Spatial Analysis in Determining Physical Factors of Pedestrian Space Livability, Case Study: Pedestrian Space on Jalan Kemasan, Yogyakarta

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Spatial Analysis in Determining Physical Factors of Pedestrian Space Livability, Case Study: Pedestrian Space on Jalan Kemasan, Yogyakarta

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Abstract. The existence of street as a place to perform various human activities becomes an important issue nowadays. In the last few decades, cars and motorcycles dominate streets in various cities in the world. On the other hand, human activity on the street is the determinant of the city livability. Previous research has pointed out that if there is lots of human activity in the street, then the city will be interesting. Otherwise, if the street has no activity, then the city will be boring. Learning from that statement, now various cities in the world are developing the concept of livable streets. Livable streets shown by diversity of human activities conducted in the streets' pedestrian space. In Yogyakarta, one of the streets shown diversity of human activities is Jalan Kemasan. This study attempts to determine the physical factors of pedestrian space affecting the livability in Jalan Kemasan Yogyakarta through spatial analysis. Spatial analysis was performed by overlay technique between liveable point (activity diversity) distribution map and variable distribution map. Those physical pedestrian space research variable included element of shading, street vendors, building setback, seat location, divider between street and pedestrian way, and mixed use building function. More diverse the activity of one variable, then those variable are more affected then others. Overlay result then strengthened by field observation to qualitatively ensure the deduction. In the end, this research will provide valuable input for street and pedestrian space planning that is comfortable for human activities.

Keywords: Pedestrian space livability, spatial analysis, Yogyakarta

1. Introduction

People utilize streets for their activities on daily basis, as streets are the main public spaces in cities [1,2].Therefore, to underpin its function, streets should accommodate many aspects such as economic, aesthetic and social aspects [3,4]. Economic aspects related to commodity circulation, aesthetic aspects related to positive image and visual element; and social aspects related to diversity of human activities conducted in the streets' pedestrian space. Jacobs [5] has pointed out that if there is lots of human activity in the street, then the city will be interesting. However, reality shown that usually streets are dominated by vehicles rather than human activities. It is shown that most of the city has lost its attractiveness.

Based on previous mentioned facts, various cities in the world are now developing the concept of livable streets. They enchanted pedestrian space to increase activities conducted there. According to

Jacobs, Jacobs, and Krier [5–7], livable streets shown by diversity of human activities conducted in the streets' pedestrian space in various range of time. Livable Street is increasingly becoming a vital factor of city attractiveness. Given the importance, this paper calls into question what is the main factor that influence streets' livability. Many proceeding research focusing on general concept of livable street theory and its purpose, therefore this paper focus in how physical aspect of pedestrian space influence streets' livability which is indicated by activity diversity. The research located is in Jalan Kemasan, Kotagede, Yogyakarta, because it shows diversity of activities in various range of time.

2. Methods

In order to analyze factors that influence streets' livability, deductive approach was selected because it is one of the most practical methods that represent a viable alternative to inductive approach. It allowed researcher to observe conceptual variable directly. Conceptual variable mentioned consist of three attributes: safety, comfort and building function. The selection of these three attributes based on the most commonly attributed determinant by experts as can be seen in Table 1 and Conceptual variables then break down into operational variable as display in Table 2. Spatial analysis was performed by overlay technique between livable point distribution map and operating variable distribution map (Figure 1). The results then strengthened by field observation to find the physical factors of pedestrian space livability.

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Table 1. Livable streets conceptual variables based on experts

Livable Streets Conceptual Variable	Appleyard(1981)	Jacobs, J (1961)	Jacobs, A (1993)	Lusher et. al (2008)	*The American Institute of Architects* (2005)	*Schmitz and Scully* (2006)	Simonds (1994)
Safety	**v**	**v**	**v**			**v**	**v**
Comfort	**v**	**v**	**v**				**v**
Building function		**v**		**v**	**v**	**v**	
Variation of accessibility					v	v	
Social relation	v		v				
Economic improvement factor		v		v			
Level of identity strength			v		v		
Vehicle speed	v			v			
Pedestrian dimension			v	v			
Integral circulation			v				v
Traffic volume	v				v		
Visual interest		v					
Public health				v			
Landscape conservation					v		

