A SAFETY REVIEW OF MOTORCYCLE LANE IN MALAYSIA

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INTRODUCTION
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Motorcycle is the most affordable and viable option of transportation in low and middle income countries

(Source: WHO, 2015)
INTRODUCTION

Registered motorcycle are almost half (47%) of the total registered vehicle. Combined with the increasing trend of motorcycle fatalities, motorcycle safety is of high interest.

(Source: JPJ & PDRM, 2019)
INTRODUCTION

In 2018, out of 6,284 road fatalities, 4,128 fatalities were recorded by motorcyclist and pillion rider.

Approximate of RM5.8 million losses due to motorcycle fatalities only.

(Source: PDRM, 2019)
INTRODUCTION

Mixed traffic system
❖ leads to complex manoeuvres and interactions between road users

Non-exclusive motorcycle lane (NEMCL)
❖ a part of the traffic carriageway, separated with non-physical barrier
❖ Lane width: 2.0 – 2.5 m
❖ Total length: 199.2 km
❖ May reduce crash risk by 80%

Exclusive motorcycle lane (EMCL)
❖ Built separately from the traffic carriageway (physical barrier)
❖ Lane width: 3.0-3.5 m
❖ Reduce crash by 39%
❖ Total length: 262.5 km (< 1% of the overall road length)
Non-Exclusive Motorcycle Lane in Malaysia

- Alor Setar - Butterworth
- Pontian – Batu Pahat
- Muar
- Kelantan
EXCLUSIVE MOTORCYCLE LANE IN MALAYSIA

FR02 KESAS GUTHRIE PUTRAJAYA

Designing for Safer Two-Wheelers’ Lane
MOTORCYCLE LANE IN OTHER COUNTRIES

Suramadu Bridge, Indonesia
Bali Mandara Toll Road, Indonesia
Epifanio Delos Santos Avenue (EDSA), Phillipines
Zhongxiao Bridge, Taiwan
ISSUES & CHALLENGES OF MOTORCYCLE FACILITIES IN MALAYSIA

1. Under-utilisation
2. Lack of comprehensive crash data
3. Various design of egress/ingress
4. Limited extensive study
UTILISATION & COMPLIANCE OF MOTORCYCLE LANE

Study conducted in 2016
## UTILISATION AND COMPLIANCE RATE OF MOTORCYCLE LANE

### Motorcycle lane utilisation by location

<table>
<thead>
<tr>
<th>Location</th>
<th>Number of motorcycle</th>
<th>Compliance</th>
<th>Non-Compliance</th>
<th>MC volume per hour (% compliance)</th>
</tr>
</thead>
<tbody>
<tr>
<td>KB-PP</td>
<td>887</td>
<td>370</td>
<td>517</td>
<td>41%</td>
</tr>
<tr>
<td>KT-KTN</td>
<td>577</td>
<td>300</td>
<td>277</td>
<td>80%</td>
</tr>
<tr>
<td>BW-AS</td>
<td>511</td>
<td>125</td>
<td>386</td>
<td>98%</td>
</tr>
<tr>
<td>JB-ME(BP)</td>
<td>296</td>
<td>112</td>
<td>184</td>
<td>95%</td>
</tr>
<tr>
<td>PTN-BP</td>
<td>202</td>
<td>116</td>
<td>86</td>
<td>89%</td>
</tr>
<tr>
<td>SBA</td>
<td>1515</td>
<td>0</td>
<td>1515</td>
<td>0%</td>
</tr>
<tr>
<td>NL-BT</td>
<td>723</td>
<td>422</td>
<td>301</td>
<td>0%</td>
</tr>
<tr>
<td>LDP-PTJ</td>
<td>532</td>
<td>222</td>
<td>310</td>
<td>0%</td>
</tr>
<tr>
<td>KESAS</td>
<td>1333</td>
<td>443</td>
<td>890</td>
<td>65%</td>
</tr>
<tr>
<td>FHW</td>
<td>2689</td>
<td>0</td>
<td>2689</td>
<td>72%</td>
</tr>
</tbody>
</table>

### Compliance Analysis
- The highest volume:
  - NEMCL = KB-PP
  - EMCL = FHW
- Most of NEMCL compliance rate > 80% except KB-PP (41%)
- Compliance rate for FHW is 72% & KESAS is 65%.
NEMCL provided along traffic carriageway with non-physical barrier (road marking). Thus, there are potentials of other vehicle to encroach into the EMCL - Possible conflict is high.

