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FACTORS AFFECTING CHOICE OF ROAD CROSSING METHOD

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Abstract

Road user obidience on traffic regulation, such as road crossing on designated facilities depends on various factors. One factor might be the easiness to use the facilities. Pedestrian bridge in front of Tarumanagara University, Jakarta was not used by all pedestrian to cross Jl. S. Parman. A relatively small number of illegal road crossing was existed. Appart from limited law enforcement conducted by the police, there might be several reasons for choosing between using pedestrian bridge to cross or carry out illegal road crossing. In this paper some possible reasons were observed, i.e. gender, physical body shape (fat or slim) as a proxy for physical barrier to use pedestrian bridge, volume to capacity ratio (V/C) as a proxy for barrier to carry out illegal road crossing, etc. Traffic counting for both vehicles (classified into light vehicles, motorcycles and heavy vehicles), and pedestrian (crossing using pedestrian bridge and crossing ilegally) were conducted in every 5 minutes period during morning, noon and afternoon counting periods. Road capacity was calculated based on Indonesian Highway Capacity Manual (IHCM) 1997. The data was then analyzed to test wheter there is significant correlation between V/C and number of legal and illegal crossing per 5 minutes period. To assess the effect of gender and physical body shape to the choice of road crossing method, some comparison analysis was conducted between different gender and different physical body shape. The result shows that V/C was not an important reason to affect road crossing method choice. Over weight female tend to conduct illegal crossing, especially in the afternoon. Security reason might avoid this group of people to use pedestrian bridge together with physical barrier.

Keywords: factors, affecting, road crossing method

1. INTRODUCTION

Road user obidience on traffic regulation, such as road crossing on designated facilities depends on various factors. One factor might be the easiness to use the facilities. Pedestrian bridge in front of Tarumanagara University, Jakarta was not used by all pedestrian to cross Jl. S. Parman. A relatively small number of illegal road crossing was existed. Appart from limited law enforcement conducted by the police, there might be several reasons for choosing between using pedestrian bridge to cross or carry out illegal road crossing. This paper is intended to reveal the factors affecting the choice of road crossing method.

2. LITERATURE REVIEW

According to [1], road crossing facilities can be divided into two types, i.e. level crossing and non-level crossing. Level crossing is facilitated with Zebra Cross, i.e. white marking to indicate space for pedestrian crossing beyond the vehicle stop line. Full priority is given to pedestrian when they cross the road on Zebra Cross. Higher safety is provided in Pelican Crossing (Figure 1). This is Zebra Cross with additional push botton equipment to trigger green signal for pedestrian (red signal for vehicular traffic vv). Non-level crossing consists of pedestrian bridge or pedestrian underpass.

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Fig. 1. Example of a Pelican Crossing

Based on [2], pedestrian bridge should be strongly constructed and easy to maintain. Pedestrian bridge should also fulfil the following:

1. Minimum width of 2 meters
2. Maximum stairs inclination of 20 degree
3. Equiped with appropriate fence
4. Accesible for wheel chair users

According to [3] in the planning and design of pedestrian facilitities incuding pedestrian crossing facilities, there are seven primary variables to be considered, i.e. security, conveninece, continuity, comfort, system coherence/integration and attactiveness. These seven variables are interelated.

Although there are available pedestrian bridges, illegal crossing still happens. This is a vey risky behaviour both for pedestrian and vehicular traffic. According to [4], although using pedestrian bridge was admitted to be safer, it cause additional travel time and considered not practical.

Crossing error divided into 3 types, i.e. mistakes, slips and lapses [5]. Mistakes further divided into knowledge-based and rule-based mistakes. Knowledge-based mistakes are taking wrong crossing route. Rule-based mistakes are crossing during high volume of vehicular traffic with low confidence and without assisstance. Slips (capture error) are habits to cross the road without using legal facilities and without assisstance. Lapses are keep crossing ilegallly although perceived that their actions were risky and failed to avoid the incoming vehicles.

3. DATA COLLECTION METHOD

Figure 2 shows the sketch of field survey location. The pedestrian bridge is connecting West side of S. Parman Road (Campus 2 of Tarumanagara University and other properties) and East side of S. Parman Road (Campus 1 of Tarumanagara University and other properties).

