

SAFETY LEVEL OF PEDESTRIAN IN URBAN AREA

(Study Case: Residential area adjacent with official area)

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ABSTRACT

There are other road users who have high rates involvement as victims of accidents, namely vulnerable road users such as pedestrians. The study concern to find out the safety level and facilities of pedestrians. This study takes place within official and residential areas with high pedestrians mobility. Furthermore, traffic conflict analysis used as the method to measure the safety level of pedestrians. From the survey results, urban areas especially in study case is not equipped with safety facilities for pedestrians such as pedestrians crossing, road sign, mark, speed limit for vehicles, and 70% serious traffic conflict lead to potential accident which involving pedestrians. The result proves low safety level for pedestrians in urban area. As the recommendation, land use and innovation in pedestrians safety facilities installation is needed such as combination of zebra cross, speed limit, sign, mark, and speed hump to reduce vehicle speed when approaching the crossing facilities.

Keywords: *pedestrians safety, traffic conflict analysis*

ABSTRAK

Terdapat pengguna jalan lain yang memiliki angka keterlibatan yang tinggi sebagai korban kecelakaan, yaitu pengguna non kendaraan bermotor seperti pejalan kaki. Kajian ini mengenai tingkat pelayanan keselamatan dan fasilitas bagi pejalan kaki. Kajian ini mengambil lokasi wilayah perkantoran dan wilayah pemukiman dengan mobilitas pedestrian yang tinggi. Selanjutnya, digunakan analisis konflik lalu lintas sebagai metode pengukuran tingkat keselamatan responden. Dari hasil survey, kawasan perkotaan dalam studi kasus tidak difasilitasi dengan fasilitas keselamatan bagi pejalan kaki yaitu tidak adanya batasan kecepatan bagi kendaraan bermotor serta terjadinya 70% konflik serius yang mengarah kepada potensi kecelakaan selama jam pengamatan yang melibatkan pejalan kaki. Diperlukan penanganan bagi keselamatan pejalan kaki yaitu pemanfaatan tata guna lahan dan pemasangan fasilitas keselamatan seperti zebra cross, pembatasan kecepatan, rambu, marka, dan speed hump untuk mengurangi kecepatan kendaraan bermotor yang akan melewati fasilitas penyeberangan.

Kata Kunci: keselamatan, pejalan kaki, analisis konflik lalu lintas

INTRODUCTION

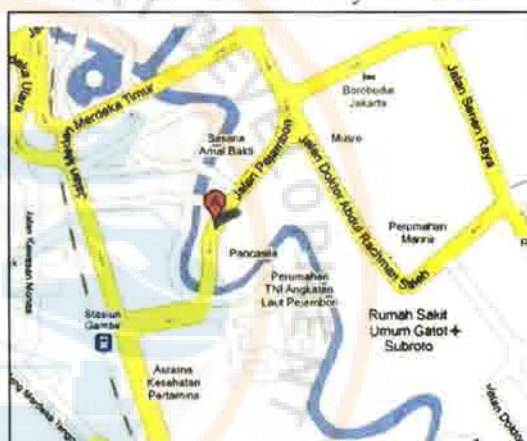
Road safety is a global problem that is not the only transportation problem but has become a social problem. The level of road safety according to WHO report, currently reached 1.2 million deaths and more than 30 million injuries/defects caused by traffic accidents per year. 85% deaths from these accidents occur in developing countries which the number of vehicles as much as 32% of total vehicles in the world. The level of road accidents in the Asia-Pacific contributed 44% of the total accidents in the world includes Indonesia. Based on the study that conducted by joint team of Universitas Gajah Mada (UGM) and University of Indonesia (UI), economic losses because of traffic accidents in 2002 at least 30.82 trillion rupiah (3.5 billion US\$) or 21.7% GDP.

The high number of accidents occur almost on every road users. The highest number achieved by a motorcycle followed by passenger cars. Even so, in fact there are other road users who have high rates involvement as the victims of accidents, namely vulnerable road users. Unfortunately, in Indonesia is not recorded properly because lack of government attention to them, such as cyclists and pedestrians. Also, there are the absence of pedestrians safety facilities on some main roads in Indonesia as the evidence.