Table 2. Livable streets operating variable

Conceptual Variable	Operating Variable	Measure
Comfort	1. Element of shading	Shading vegetation and roof shade or building canopy
	2. Street Vendors	Street vendors that giving access to pedestrian
	3. Building setback	Short setback building
	4. Availability of seat in pedestrian way	Seat or bench or stool available
Safety	5. Divider between street and pedestrian way	On street parking and tree lined curb
Building function	6. Mixed use building function	Vertical and horizontal mixed use building function

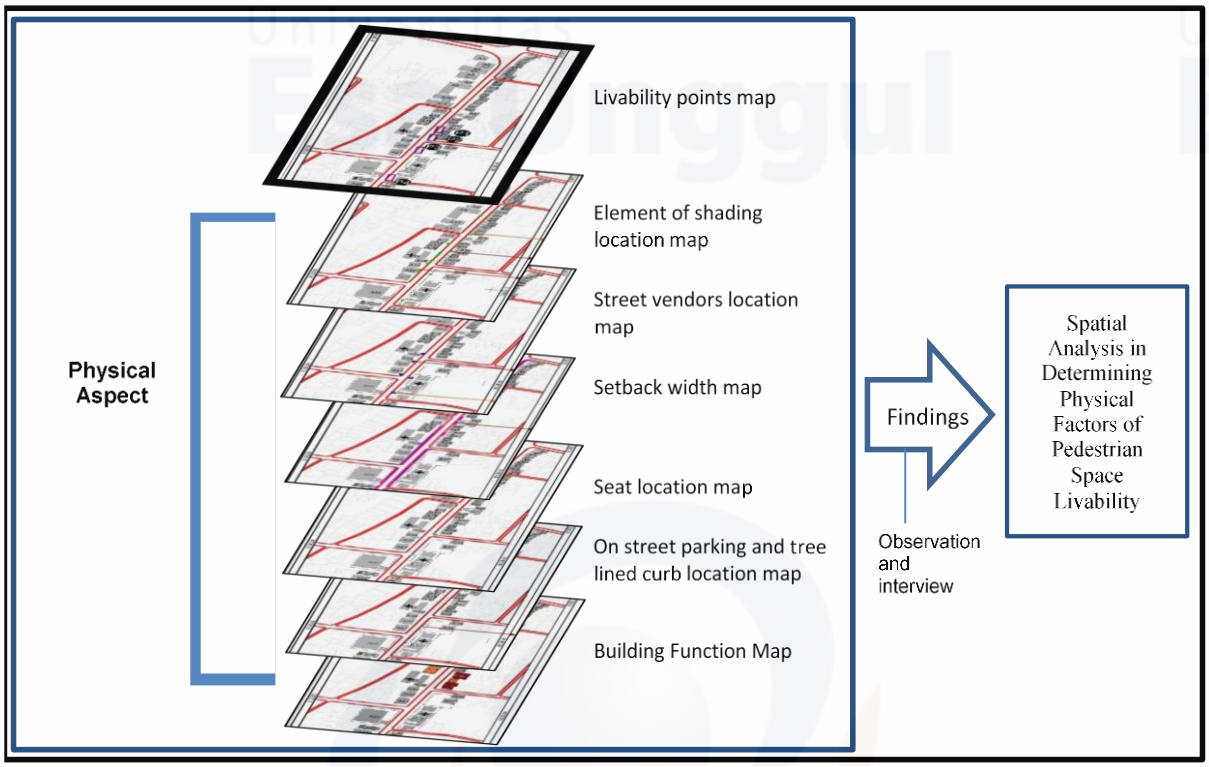

Figure 1. Spatial analysis method in determining physical factors of pedestrian space livability on Jalan Kemasan

Observation points of this study were determined through mapping on the most vociferous point or the most active point in Jalan Kemasan. Moudon [8] noted that those activities grouped into two kind of activities, dynamic and static activity. Whereas, the ideal number of pedestrian ranged from 8 to 18 pedestrians per minute per meter. Observation points which have less than 8 pedestrians per minute tend to be inanimate, while the spot which has 18 pedestrians felt over crowded. Observation time divided into two periods, morning and afternoon. Observation in the morning performed between 07.00-11.00 WIB, while in the afternoon observation performed between 12.00-16.00 WIB. It was chosen because most of the activities happened around that time. Observation conducted on weekday to minimize count up tourists from outside Yogyakarta.