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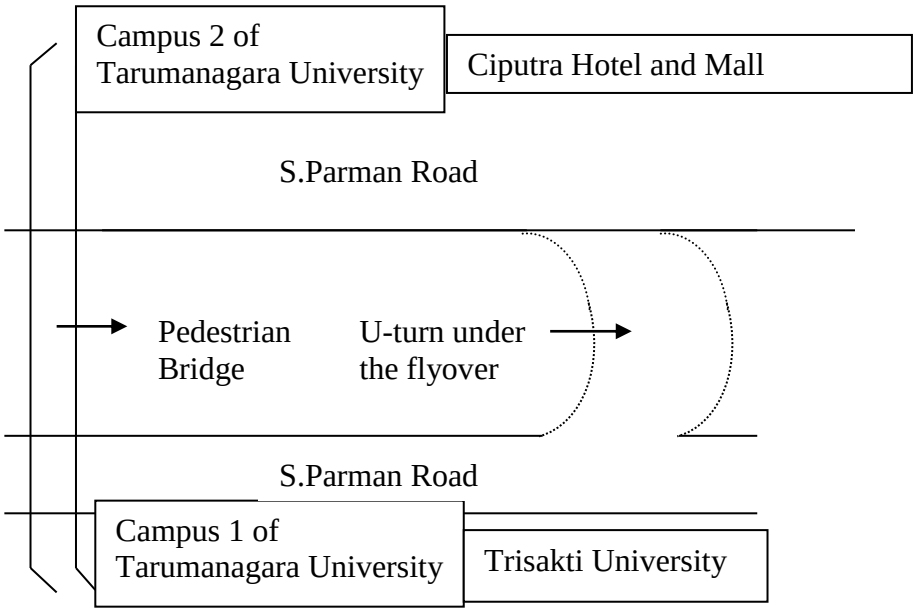

Fig. 2. Field survey location sketch

Field surveys were conducted in three periods morning (7.00-8.00), noon (12.00-13.00) and afternoon (17.00-18.00). In each hourly period the data was recorded every five minutes. The followings were observed:

1. Number of pedestrian using the bridge to cross the road both from East side and West side. To check the asumption that every person who go up from one side will cross to bridge to reach another side, a smal survey conducted in the first 5 minutes of each period (morning, noon and afternoon) by hand over a card to the pedestrian and asked him/ her to return the card in another side. The asumption was considered valid as 98.4% of the cards were reteturned.
2. Number of pedestrian conducting illegal crossing both from East side and West side.
3. Traffic flow of S. Parman Road in both directions.

When recording pedestrian data, they were classified by gender and classified by physical body shape (overweight and non-overweight). To describe wheter a person is overweight or not, World Health Organization [6] using Body Mass Index, BMI (defined as the body mass divided by the square of the body height, and is universally expressed in units of kg/m^2). A person with BMI of 25 kg/m^2 is considered to be overweight. Figure 3 show the comparison of different category of people based on BMI. In this study, we do not interact directly with the pedestrian and therefore BMI of pedestrian was impossible to calculate.Therefore a subjective criteria was used by the authors to judge wheter a pedestrian was overweight or non-overweight. Figures 4 through 7 show example of non-verweight male, overweight male, non-overweight female and non-overweight female respectively. Off-course those pictures not necessarily showing uper limit of non-overweight males/ females and neither showing lower limit of overweight males/ females, but the authors tried their best to conduct consistent classification throughout the replay of the video recording.

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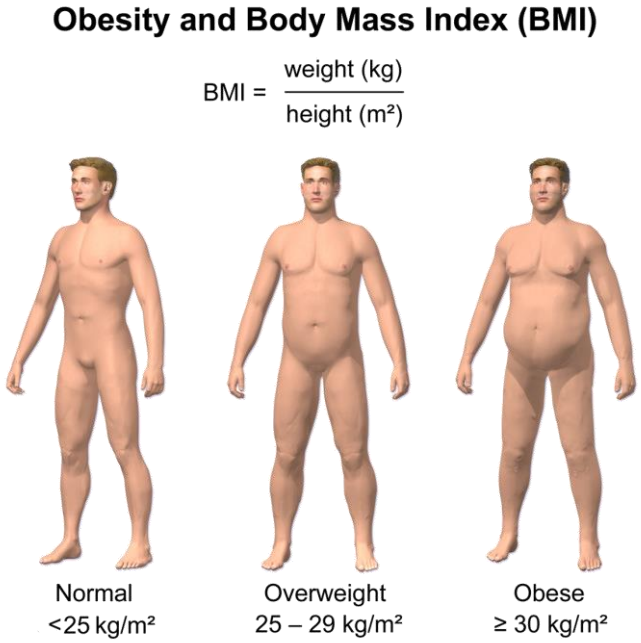