The location that easily found with lack of pedestrians facilities in urban area is residential area with large number of pedestrians, especially children and residents itself. Moreover, the condition could be worse in residential area that closed by the office location with a lot of people around who work around office area. In fact, a phenomenon that often happens in Indonesia is the abuse of pedestrians facilities

functions; that are used for other things such as motorcycle users who use the sidewalk, cars parked on the sidewalk, and sidewalk vendors.

One of the urban locations that contained a link between the location of residential and official areas is Pejambon Street, Central Jakarta. Pejambon Street is bounded by official area and Immanuel Church on the south, Gambir Station in the west, while the residential area located in the east and official areas located on the north. There are high number of pedestrians in this area but not balanced with safety facilities.



Source: Google Map

Figure 1. Site Location of Study Case (Pejambon Street, Jakarta Pusat)

Based on these conditions, it is necessary to study the level of pedestrians safety that occurred in residential locations that close to the official. By this study, it is expected to provide recommendations to the government about the importance of improvement and installation for pedestrians facilities.

However, the problems that must be solved in this study are as follows:

1. How much the safety level of pedestrians in urban area, particularly in residential area closed by official area;

2. What is the problem of safety and facilities for pedestrians;
3. How to increase the safety level of pedestrians;
4. How to design convenient condition for pedestrians as road user.

The objective of this study is to determine the safety level of pedestrians facilities in urban areas, particularly residential area that close with official area.

LITERATURE REVIEW

Urban Area

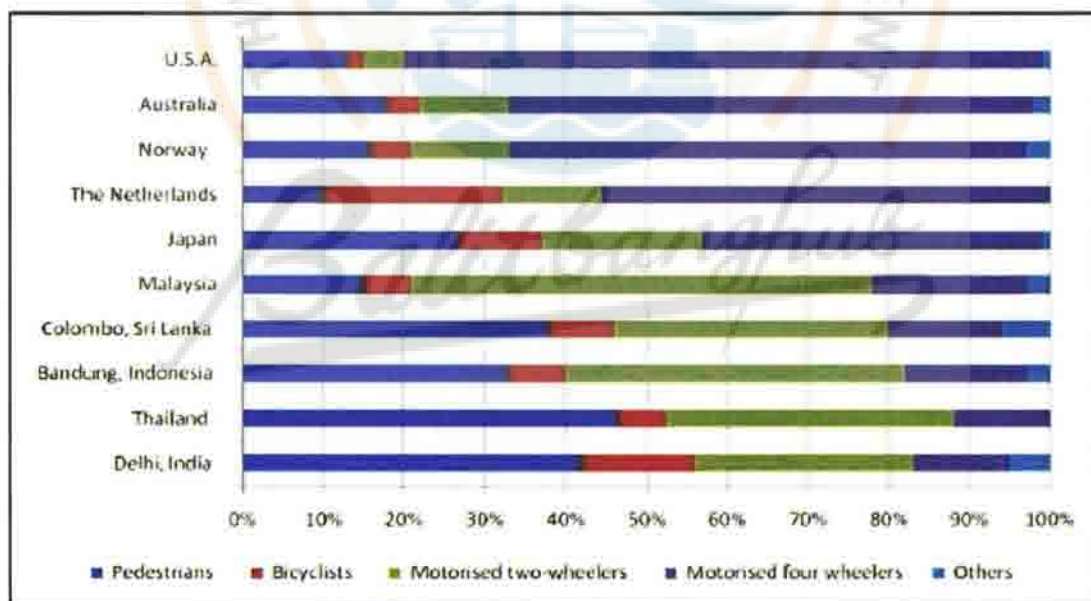
As contained in Indonesian Highway Capacity Manual 1997⁴, the urban road segments have permanent and sustained development throughout almost all the way, at least on one side of the road-whether in the form of land development or not. Roads in or near urban centre with more than 100,000 residents are always

classified in this group. Roads in urban areas with population less than 100,000 but has a side street that has sustained development also be included in urban road.

Pedestrians Safety

There have been many studies done related to pedestrians safety in several countries in the world. From these studies it can be concluded that in most developing countries with low middle economic level has high number level of accidents involving pedestrians. Based on research result from the World Health Organization 2004², the number of pedestrians accident rate in several cities in developing countries -such as Colombo in Sri Lanka, Bandung in Indonesia, and Delhi in India- almost reach 50% of total incidence. The figure shown in the picture below.