The highest misuse
- Weekday : KT-KTN
- Weekend : BW – AS
- Overall : BW – AS
The risk posed by motorcycle using the main carriageway is higher due to higher speed and exposed to the other traffic mode.
SATISFACTION INDEX

Study conducted in 2016
MOTORCYCLE LANE

Factors for not using motorcycle lane

<table>
<thead>
<tr>
<th>Factors</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not safe (Crime)</td>
<td>22%</td>
</tr>
<tr>
<td>Influence</td>
<td>2%</td>
</tr>
<tr>
<td>Distance</td>
<td>4%</td>
</tr>
<tr>
<td>Time</td>
<td>6%</td>
</tr>
<tr>
<td>Crowded</td>
<td>8%</td>
</tr>
<tr>
<td>No MC lane provided</td>
<td>45%</td>
</tr>
<tr>
<td>Others</td>
<td>13%</td>
</tr>
</tbody>
</table>

Respondent who not using MC
1. No motorcycle lane provided at their area
2. Motorcycle lane is not safe

Respondent who use EMCL
1. To avoid congestion on the traffic carriageway
2. Safety purposes

Respondent who use
1. To avoid congestion on the traffic carriageway

Total sample: 1,835
312 respondents are not using motorcycle lane (17%)
PERCENTAGE OF SATISFIED RESPONDENTS

<table>
<thead>
<tr>
<th>Location</th>
<th>Pavement surface</th>
<th>Maintenance</th>
<th>Roadside safety</th>
<th>Lighting</th>
<th>Egress/ingress</th>
<th>Security</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEMCL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PNTN-BP</td>
<td>13</td>
<td>50</td>
<td>58</td>
<td>50</td>
<td>56</td>
<td>58</td>
</tr>
<tr>
<td>JB-MLKA</td>
<td>33</td>
<td>33</td>
<td>42</td>
<td>33</td>
<td>42</td>
<td>33</td>
</tr>
<tr>
<td>BW-AS</td>
<td>0</td>
<td>24</td>
<td>42</td>
<td>24</td>
<td>24</td>
<td>36</td>
</tr>
<tr>
<td>KT-KTN</td>
<td>24</td>
<td>18</td>
<td>41</td>
<td>35</td>
<td>44</td>
<td>53</td>
</tr>
<tr>
<td>KB-PSR</td>
<td>42</td>
<td>26</td>
<td>58</td>
<td>53</td>
<td>53</td>
<td>68</td>
</tr>
<tr>
<td>PTH</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OVERALL</td>
<td>22</td>
<td>30</td>
<td>48</td>
<td>39</td>
<td>44</td>
<td>50</td>
</tr>
</tbody>
</table>

| EMCL     |                  |             |                 |          |                |          |
| FHW      | 2                | 8           | 10              | 3        | 6              | 4        |
| KESAS    | 8                | 13          | 14              | 5        | 10             | 9        |
| LDP-PTJ  | 5                | 9           | 17              | 4        | 9              | 7        |
| NL-BT    | 0                | 11          | 33              | 11       | 17             | 11       |

| OVERALL  |                  |             |                 |          |                |          |

- **NEMCL**
  - Security attribute has the highest percentage of satisfied respondents (50%)
  - Pavement surface condition has the lowest percentage of satisfied respondent (22%)
  - Butterworth–Alor Setar road has the lowest average score for NEMCL

- **EMCL**
  - Roadside safety attribute has the highest percentage of satisfied respondents (18%)
  - Pavement surface condition has the lowest percentage of satisfied respondent (3%)
  - Federal Highway has the lowest
**SATISFACTION INDEX**

- Total number of respondents = 1,835
- Overall satisfaction score for EMCL is 46% while for NEMCL is 60%
COMMON SAFETY DEFICIENCIES ON NEMCL

- Pavement surface
- Misused
- Improper termination
- Parked vehicle
- Faded road marking
- Non-standard lane width
- Water ponding
COMMON SAFETY DEFICIENCIES

- Pavement surface
- Dark tunnel
- Various design of ingress/egress
- Roadside hazard
- Horizontal & vertical alignment
- Rubbish on the lane
- Unmaintained guardrail
- Debris
**EGRESS & INGRESS**

Study conducted in 2017

**Egress**
Point of exiting from EMCL

**Ingress**
Point of entering into EMCL

EMCL – motorcycle traffic only

Main carriageway – mixed traffic vehicle
TYPES OF EGRESS & INGRESS

<table>
<thead>
<tr>
<th>EMC L</th>
<th>Direction</th>
<th>Egress</th>
<th>Ingress</th>
</tr>
</thead>
<tbody>
<tr>
<td>F02</td>
<td>KL – Klang</td>
<td>17</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>Klang – KL</td>
<td>16</td>
<td>19</td>
</tr>
<tr>
<td>KESA S</td>
<td>KL – Klang</td>
<td>21</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>Klang – KL</td>
<td>15</td>
<td>19</td>
</tr>
</tbody>
</table>