Fig. 3. Obesity and BMI
Source: World Health Organization [6]

Fig. 4. Example of non-overweight male pedestrian

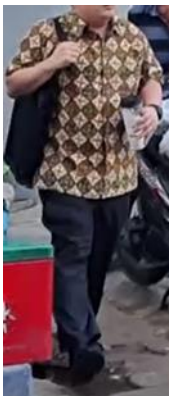

Fig. 5. Example of overweight male pedestrian

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Fig. 6. Example of non-overweight female pedestrian

Fig. 7. Example of overweight female pedestrian

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4. DATA ANALYSIS METHOD

There were hypothetically three reasons for crossing method choice. The followings were the hypothotical reasons:

1. High V/C (in the study area related with low vehicular speeds) encourage illegal crossing.
2. Overweight pedestrians were more likely to conduct illegal crossing compare to non-overweight pedestrians as they required more energy to use the pedestrian bridge.
3. Pedestrians were more reluctant to use pedestrian bridge in the afternoon (17.00-18.00) for security reason.

To evaluate correlation between V/C and number of illegal crossing, a Pearson Correlation Analysis was conducted with significant level of 0.05. Capacity (C) is calculated using [7]. The five minutes traffic flow was multiplied by twelve to get hourly volume (V). In the afernoon peakhour, extreem congestion made a static traffic flow survey become unuseful as very low V did not express very high upstream demand. So V/C value should be treated by care. To evaluate effect of gender, physical body shape of pedestrian and time of day observation period, proportiosn of each categories were compared.

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5. RESULTS

Table 1 and Table 2 show number of pedestrian crossing the pedestrian bridge every five minutes classified by gender and physical body shape in three survey periods from sEast side and West Side of S. Parman Road respectively. Table 3 usess the same format but for illegal crossing. The followings are abbreviation applicable for all parts of this paper onward, i.e. OM (Overweight Male), NM (Non-Overweight Male), OF (Overweiight Female), NF (Non-Overweight Female).

Table 1. No. of pedestrian crossing the pedestrian bridge from East side of S. Parman Road

The Five Minutes Period	Morning				Noon				Afternoon			
	OM	NM	OF	NF	OM	NM	OF	NF	OM	NM	OF	NF
1	4	17	1	9	9	25	5	11	-	14	2	5
2	2	8	1	12	7	22	3	7	4	16	1	9
3	1	8	1	4	8	24	3	16	4	17	3	4
4	3	9	3	6	11	30	4	13	2	12	-	9
5	4	5	3	10	6	34	2	4	4	8	1	10
6	5	8	2	7	8	27	1	8	2	9	1	8
7	3	12	-	4	9	33	4	10	5	13	4	12
8	2	10	3	7	5	31	6	6	3	15	3	8
9	3	7	3	6	3	28	5	9	6	9	4	6
10	6	9	1	8	3	36	5	14	3	8	2	10
11	2	9	3	7	2	34	3	10	7	8	5	9
12	1	11	2	9	4	37	4	8	2	10	3	8
Σ	**36**	**113**	**23**	**89**	**75**	**361**	**45**	**116**	**43**	**129**	**29**	**98**
Proportion	**0.24**	**0.76**	**0.21**	**0.79**	**0.17**	**0.83**	**0.30**	**0.70**	**0.25**	**0.75**	**0.23**	**0.77**

Table 2. No. of pedestrian crossing the pedestrian bridge from West side of S. Parman Road