3. Result and Discussion

Observation shows that static and dynamic activity occurs at Jalan Kemasan. Static activities consist of sitting, talking, eating, standing, or waiting for others. While dynamic activity shown by walking. All these activities occur all day long, either morning or afternoon. There were 10 most livable points based on the number of activity occurred. Those points shown in the figure 2 and figure 3. Spatial analysis performed by overlay technique between livable point distribution map and operating variable distribution map. The more variable found in livable points, the more it affects the livability. Overlay results shown in the figure 4.

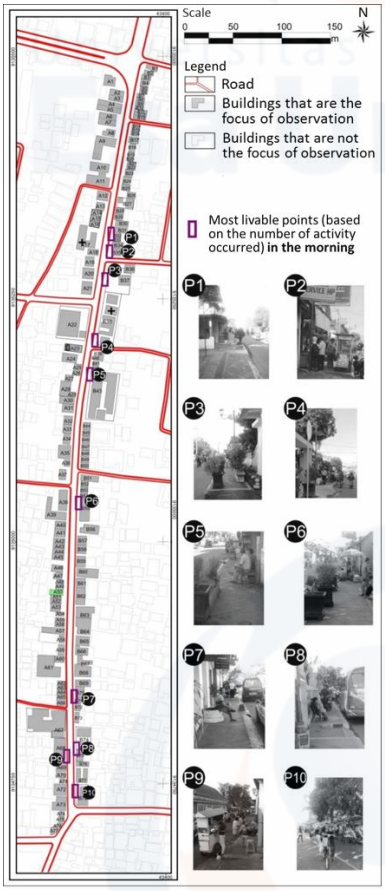

Figure 2. Most livable points map in the morning

Figure 3. Most livable points map in the afternoon

P1 – P10 dots show most livable points in the morning, whereas S1-S10 dots show most livable points in the afternoon. Quantity and kind of activity occurred in those points are shown in table 3.

Table 3. Number and kind of activity occurred in most livable points (people/meter/minute)

Points	Dynamic Activities	Static Activities							Quantity
	walking	sitting	standing	talking	squatting	sweeping	eating	snacking/shopping	playing	
Most livable points map in the morning										
P1	5	1	2							8
P2	5	1					1	2		9
P3	5	2	1							8
P4	5	3	1	3	1		1			14
P5	6	3		2						11
P6	6	1		2	1			3		13
P7	9	3	1	2	1					16
P8	8	2		2				2		14
P9	7	1	1	2			2	2		15
P10	9	2		2			2	3		18
Most livable points map in the afternoon										
S1	5	1	1			1				8
S2	4	1	1						2	8
S3	3	2		2	1			1		9
S4	5	1	1					1		8
S5	4	2						2		8
S6	4	2		2						8
S7	6	1	1	2						10
S8	5		2			1				8
S9	6	2	2	2						12
S10	7	2	1	2			1	1		14

