TAPER RATIO 1:1	
BUFFER (D)	MIN. 1.5m	MIN. 0.6m
SHELTER WIDTH (E)	MIN. 3.5m	MIN. 3.0m



CONCRETE SLAB DETAILS

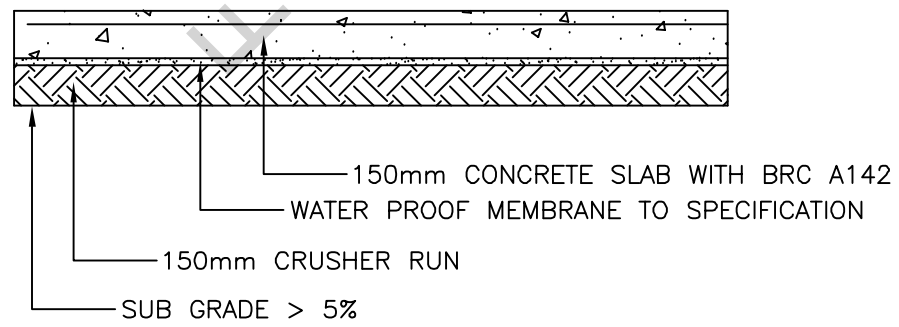
SCALE N.T.S.



LAYOUT PLAN: MOTORCYCLE SHELTER (TYPE 2 – UNDER BRIDGE)

SCALE 1:100

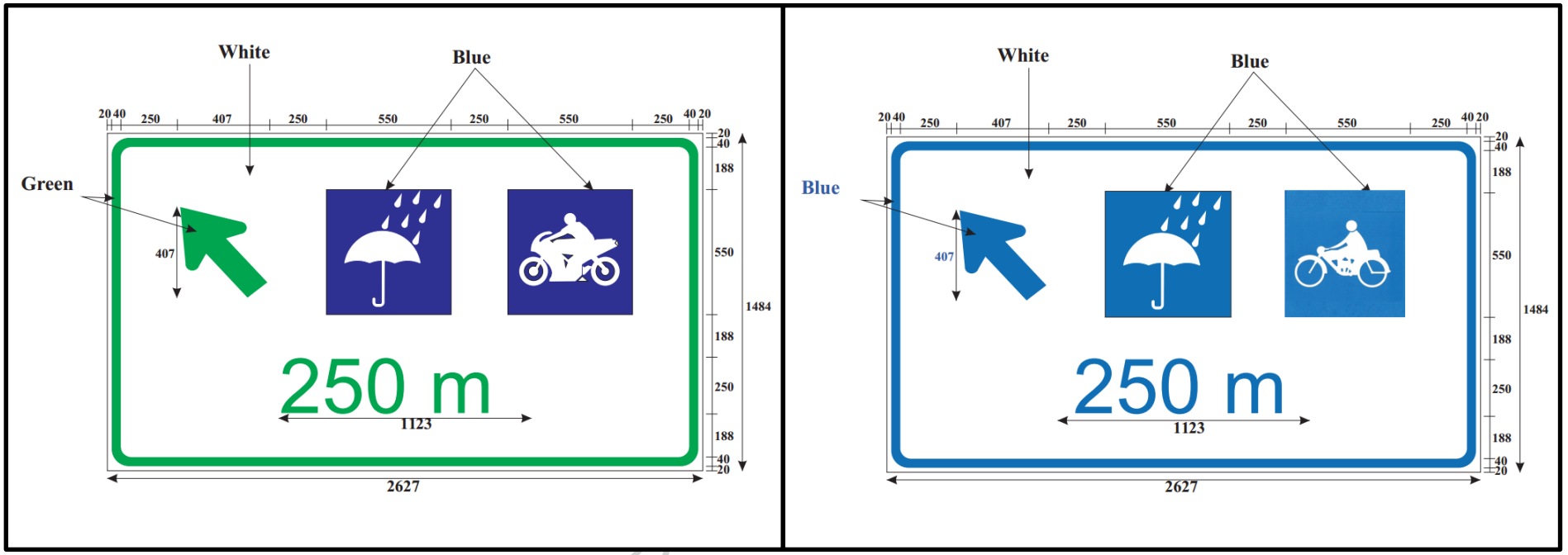
DIMENSION	EXPRESSWAY	NON EXPRESSWAY
INGRESS/ ENTRY LENGTH (A)	BASED ON TAPER RATIO 1:1	
SHELTER LENGTH (B)	VARIES (BASED ON BRDIGE DIMENSION/LOCATION)	
EGRESS/ EXIT LENGTH (C)	BASED ON TAPER RATIO 1:1	
BUFFER (D)	MIN. 1.5m	MIN. 0.6m
SHELTER WIDTH (E)	MIN. 3.5m (SUBJECT TO AVAIBILITY OF SPACE)	