However, from the research that has been done before, the speed of vehicles is one of the factors that affect the safety for road

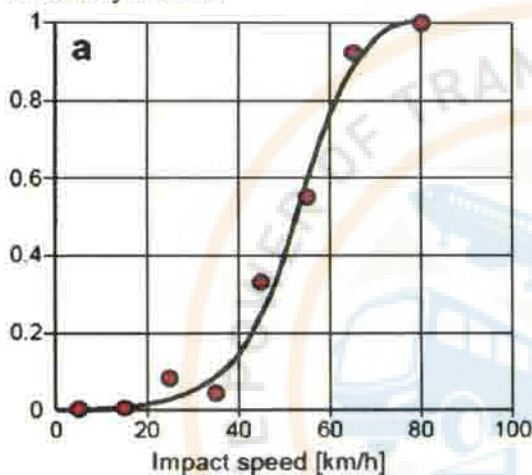


Source: World Health Organization, 2004

Figure 2. Safety Level of Road User in Several Countries in The World

users, particularly accidents involving pedestrians and motor vehicles. The relationship between motor vehicles speed with pedestrians accident victims can be described as figure 3. Base on the figure, there is less than 50% chance of pedestrians to survive if hit by vehicle speed around 50 km/hour. Moreover, there must be death if pedestrians hit by vehicle speed in 80 km/hour or more.

Probability of death



Source: Pasanen on Ria, 2007

Figure 3. The impact of vehicle speed and pedestrians casualty

Pedestrians Facilities

According to Peraturan Pemerintah No. 43 in the year 1993 about Road Traffic and Infrastructure⁵ article 39 states that pedestrians should be supporting by the facilities which consist of:

- Sidewalk;
- Crossings, which are stated and road markings or signs;
- Pedestrians bridge;
- Tunnel crossings.

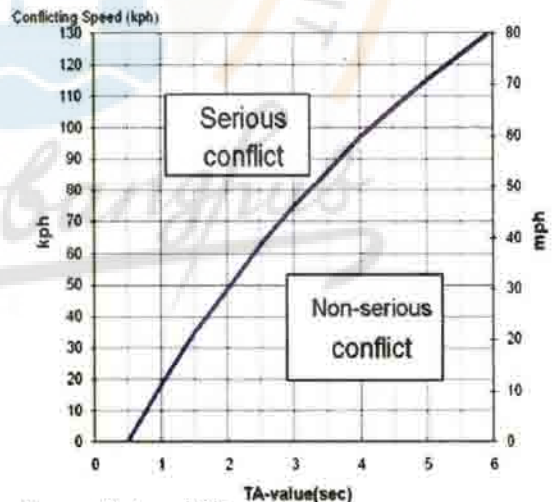
As for determining the location, construction, management, and maintenance

support facilities is conducted by the Ministry of Transportation.

Traffic Conflict Technique

Conflict analysis has similarities with the analysis of accidents. If the accident analysis only done on the available database that tells about an incident that happened, meanwhile conflict analysis may represent events that actually occurred at the site with details.

The Swedish Traffic Conflicts Technique (TCT), common used today, is based on two concepts: Time to Accident (TA) and Conflict Speed (CS) (Hydén, 1987⁶). TA is the time that remains from the moment of involved road user takes evasive action or collision would have occurred if the speeds and directions of the involved road users had not changed. CS is the speed of road user that takes evasive action, just prior to the evasive action. To find the results of the analysis base on the picture as follows.



Source: Hydén, 1987

Figure 4. Conflict Diagram

Serious Conflict is a potential conflict that has huge opportunity to accident.