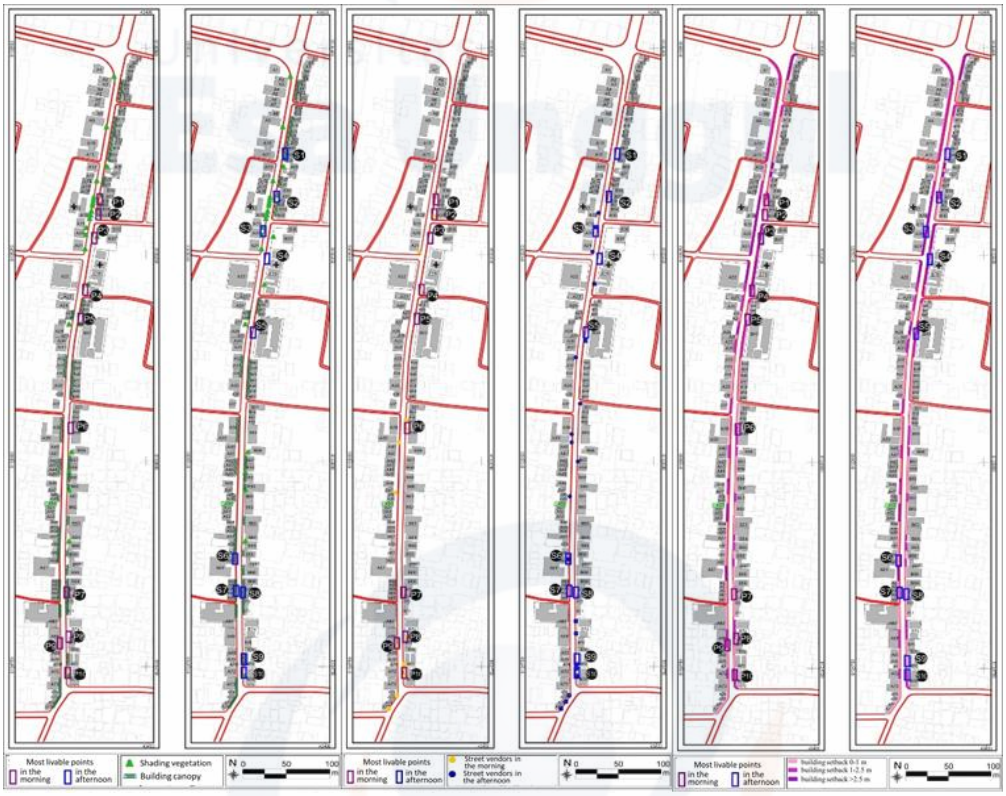

Figure 4. Overlay technique between livable point distribution map and operating variable distribution map: (a) element of shading; (b) street vendors; (c) building setback (d) seat location; (e) divider between street and pedestrian way; (f) mixed use building function

Furthermore, in order to obtain outcome, conductive overlay done between livable points map and all variable distribution map (Figure 5). Overlay results shown in the Table 4.

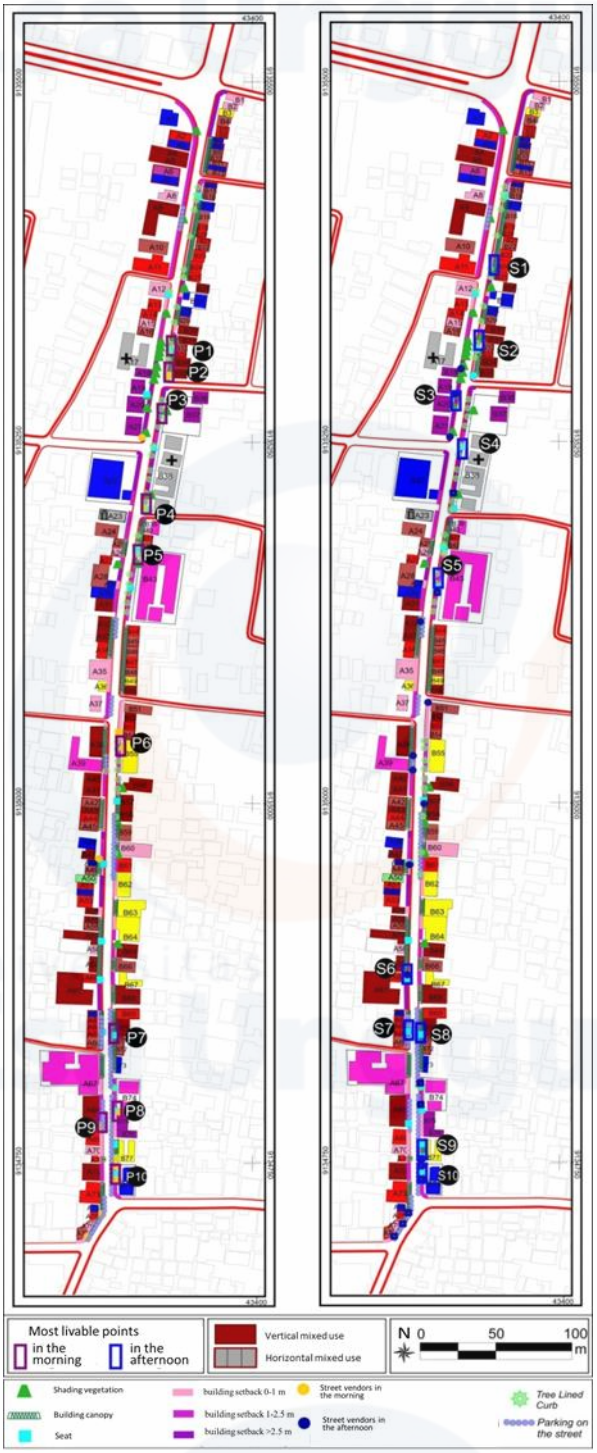

Figure 5. Final overlay results

Table 4. The linkage between livable points (activities) and all variables (physical factors)