- **Entry radius of 90 degree**
- **Entry radius < than 90 degree, Length < 15m**
- **Entry radius < than 90 degree, Length > 15m**
- **Skewed or Y-shape access**
EGRESS
INGRESS
• Capacity of the road network are closely related with the capacity at access and capacity at access influenced by critical gap value

• Critical gap: minimum time interval between two consecutive vehicles in the major road that allows entry of one minor road vehicle

• Longer critical gap means less vehicle can pass through the access and therefore capacity will reduce. It may create back lock traffic condition on the departure lane.

• Shorter critical gap value may contribute for more vehicle to pass through the access and increase in the capacity. However, it may lead to safety issue where poor gap acceptance decisions will increase the likelihood of crash to happen.
Only critical gap for passenger car was proposed in HCM (6.2 sec at intersection and 4.1 sec at roundabout).

Motorcycle are small in size – do not require much space for maneuvering. Motorcycle have no body frame – field of view is not restricted.

Critical gap for motorcycle remains as the missing link. It is anticipated that critical gap for motorcyclist is shorter than passenger car.
STUDY LOCATION

STUDY LOCATION

EGRESS

E1-01: KESAS – Subang Jaya
E3-01: Padang Jawa
E4-01: Amcorp Mall
E1-02: KESAS – Taman OUG
E3-02: Subang Airport
E4-02: Ke Bulatan Kayangan

INGRESS

I1-01: Susur Batu Tiga
I3-01: Seksyen 7
I4-01: Susur NPE
I1-02: Petronas Shah Alam
I3-02: Setia Jaya
I4-02: Dari Bulatan Kayangan

High volume of motorcycle at access
Straight & flat terrain
No sight distance issue

Designing for Safer Two-Wheelers’ Lane
DATA COLLECTION

Video recording technique

- Video was mounted on a special pole with height 3m – 4m from ground
- Capture the motorcyclist exiting or entering EMCL and type of oncoming vehicle on the intended lane

Time

- 2 hours peak (7.00 – 9.00 am)
- 2 hours off-peak (10.00 – 12.00 am)
- A total of 48 hours video playback
• **Gap time**: The difference between arrival time \( t_1 \) and crossing time \( t_2 \), measured in seconds.

• Other data collected alongside are accepting or rejecting gaps decision and type of oncoming vehicle on the intended lane.
RESULTS

- A total of 3,538 samples were observed (1,532 samples at egress and 2,006 samples at ingress)
- 93% were observed to accept the available gap time at the first attempt and only 7% of rejection was observed
- Rejection at ingress (9%) is higher than at egress (5%). This is inline with findings on critical gap value where longest gap obtained in this study was at ingress.
- At egress, higher rejection was observe when oncoming vehicle is heavy vehicle (9%)
- Mean gap at egress is higher than ingress – less risky gap accepting behaviour at egress
RESULTS

The value corresponding to probability of 0.5 is termed as critical gap value where motorcyclist have equal chances to accept or reject the gap time.

Using binary logit models, the critical gap was found to be 2.28 seconds when the oncoming vehicle at egress is passenger car.

The critical gap determined from Model 2 was 2.42 seconds which is 0.14 seconds higher than critical gap value when the oncoming vehicle is passenger car.

The critical gap determined from Model 3 was 2.43 seconds which is slightly higher than critical gap value at egress when the oncoming vehicle is heavy vehicle (the
**RESULTS**

- **Wider angle of entry** at egress and ingress leads to a lower critical gap – contrary to the forced complete stop required at typical intersection.

- Small size of motorcycle required **less space for maneuvering** – easier for motorcycle to squeeze through any offered gap or occupy lateral space efficiently.

- Motorcyclist choose longer critical gaps when oncoming vehicle is heavy vehicle - **size arrival effect** which indicates that the larger vehicle was perceived closer.

- Longest critical gap was determined at ingress – motorcycles on the EMCL were found to ride more than one-line within the same lane – **limited lateral space**.
The high volume, increasing growth and crash rate indicating the needs for more motorcycle lane

Inconsistency designs of egress and ingress needs to be reviewed

Critical gap for motorcycles is smaller than for four-wheel vehicles

Applying motorcycle’s critical gap is believed to be able optimise the space required for the construction of EMCL