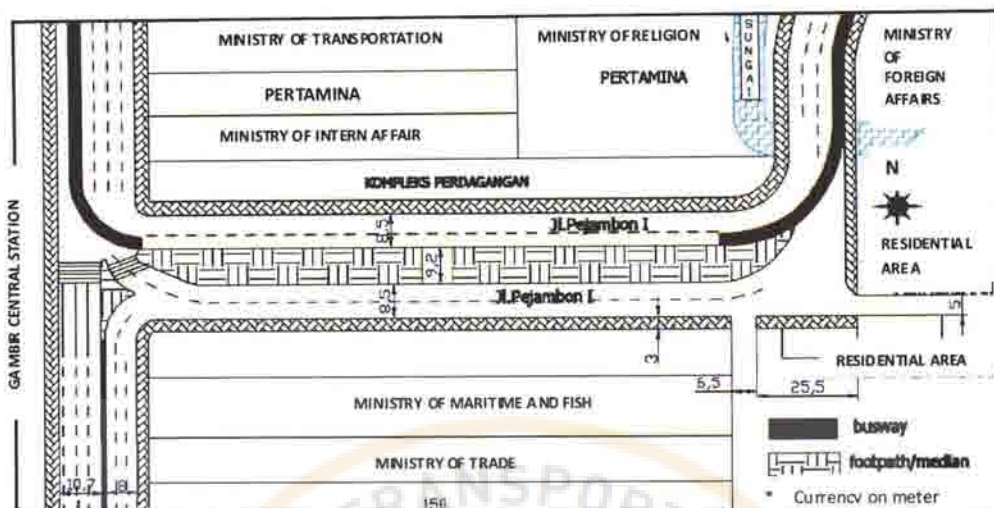


Figure 5. Site Research

Non Serious Conflict (conflict is not serious) is a potential conflict which has a little opportunity to accident.

METHODOLOGY

This research based on primary data that conducted in Pejambon Street I, Central Jakarta as the study case. The surveys consist of observation, traffic volume for all road users, conflict survey, and speed survey. The survey conducted for a week on June 2010. Moreover, the data analysed by S-Curve and descriptive also related software such as CD Software for traffic conflict analysis and MS Excel.

Site research

Pejambon Street I, Central Jakarta is one of the strategic region in urban area since the location in the centre of capital city. In the south links to Ministry of Fisheries and Marine Resources then Ministry of Commercial while the north is bordered by official area that consist of Ministry of Internal Affairs, Ministry of Transportation, Ministry of Religious Affairs, Ministry of Foreign Affairs, and PERTAMINA (Oil and Gas State Company). On the west adjacent to Gambir Central Station and the east is residential area. For more details, the layout shown in the figure 5.

Table 1. Traffic Volume in Peak Hour in Pejambon Street

	Pejambon Street North Side				Pejambon Street South Side			
	MC (veh /hour)	C (veh /hour)	LV (veh /hour)	Cyclist	MC (veh /hour)	C (veh /hour)	LV (veh /hour)	Cyclist
per hour	4282	1377	55	7	1895	1664	82	15
Emp (equivalent)	0,25	1,00	1,2		0,25	1,00	1,2	
Total/veh type	1070,5	1377	66		473,75	1377	98,4	
TOTAL/ approaching	2513,5				1949,15			
TOTAL	4463 vehicle/hour							

Source: Survey Result

RESULTS AND DISCUSSION

Traffic Volume

There are high number of traffic that reach 4463 vehicles/hour. The detail as follows (Table 1)

Pedestrian Volume

Pedestrians volume at Pejambon Street is very busy in the morning. It can be seen in the picture beside that pedestrians along Pejambon Street is resident who live in Pejambon area and others who has activities around.



Figure 6. Pedestrians at Pejambon Street



Figure 7. Violation that concerned on pedestrians safety and facilities at Jalan Pejambon