CONCRETE SLAB DETAILS

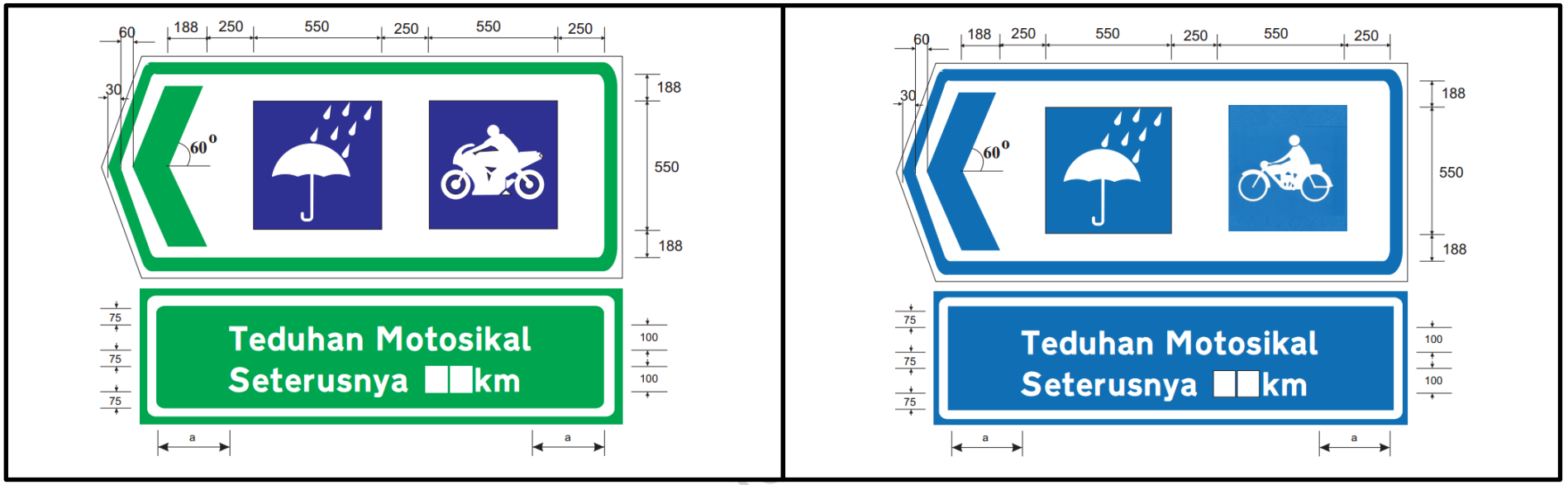
SCALE N.T.S.

APPROACHING SIGN (ADVANCE DIRECTIONAL SIGN) OF SHELTER FACILITIES



SPECIFICATION				
Details Lettering	Letter Height	Type	Character Colour	Remarks
EXPRESSWAY SIGNAGE				
i) Distance/ Numeral	H=250	LLM Normal	Green	Green border on white background
NON-EXPRESSWAY SIGNAGE				
i) Distance/ Numeral	H=250	Transport Heavy	Blue	Blue border on white background

