Evaluation of Side Friction In IHCM For Highway 6 Lanes 2 Ways Divided

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Abstract. IHCM (Indonesia Highway Capacity Manual) was issued and came into force in 1997. After 20 years there has been a change in traffic from the number and composition, as well as the traffic regulation policy. As a result of this, the determination of IHCM’s road capacity is often incorrect. Therefore it is necessary to evaluate IHCM. This study tries to evaluate IHCM through side obstacle factors, as one of the factors that determine the value of road capacity. Research is limited to evaluating the weight of each side obstacle factor and the effect of land use from the survey results using statistical analysis. From the analysis, it is found that the conditions for the use of shops, markets, hotels, gas stations are in the category of moderate side barriers and the ranking of the relative weights of the side barriers at IHCM is still appropriate.

1. Introduction

1.1. Background
Transportation system is a road network system that physically connects an activity space with other activities space, which influences the development of a region (space of activity) and the development of a space of activity will require an increase in the transportation service system (Tamin, 2000).

The development of activity space (activity) mainly occurs on the side of the road. Activities on the side of the road have an impact on traffic performance which can hamper traffic flow, which is then called side friction. Because it influences the flow of traffic it means it also affects the capacity of the road.

Side friction in the IHCM (Indonesian Highway Capacity Manual) are classified consisting of non-motorized vehicles (weight 0.4), pedestrians (0.5), left-right access roads (weight 0.7) and parked / stopped vehicles (weight 1, 0) (IHCM, 1997). The effect of side friction on capacity is the accumulation of the number of each occurrence of the side resistance factor multiplied by its weight.

In addition to IHCM, 1997 has been too long, the calculation of road capacity based on IHCM is often lower than the volume of traffic observed. Therefore IHCM needs to be evaluated. This research is

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expected to contribute to the research to revise IHCM in terms of the side effect factors on road capacity.

1.2. Identification of Problems
a. Relation of each side friction factor to traffic volume.
b. The relationship of each side resistance factor to the speed of traffic.

1.3 Problem Formulation
From the identification of the above problems can be formulated:
a. What is the relationship between the conditions of land use and the magnitude of each factor in the side friction?
b. How does the traffic condition affected by the value of each side friction factor?
c. How is the difference in the side friction based on IHCM with the survey results?

1.4 Research Objectives
The purpose of this study:
a. Analyze the value of side friction in different land uses.
b. Arrange the correlation between land use with the value of the side friction factor.
c. Evaluate each side friction factor IHCM version

1.5 Limitation of Problems
This research is limited by the following scope:
1. Highway configuration 6/2 D (six lane two ways divided)
2. Study in the city of Jakarta
3. Other factors and capacity calculation formulas follow IHCM.

2. Literature Review

2.1. Side Friction Factors Against Capacity Based on IHCM
Side Friction are grouped in five classes, from very low to very high class as an accumulation of the four side obstacle factors. Classification of side Friction can be seen in Table 2.1 below:
Table 2.1. Classification of Side Friction (source: IHCM 1997)

| Side Friction Level | Code | Amount of All Number of Side Friction per hour | Land Use Condition                                      |
|---------------------|------|-----------------------------------------------|--------------------------------------------------------|
| Very Low            | VL   | <100                                          | Residential area; almost no activity                   |
| Low                 | L    | 100-299                                       | Residential area; in the form of public transportation and so on. |
| Medium              | M    | 300-499                                       | Commercial area; very high road side activity          |
| High                | H    | 500-899                                       | Industrial area; several shops on the side of the road |
| Very High           | VH   | >900                                          | Commercial area; market activity beside the road       |