Points	Dynamic Activities	Static Activities	Total Activities	Element of Shading		Street vendors that giving access to pedestrian	Building setback			Seat	divider between street and pedestrian way		Mixed use building
				Shading Vegetation	Building Canopy		Building setback 0-1 m	Building setback 1-2.5 m	Building setback > 2-.5 m		Parking on street	Tree lined curb	
in the morning													
P1	5	3	8	v	v		v					v	v
P2	5	4	9		v	v	v			v			v
P3	5	3	8	v					v			v	v
P4	5	9	14	v		v		v		v		v	v
P5	6	5	11	v				v		v		v	v
P6	6	7	13			v		v		v		v	v
P7	9	7	16		v		v			v	v		v
P8	8	6	14			v		v		v	v		v
P9	7	8	15			v		v		v	v		v
P10	9	9	18	v		v		v		v	v		v
in the afternoon													
S1	5	3	8	v	v		v					v	v
S2	4	4	8	v				v					v
S3	3	6	9	v		v			v	v			v
S4	5	3	8			v		v		v		v	v
S5	4	4	8	v		v		v		v		v	v
S6	4	4	8		v	v	v			v			v
S7	6	4	10		v		v			v	v		v
S8	5	3	8		v		v				v		v
S9	6	6	12		v		v			v	v		v
S10	7	7	14	v		v		v		v	v		v

Based on the results of overlay and morning-afternoon observation, it revealed 3 physical factors that affect Jalan Kemasan livability the most. Those are: divider between street and pedestrian way, element of shading, and availability of seat in pedestrian way. The linkage illustrated on the figures 6.

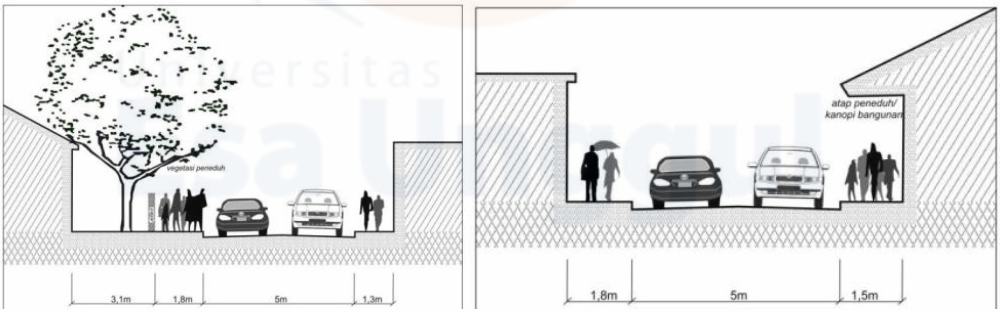

Figure 6. The linkage between element of shading and activity

Figure 6 shown that street with shading, either by a tree or building roof, have much more activity than other part without shading. It relates to sun exposure, which pedestrian feels more comfortable perform their activity under shading. In the afternoon, where sun exposure is higher, almost every activity done under shading. In line with Jacobs [9] and Simonds [10] that said trees and any other shading material is substantial to create pedestrian comfortness.

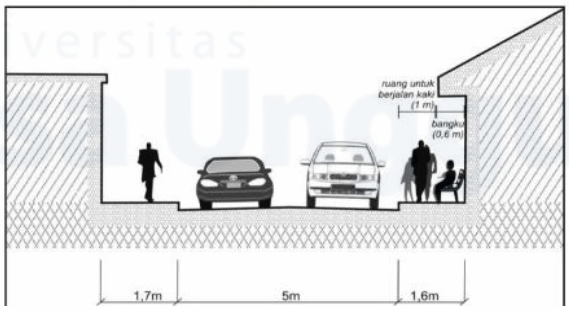

Figure 7. The linkage between availability of seat and activity

Figure 7 shows that the side of the street with seat has more activity than the side that do not. In line with what is said by Jacob [5]and Appleyard [6], availability of seat is important because it relates to pedestrian comfort. It functions as spot to sit, chat and rest.