CONFIRMATION SIGN OF SHELTER FACILITIES



SPECIFICATION				
Details Lettering	Letter Height	Type	Character Colour	Remarks
EXPRESSWAY SIGNAGE				
i) Wording	H=100	LLM Normal	White	Background – Green
ii) Numeral	H=100	LLM Normal	White	Background - Green
NON-EXPRESSWAY SIGNAGE				
i) Wording	H=100	Transport Heavy	White	Background – Blue
ii) Numeral	H=100	Transport Heavy	White	Background - Blue

NOTE: ***'Teduhan Motosikal Seterusnya __km' need to be mention if only the next nearest motorcycle shelter is within 5km distance.***

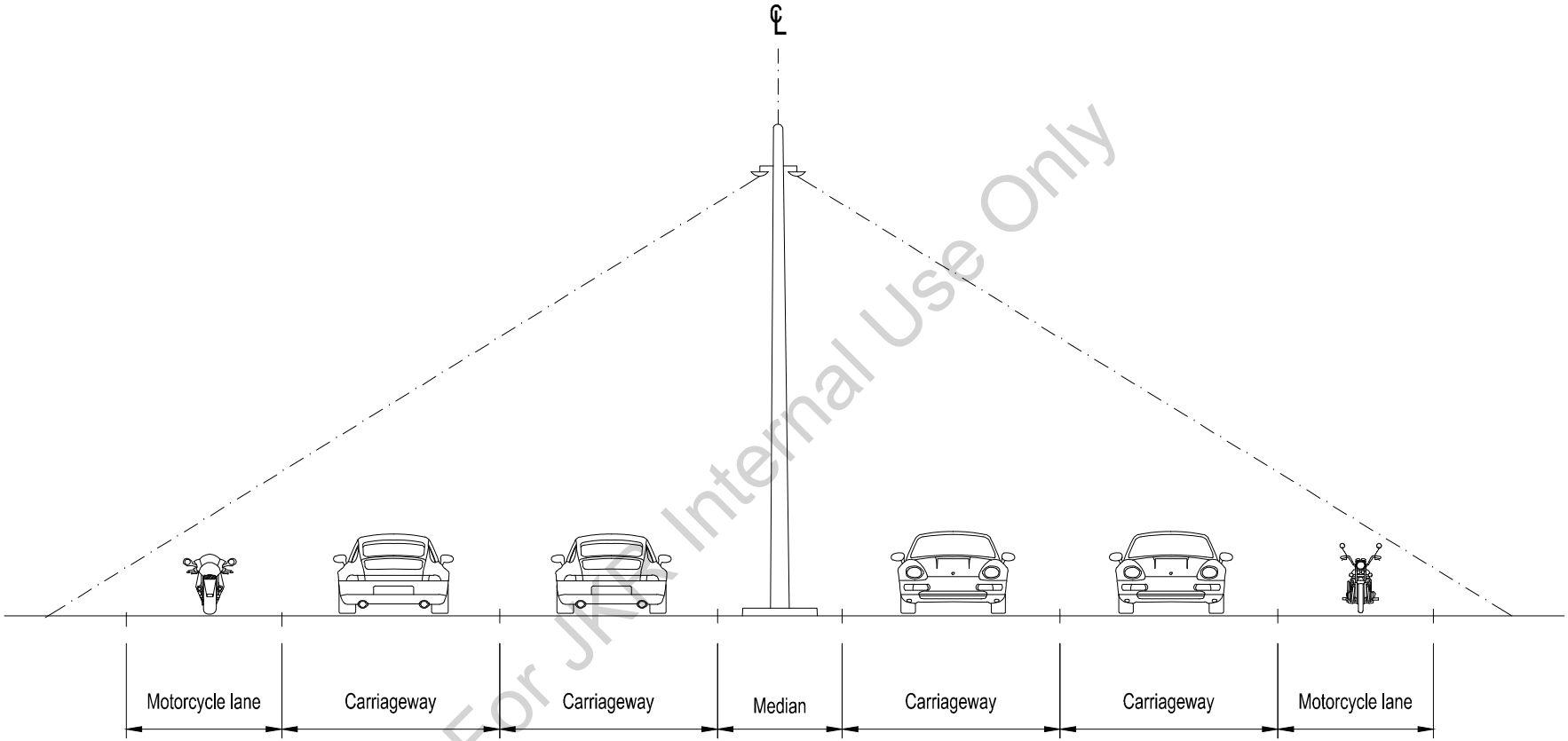


Figure 7.0 : Example of a Cross - Section Of Non Exclusive Motorcycle Lane