Table 2.2. Side Friction Factors for Adjustment Highway Capacity

| Highway Type | Side Friction Factor Level | Adjustment Factors for Side Barriers and Kerb - Barrier Distance (FCsf) | Distance Kerb-Barrier |
|--------------|----------------------------|---------------------------------------------------------------|-----------------------|
|              |                            |                                                                 | ≤ 0,5                 |
|              |                            |                                                                 | 1,0                   |
|              |                            |                                                                 | 1,5                   |
|              |                            |                                                                 | ≥ 2,0                 |
| 4/2 D        | VL                         | 0.95                                           | 0.97                  |
|              | L                          | 0.94                                           | 0.96                  |
|              | M                          | 0.91                                           | 0.93                  |
|              | H                          | 0.86                                           | 0.89                  |
|              | VH                         | 0.81                                           | 0.85                  |

Based on IHCM to calculate the capacity of the highway use the formula:

\[
C = Co \times FCw \times FCsp \times FCsf \times FCcs
\]

Where:
- \( C \) = Capacity (pcu/hour)
- \( Co \) = Base capacity (pcu/jam)
- \( FCw \) = Adjustment Factor for width of lane
FCsp = Adjustment Factor for direction split (non divided highway)
FCsf = Adjustment Factor for side friction
FCcs = Adjustment Factor for city size

3. Data Collection

3.1. Survey Traffic Volume

Survey method with field observations carried out on the side of the road, the surveyor takes data on traffic volume, traffic speed and to the four side obstacle factors. Time for morning data collection (07.00-09.00), daytime (12.00-14.00) and afternoon (16.00-18.00 hours). Survey location at Cideng Highway that has 6 lanes and divided by median as canal.

Survey was conducted in two days by distribution, on Tuesday for direction Tomang and on Thursday for direction Tanah Abang. Data traffic volume on Cideng highway can be seen in Table 3.1 and 3.2 below:

| Time          | Traffic Volume (vehicle/hour) | Q(Traffic Volume) (Pcu/hour) |
|---------------|------------------------------|-----------------------------|
|               | Motor Cycle | Car | Truk/ Bus |               |
| 07.15-08.15   | 1782        | 1611| 8        | 2066.1        |
| 07.30-08.30   | 1859        | 1505| 8        | 1979.35       |
| 07.45-08.45   | 1959        | 1406| 10       | 1907.75       |
| 08.00-09.00   | 1882        | 1452| 9        | 1933.3        |
| 08.15-09.15   | 1716        | 1461| 9        | 1900.8        |
| **11.15-12.15** | **2484** | **1454** | **51** | **2136.2** |
| 11.30-12.30   | 2380        | 1441| 56       | 2103.2        |
| 11.45-12.45   | 2252        | 1423| 57       | 2054.4        |
| 12.00-13.00   | 2251        | 1458| 49       | 2079.55       |
| 12.15-13.15   | 2202        | 1464| 42       | 2064.9        |
| 17.15-18.15   | 3096        | 1104| 36       | 1921.2        |
| 17.30-18.30   | 2943        | 1002| 26       | 1768.95       |
| 17.45-18.45   | 2677        | 890 | 21       | 1584.45       |
| 18.00-19.00   | 2791        | 910 | 18       | 1629.35       |
| 18.15-19.15   | 2765        | 869 | 19       | 1583.05       |

Table 3.1. show peak hour volume occurs on the hour 11.15-12.15 that has traffic volume 2136.2 pcu/hour (pcu value for each vehicle based on IHCM).
Tabel 3.2  Traffic Volume of Cideng Highway on Thursday