The Five Minutes Period	Morning				Noon				Afternoon			
	OM	NM	OF	NF	OM	NM	OF	NF	OM	NM	OF	NF
1	2	11	2	14	8	36	4	9	3	11	2	10
2	2	8	-	2	7	19	3	11	3	14	3	9
3	1	4	1	5	8	32	2	15	7	11	2	1
4	2	11	3	5	9	29	5	12	5	15	3	6
5	3	5	2	11	4	31	1	6	3	5	1	5
6	5	5	3	5	6	21	4	9	5	12	5	11
7	5	14	5	8	7	26	7	9	6	9	-	8
8	2	9	-	5	5	32	5	11	3	12	3	9
9	2	3	2	4	2	29	4	5	1	14	2	5
10	4	13	1	5	2	36	3	12	4	7	5	4
11	3	8	5	10	1	33	4	9	6	11	3	12
12	3	5	1	7	4	28	1	12	2	12	4	6
Σ	**34**	**96**	**25**	**81**	**63**	**352**	**43**	**120**	**48**	**133**	**33**	**86**
Proportion	**0.26**	**0.74**	**0.24**	**0.74**	**0.15**	**0.85**	**0.26**	**0.74**	**0.27**	**0.73**	**0.38**	**0.62**

Table 3. No. of pedestrian crossing illegaly

The Five Minutes Period	Morning				Noon				Afternoon			
	OM	NM	OF	NF	OM	NM	OF	NF	OM	NM	OF	NF
1	-	-	-	1	-	-	-	1	2	7	1	-
2	-	1	-	-	-	-	1	2	1	-	-	-
3	1	-	1	-	-	1	2	-	1	2	3	-
4	-	-	-	-	-	1	2	-	-	1	2	1
5	-	1	-	-	-	-	-	-	1	3	-	1
6	-	1	-	-	-	1	3	2	-	1	-	-
7	-	-	1	-	-	1	-	1	2	1	1	3
8	-	-	-	-	-	-	-	-	-	1	1	-
9	-	-	-	-	1	-	-	-	1	2	1	1
10	-	-	1	1	-	1	3	3	2	1	1	1
11	-	-	-	-	1	3	-	-	1	4	3	3
12	-	-	-	-	-	-	4	2	2	3	2	-
Σ	**1**	**3**	**3**	**2**	**2**	**8**	**15**	**11**	**13**	**26**	**15**	**10**
Proportion	**0.25**	**0.75**	**0.60**	**0.40**	**0.20**	**0.80**	**0.58**	**0.42**	**0.33**	**0.67**	**0.60**	**0.40**

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Table 4 shows Southbound and Northbound V/C of S. Parman Road respectively every five minutes in three survey periods. When a Pearson Correlation Analysis was conducted for both legal and illegal crossing, very few correlations were significant in 0.05 significant level. Among those few, only one showing correct sign (-0,564), i.e. between number of overweight male crossing from East side with V/C in the noon survey period. This implies that the lower the V/C (the higher the vehicular speed) the higher the number of overweight male crossing using pedestrian bridge from East side.

Table 4. Southbound V/C of S. Parman Road

The Five Minutes Period	V/C					
	Southbound			Northbound		
	Morning	Noon	Afternoon	Morning	Noon	Afternoon
1	0.93	0.99	0.60	0.80	0.69	0.56
2	0.94	0.99	0.51	0.80	0.75	0.57
3	0.99	1.08	0.43	0.77	0.81	0.58
4	1.08	1.15	0.43	0.70	0.79	0.55
5	1.02	1.14	0.42	0.73	0.68	0.47
6	0.96	1.12	0.48	0.83	0.64	0.56
7	0.94	1.08	0.50	0.90	0.63	0.60
8	0.97	1.17	0.52	0.79	0.60	0.57
9	0.84	1.23	0.49	0.71	0.65	0.55
10	0.84	1.21	0.51	0.72	0.71	0.53
11	0.85	1.13	0.46	0.72	0.76	0.51
12	0.90	1.16	0.48	0.67	0.73	0.50

Table 5 and Table 6 summarize (Table 1 and Table 2) the proportion of OM vs NM and the proportion of OF vs NF for three survey periods crossing the pedestrian bridge from East side and West side of S. Parman road respectively. Table 7 summarize Table 3 in the same format for illegal crossing. It is clear especially from Table 7 that overweight female tend to cross illegaly compare to non-overweight female.