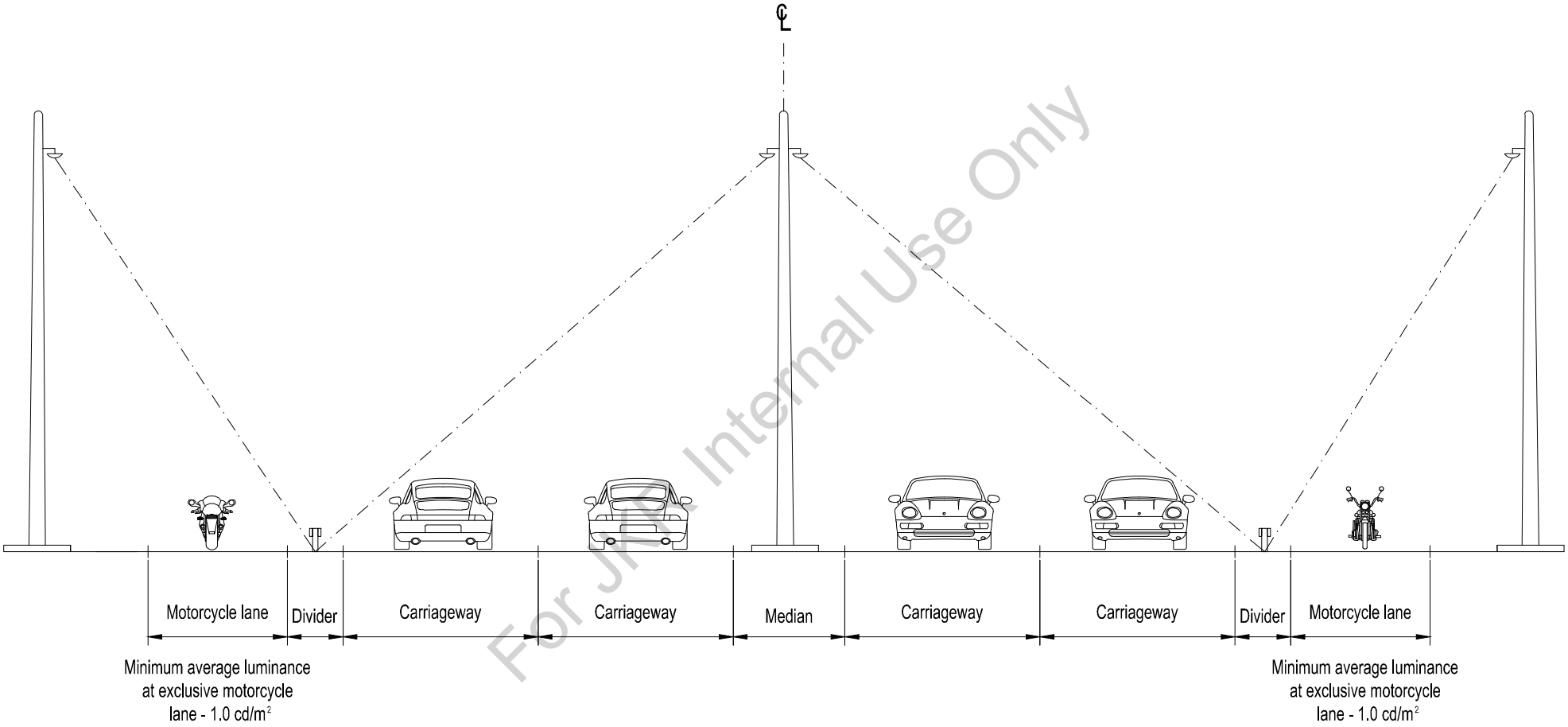
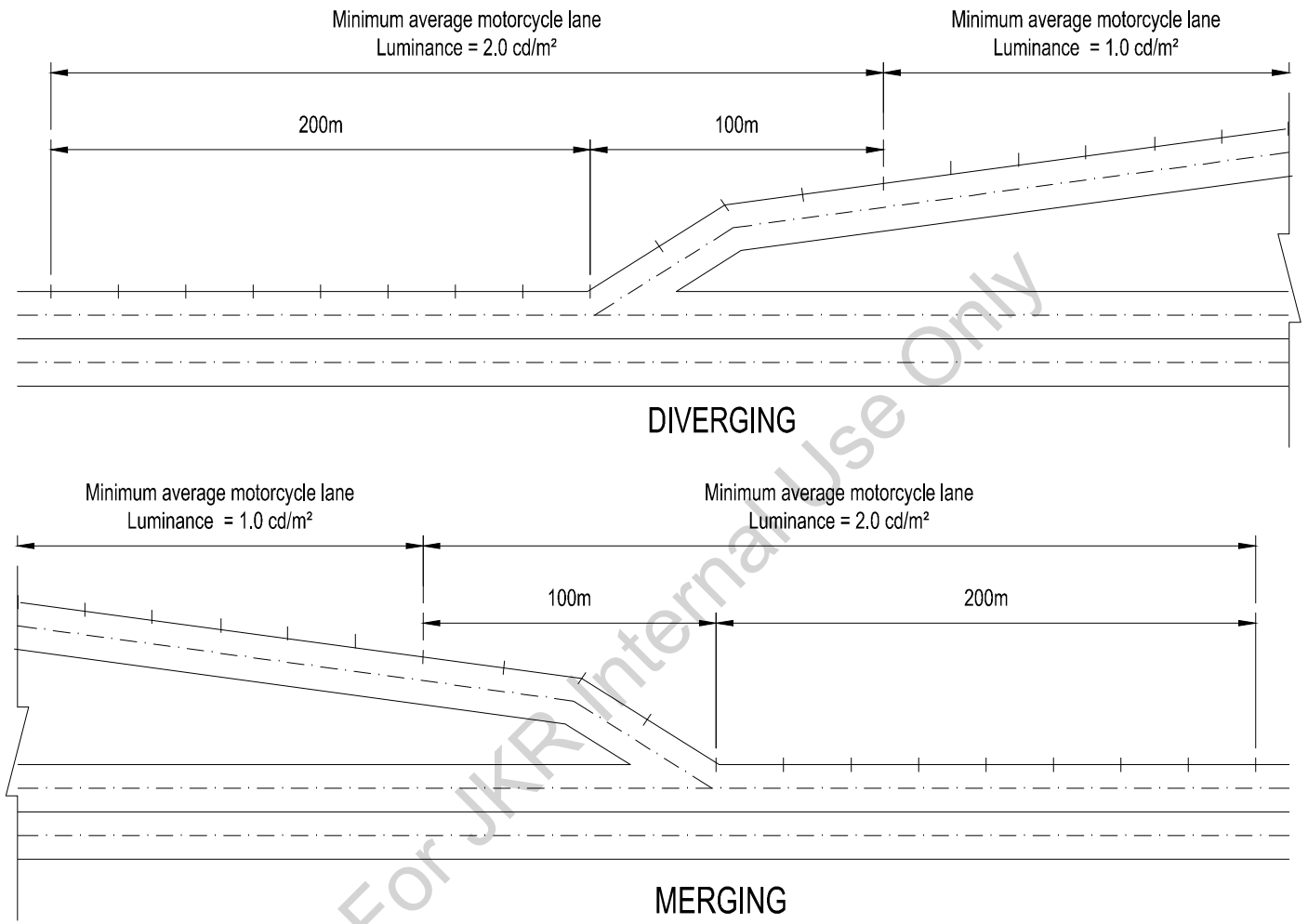


Figure 7.1 : Example of a Cross - Section Of Exclusive Motorcycle Lane



LIGHTING LAYOUT AT GORE AREAS OF EXCLUSIVE MOTORCYCLE LANE

Figure 7.2 : Example of a Street Lighting Layout at Gore Areas for Exclusive Motorcycle Lane