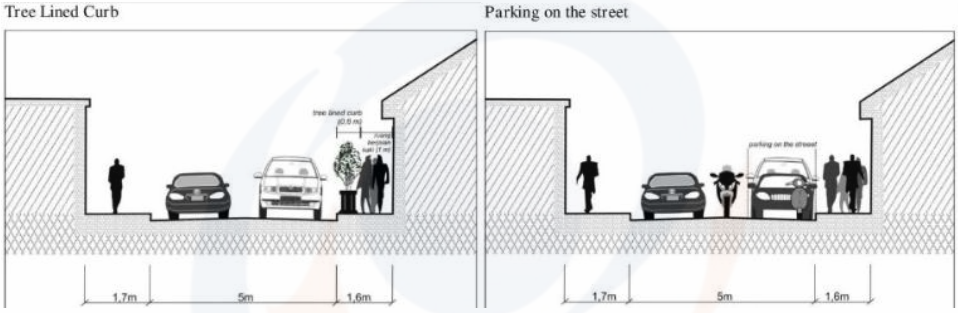

Figure 8. The linkage between divider of pedestrian way and activity

Pedestrian way with divider such as tree lined curb and parking-on-the-street vehicle have much more activity than the one which do not (Figure 8). The divider between street and pedestrian way improves sense of security from traffic accident. This sense of security also arises from the difference height between pedestrian and road. However, Jalan Kemasan pedestrian and road have relatively the same high, spots with tree-lined curb and parking-on-the-street vehicle make act as divider giving the same security sense. In addition, the presence of other aspects such as street vendors, building setbacks, and mixed use building function also affect pedestrian space livability (Figure 9). Although, those aspects effect are not as big as the first three.

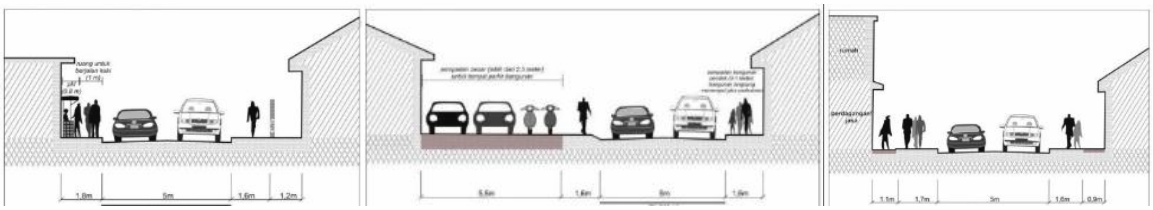

Figure 9. The linkage of other variable
(street vendors, building setbacks, and mixed use building function)

The presence of street vendors relates to the ability to attract people to engage and interact. In accordance to Jacobs [5] that street vendors in pedestrian space able to intensify activity numbers. However, in Jalan Kemasan, it needs to underpin that street vendors who support the sense of security are street vendors who do not use the entire pedestrian way and still give access to pedestrian. Whereas, street vendors who use all pedestrian way raises sense of discontent and harbors accidents.

Furthermore, the existence of a short setback building (0-1 meters) correlates with the security of the pedestrian. It provides pedestrian way sustainability and heat shading. Whereas, mixed use building function relates to make Jalan Kemasan more interesting by doing various activities. This is in line with Jacobs [5] and Schmitz and Scully [11] that said mixed use building more affect diversity of pedestrian then non mixed use building.

4. Conclusion

The research revealed that presence physical factor such as element of divider between street and pedestrian way, element of shading, and availability of seat greatly affects Jalan Kemasan pedestrian way livability. In addition, other factors such as street vendors, building setbacks, and mixed use building function also effect livability only in small portion. In general, these findings suggest more human pedestrian way planning. Pedestrian way need to be more livable and gives space to create activity. This research leads us to better way to plan pedestrian way by considering these things:(A) Continuous pattern of shading to protect pedestrian from sun exposure. In the city center such as Jalan Kemasan, building roof is an effective example of shade. The widths of the building's roof located next to the street should be at least 1.25 meters to fully cover pedestrian activity.(B) Increasing pedestrian security by adding differentiation of altitudes between the pedestrian way and the street, arrange tree lined curb orderly and allowing on-the-street parking. On-the-street parking is only permitted if there is suitable width and brings no potential traffic issues. (C) Providing comfortable seat or bench in a pedestrian way in order to accommodate pedestrian who need to take a rest. Observations showed that many pedestrian sit on pots, hallways, or pedestrian pavement. This shows the importance of seat availability.(D) Buildings with large setback should be avoided, especially those that do not have fence and permanent parking garage. It will courage inaccessibility. Building with short setback is very good for pedestrian. It creates the continuity of the pedestrian way and provides shading to protect pedestrian from sun exposure. (E) Arranging street vendor to assist pedestrian continuity. Space provide by street vendor should courage comfort and safety. (F) Buildings located in the next the street should be made in order to have mixed use function This research shows that mixed use buildings have more varied function, thus it courage more activies.

5. References

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