Speed Survey

Speed survey conducted on 4 locations that are before the branch of Pejambon

Table 2. Volume Pedestrian at Pejambon Street

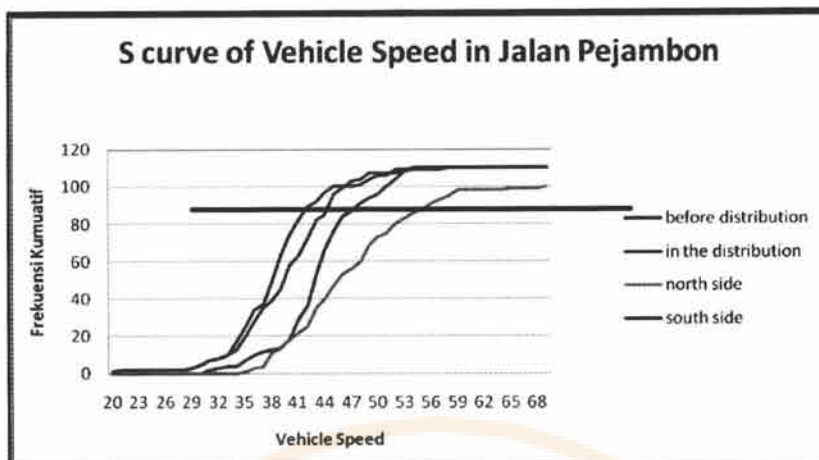
Time	Total	
	South	North
06.30-06.45	74	29
06.45-07.00	106	12
07.00-07.15	72	9
07.15-07.30	43	19
07.30-07.45	73	23
07.45-08.00	103	8
08.00-08.15	79	15
08.15-08.30	73	7
Per hour	295	69
TOTAL	364 pedestrians/hour	

Source: Survey Result

There are high numbers of pedestrians/hour which reach 364 pedestrians/hour. More than 80% of them do the activities in the south side. Unfortunately, this number does not noticed by government and other road user. It is proven by many violations as follows.

1. Motor vehicle park at the sidewalk;
2. No crossing facilities;
3. No crossing priorities;
4. No mark and sign for pedestrians;
5. Street vendor on the sidewalk.

Street, on the branch (the bend) of Pejambon Street, the south side, and the north side. The results can see below.



Source: Analysis

Figure 8. S-curve of Vehicle Speed at Pejambon Street

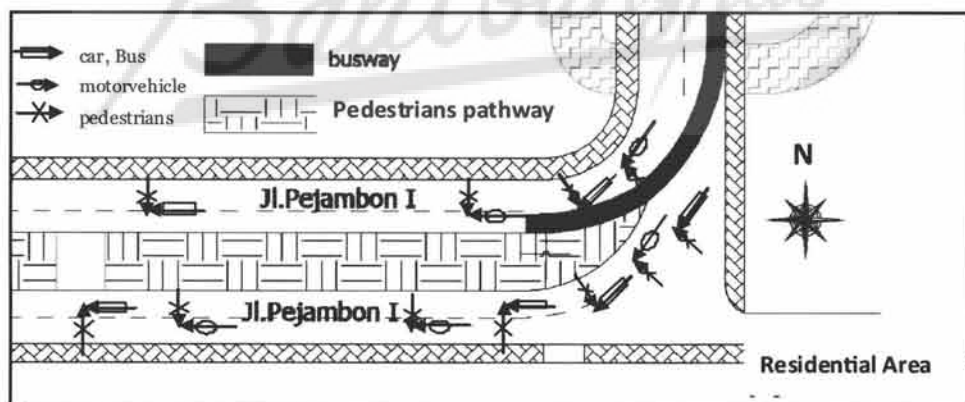
As in the figure 8, 85 percentile on the distribution road is 49.35 km/hour, whereas on the branch is 44 km/hour, then in the north and south reach 45 and 54 km/hour. Base on figure 3 about probability of death, if the speed around 45-55 km /hour means there are 40-55% probability to death of pedestrians.

Traffic Conflict Result

Based on primary data, there are 51 conflicts that counted by the surveyor in the peak hours at Pejambon Street. The location shows in figure 9.

From the figure 10 shows that the majority of conflicts between pedestrians occur with high-speed of motor vehicles. They do not care about the presence of pedestrians who cross along the way. As the result, many pedestrians were running when they cross describes pedestrians does not feel safe while crossing.

The picture beside is a serious conflict between pedestrians and motorcycles. There can be seen that the distance of conflict between them around 2 meters and motorcycle speed almost 40 km/h. There is an effort and evasive action from pedestrian with crossing the street by running.