Tabel 5. Proportion of OM vs NM and proportion of OF vs NF crosing from East side of S. Parman road

Survey Period	Proportion of			
	OM	NM	OF	NF
Morning	0.24	0.76	0.21	0.79
Noon	0.17	0.83	0.30	0.70
Afternoon	0.25	0.75	0.23	0.77

Tabel 6. Proportion of OM vs NM and proportion of OF vs NF crosing from West side of S. Parman road

Survey Period	Proportion of			
	OM	NM	OF	NF
Morning	0.26	0.74	0.24	0.74
Noon	0.15	0.85	0.26	0.74
Afternoon	0.27	0.73	0.38	0.62

Tabel 7. Proportion of OM vs NM and proportion of OF vs NF crosing illegally

Survey Period	Proportion of			
	OM	NM	OF	NF
Morning	0.25	0.75	0.60	0.40
Noon	0.20	0.80	0.58	0.42
Afternoon	0.33	0.67	0.60	0.40

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Tables 8 through 10 eliminate the gender effect from Tables 5 through 7 and leaving physical body shape as the only factor to clasifiy the pedestrian. It is clear from Tables 8 and 9 that the pedestrian bridge users were mainly (about 75%) non-overweight. Tables 8 through 10 show higher proportion (about 45%) of overweight pedestrian who cross illegaly compare to overweight pedestrian who cross legally (about 25%). Off-course proportion based analysis of such small sample like this study should consider proportion of overweight pedestrian in general population. Table 11 shows that significantly more proportion of illegal crossing on the afternoon survey period. Security reason may cause this result. Lastly Table 12 shows that the male pedestrian were dominant (65%) from 2383 pedestrians in three survey periods. The proportion of male pedestrian become more dominant during the noon survey period (about 71%)

Table 8. Proportion of overweight and non-overweight pedestrian crosing from East side of S. Parman road

Survey Period	Proportion of Pedestrian Who Were	
	Overweight	Non-Overweight
Morning	0.23	0.77
Noon	0.21	0.79
Afternoon	0.24	0.76

Table 9. Proportion of overweight and non-overweight pedestrian crosing from West side of S. Parman road

Survey Period	Proportion of Pedestrian Who Were	
	Overweight	Non-Overweight
Morning	0.25	0.75
Noon	0.18	0.82
Afternoon	0.27	0.73

Table 10. Proportion of overweight and non-overweight pedestrian crosing illegaly

Survey Period	Proportion of Pedestrian Who Were	
	Overweight	Non-Overweight
Morning	0.44	0.56
Noon	0.48	0.52
Afternoon	0.43	0.57

Table 11. Proportion of illegal crossing compare to toal pedestrian crossing on three survey periods

Proportion of Illegal Crossing		
Morning	Noon	Afternoon
0.02	0.03	0.10

Table 12. Proportion of gender in three survey periods and three crossings

Type of Crossing	Survey Period					
	Morning		Noon		Afternoon	
	Male	Female	Male	Female	Male	Female
East Legal Crossing	149	112	436	161	172	127
West Legal Crossing	130	106	415	163	181	119
Illegal Crossing	4	5	10	26	39	25
Total Crossing	283	223	861	350	392	271
Proportion	0.56	0.44	0.71	0.29	0.59	0.41

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6. CONCLUSIONS AND RECOMMENDATIONS

From the results of analysis in this paper, several conclusion can be formulated as follows:

1. V/C and vehicular speed was not an important factor in choice of crossing method. Possibly because extreemly congested S. Parman Road during three survey periods causing inappropriate traffic flow determination.
2. Overweight female tend to cross illegaly compare to non-overweight female.
3. There was higher proportion (about 45%) of overweight pedestrian who cross illegaly compare to overweight pedestrian who cross legally (about 25%).
4. There was significant more proportion of illegal crossing on the afternoon survey period (10%). Security reason may cause this result.
5. Male pedestrian were dominant (about 65%) and become more domoinant at noon (about 71%)

From the results of analysis in this paper, several recommendation can be formulated as follows:

1. The pedestrian bridge should be revitalized to become more attractive for general pedestrian to cross legally, especially for overweight female and during darker siruation (afternoon period).
2. The method to classify overweight and non-overweigiht pedestrian should be improved and incorporating mor scientific aproach such as BMI.

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