| Time       | Traffic Volume (vehicle/hour) | Q(Traffic Volume) (Pcu/hour) |
|------------|-------------------------------|-----------------------------|
|            | Motor Cycle       | Car     | Truk/ Bus |                           |
| 07.15-08.15| 6679             | 2025    | 28        | 3728.35                   |
| **07.30-08.30** | **6987**   | **2030** | 31        | **3813.95**               |
| 07.45-08.45| 6699             | 2038    | 35        | 3754.75                   |
| 08.00-09.00| 6375             | 1902    | 38        | 3541.35                   |
| 08.15-09.15| 6204             | 1914    | 46        | 3520.2                    |
| 11.15-12.15| 3968             | 1772    | 52        | 2826.4                    |
| 11.30-12.30| 4034             | 1759    | 52        | 2829.9                    |
| 11.45-12.45| 4048             | 1746    | 48        | 2815.6                    |
| 12.00-13.00| 4051             | 1703    | 41        | 2764.95                   |
| 12.15-13.15| 4097             | 1759    | 37        | 2827.65                   |
| 17.15-18.15| 6214             | 1793    | 11        | 3359.7                    |
| 17.30-18.30| 6200             | 1851    | 16        | 3420.2                    |
| 17.45-18.45| 5877             | 1829    | 26        | 3329.45                   |
| 18.00-19.00| 5636             | 1836    | 26        | 3276.2                    |
| 18.15-19.15| 5994             | 1884    | 25        | 3412.5                    |

Table 3.2 show peak hour volume occurs on the hour 07.30-08.30 that has traffic volume 3813.95 pcu/hour (pcu value for each vehicle based on IHCM).

To know the condition of land use at the side of Cideng highway, we can see at the table 3.3 below:

Table 3.3. Land Use and Side Friction Survey

| Survey Day | Direction | Survey Based on IHCM                      |
|------------|-----------|------------------------------------------|
| Tuesday    | Tomang    | Shop, Office; Commercial area; very high road side activity |
| Thursday   | Tn. Abang | Market, Hotel, Shop, Gas Station; Commercial area; very high road side activity |

Table 3.3 show that categorized survey location close to Commercial area; very high road side activity in IHCM.

To know the relationship land use at the side of Cideng highway with land use category in IHCM, we can see at the table 3.4 below:
Table 3.4: Percentage Appropriate Survey and IHCM

| Direction    | Time       | Total Number | Level Classification | FCsf | Percentage M Level |
|--------------|------------|--------------|-----------------------|------|--------------------|
| Tomang       | 08.15-09.15| 300-499      | M                     | 0.98 |                    |
| Others       |            | 100-299      | L                     | 1    | 6.67%              |
| Tanah Abang  | 07.15-12.15| 300-499      | M                     | 0.98 |                    |
| Others       |            | 100-299      | L                     | 1    | 46.67%             |

Table 3.4 show that on direction Tanah Abang categorized land use more appropriate with IHCM as level Medium.

4. Data Analysis

Data analysis based on Comparing the weight of side friction factor in IHCM with the value of Pearson Correlation the traffic volume and total amount of side friction value, and the comparison we can see at Table 4.1:

| Side Friction | IHCM | Pearson Correlation (R) |
|---------------|------|-------------------------|
|               |      | Tuesday                 | Thursday               |
|               |      | Morning | Midday | Afternoon | Morning | Midday | Afternoon |
| Non Motorized Vehicle | 0.4 | 0.53  | 0.31  | 0.37  | 0.67  | 0.36  | 0.55  |
| Pedestrian    | 0.5  | 0.75  | 0.50  | 0.50  | 0.68  | 0.61  | 0.44  |
| Left-Right Access Parked/ Stopped Vehicle | 0.7 | 0.55  | 0.57  | 0.51  | 0.48  | 0.63  | 0.44  |
|               | 1    | 0.42  | 0.65  | 0.10  | 0.55  | 0.63  | 0.10  |

Table 4.1 show the relationship between weight of each side friction factor with correlation each side friction factor and traffic volume look appropriate. In the afternoon on both direction there is not any vehicle parked at the side of the road.

5. Conclusion

- In land use of Market, Hotel, Shop, Gas Station is quite similar with Commercial area; very high road side activity that categorized in IHCM.

- Weight Sequence in IHCM for side friction more close with Correlation analysis for midday and afternoon of two direction.

- The value of weight side friction in IHCM and data analysis is quite difference.
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