Source: analysis

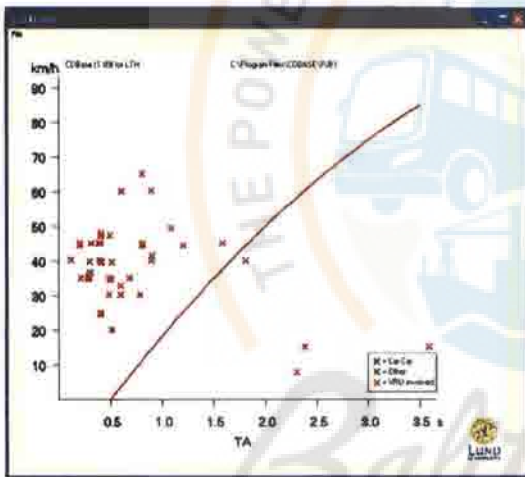
Figure 9. Traffic Conflict at Pejambon Street



Source: Survey Location

Figure 10. Pedestrian Conflict at Pejambon Street

From the analysis based on ACD Base software, there are 10 not serious conflicts and 41 serious conflicts of accidents. For more details, can be illustrated in the figure 12 based on ACD Base software.



Source: Analysis

Figure 11. Conflict Result at Pejambon Street

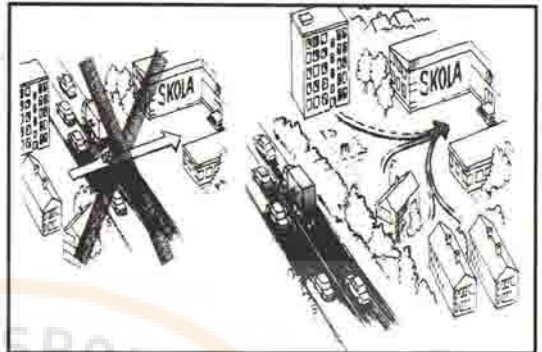
PEDESTRIANS FACILITIES IN URBAN AREA

1. Land Use

In urban area with large number of pedestrians, land use for the city planning should be designed in the city master plan

such as localisation, differentiation, and separation. The explanations are follows.

a. Localisation



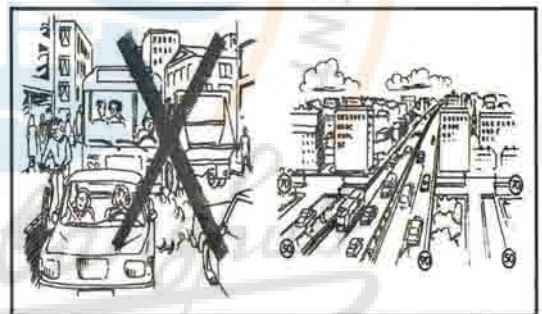
Source: Sari, 2009

Figure 12. Localisation

Localisation is one of city planning by land use integration as the function without traffic separate them.

As in the figure 12, there is no traffic among official and residential areas.

b. Differentiation



Source: Varhelyi, 2008

Figure 13. Differentiation

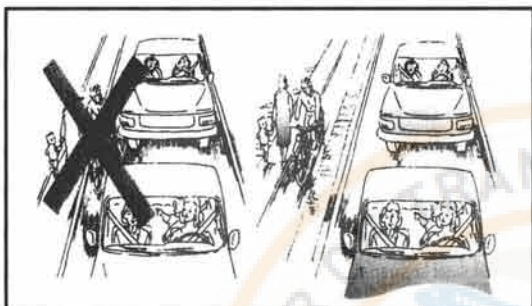
Differentiation is one of safety traffic planning in mixed traffic by manage it according to road hierarchy.

As describe in the figure 13, traffic separation of road hierarchy base on speed limit.

c. Separation

Separation principle is one of safety traffic particularly for vulnerable road user.

As describe in the figure 14, accomodating separation of pedestrians path and the carriageway.



Source: Varhelvi, 2008

Figure 14. Separation

2. Sidewalk/Sidewalk

Base on Direktorat Bina Sistem Perkotaan, 2006⁷ for residential area which adjacent with official area, minimum sidewalk width is 150-200 cm whereas the recommended width is 275-300 cm. However, it needs extra width in the region if any additional facilities such as light poles, traffic signs, or plant pot. Additional width required by the rules of Direktorat Binamarga⁸ if the sidewalk contained light pole, the additional width is 75-120 cm and 150 cm for plant pot. Thus, safe width for sidewalks in urban area with additional facilities is 300-450 cm.

Based on these requirements, the sidewalk already fulfils it. Yet, there are a lot of disruption that occurred on the sidewalk such as street vendors, motor cycle users, and motor that park on the sidewalk.

So that, the width that suggested for Pejambon Street is 350 cm.



Source: Analysis

Figure 15. Additional Sidewalk Width

3. Street Median

From site survey, pedestrians have been facilitated by the median already. Referring to the Pedestrians Crossing Treatment Warranty, 1996⁹ for road width along the 9 m, the median requirement is 1.8 m.

For urban areas especially in residential location adjacent to the official it is a **must** to install the median roads between them. Since this is not present yet in Indonesian regulation, it should be a must **stated in Indonesian regulation by the detail width of median** for pedestrians safety.

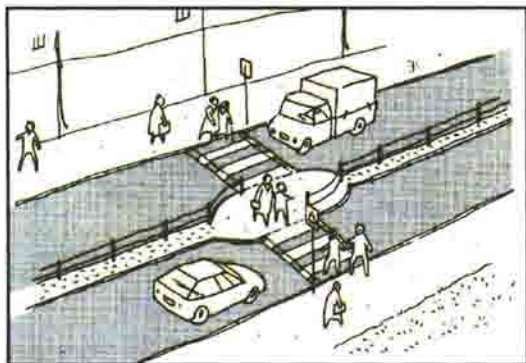
4. Crossing Facilities

As stated from Direktorat Binamarga and Direktorat Bina Sistem Perkotaan, crossing facilities type as the number of pedestrians and number of road user can be seen in table 3.

Table 3. Safety Facilities

Location	P	V	PV ²	Recommendation
Pejambon Street	4463	364	5,9x10 ⁸	<i>Zebra cross</i>

Source: Analysis



Source: Varhelyi, 2008

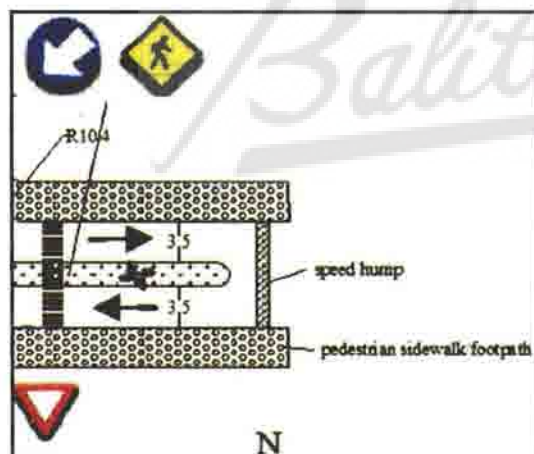
Figure 16. Speed hump on crossing facilities

5. Sign and Mark

Except giving guarantee to the pedestrian safety, it needs **appropriate regulation** to manage a safe, orderly, and convenience traffic. Signs and marks that needed to facilitate the pedestrians as follows:

- Speed limit sign;
- Crossing facility sign around the crossing area;
- Guidance sign in crossing area;
- Yield sign for crossing priorities;
- Road Mark.

Therefore, the application of overall facilities for pedestrians can put as in the figure 17 below.



Source: Varhelyi, 2008

Figure 17. Innovation for pedestrians facilities

CONCLUSION

From this study can be concluded as follows.

1. There is low safety level of pedestrians in urban area, especially in residential areas adjacent to the official. This is evidenced by many problems such as:
 - a. 70% serious conflicts involving pedestrians;
 - b. Abuse functions of sidewalk;
 - c. Inadequate safety facilities such as failure installation of speed limit for motor vehicles that do not equipped with traffic sign and mark;
 - e. Lack or not installation of safe crossing facilities;
 - f. Inconsistent land use that stated in master plan/urban spatial planning.
2. As the recommendation, it needs some improvements for safety level related to the recommendations of pedestrians safety and facilities that can be shared in long, medium, and short term solutions as follows:
 - a. Short Term Solution:



- 1) The existence of pedestrians safety facilities in urban areas, such as the zebra cross with speed hump as the adjustment speed, sign and mark, sidewalk, and median;
 - 2) Laws that regulate in detail related to the technical specifications and requirements regarding safety facilities for pedestrians.
- b. Medium Term Solution:
- 1) Socialization for all citizens to respect pedestrians safety and facilities to comply marks and signs such as speed limit sign;
 - 2) Traffic education that starts from children basic education.
- c. Long Term Solution:
- 1) Land use in accordance with spatial urban planning;
 - 2) Law enforcement with strict penalties.
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