A PEDESTRIAN-WAYS RE-ARRANGEMENT BASED ON STAKEHOLDER PERCEPTION IN ORDER TO EMPHASIZED USER'S WALKING EXPERIENCE (CASE STUDY: ENGGAL, BANDAR LAMPUNG CITY, INDONESIA)

Zenia F Sarasawati, Imma Widyawati Agustin, Johannes Parlindungan
Urban and Regional Planning Departement
Faculty of Engineering, University of Brawijaya
Malang, Indonesia
zenia.fenfanda@yahoo.com

Abstract— **Enggal area is a public space which consist open space, sports stadium, offices, settlement, and commercial buildings. Located in the downtown of Bandar Lampung City, Enggal is an area with high traffic of pedestrian. This research is conducted to formulate a design concept of pedetrian-ways which accentuate to emphasized pedestrians walking experience when walking and also increasing society interest to walk more. To emphasised pedestrians walking experience, it consist of three main principle designs of pedestrian-ways which is safety, convenience and pleasure. Collaborating with pedestrians characteristic analysis, behaviour setting analysis, pedestrian-ways geometric analysis, analytical hierarchy process and multi criteria analysis which is consist of experts and the users, Enggal area's diversity index of space shown 0,86 means the research area has a high democratic value which consist of vary elements of user. Pedestrians behaviour in synomorphic and milleu captured limited walking space of pedestrians. Pedestrians who walk with their spouse don't able to walk abreast and needs change their position into parallel when they are crossing pedestrian ways with other pedestrians. Pedestrians behaviour setting shows they are in inconvenience level as a pedestrian. They need to get out from pedestrian ways to the main road in order to averse the cadgers and broken sidewalk. The concept of pedestrian ways arrangement based on stakeholder perception shows the ranking priority of every elements from safety, convenience and pleasure which is need to be prioritized such as flat and smooth pedestrian ways design, free of cadgers and the pattern of shading plants placement.**

Index Terms— **Pedestrian-ways, stakeholder-perception, urban-design.**

I. INTRODUCTION

Pedestrian ways as a part of transportation's infrastructure must be able to serve all society needed, especially pedestrians. Pedestrian ways existance, as part of transportation infrastructure should be kept because walking is one of the transportation part (Tamin, 2010).

Various research have been conducted to develop a pedestrian ways design which able to accomodate pedestrians needs such pedestrian ways improvement to emphasized elderly to walking. This study develop a pedestrian ways design to accomodate elderly needed. Then the result are stairs degree of slope, zebra cross, vegetation variant, bus and trams shelter, facade design of building and park are emphasized elderly to walk in the pedestrian ways (Hieronymus C. Borst, 2008).

There are three main criteria to emphasized pedestrians walking experiemce whose safety; means protect pedestrians from accidents, convenience; means availibility and accessibility to walking, and pleasure; means pedestrian ways utilization in harmony [1]. Planning, development and maintenance process of pedestrian ways in cities conducted by stakeholders in multi diciplines capability such as government, lecturer, planners and other society involvement. Society participation is opinion or considerations about utilization and facilities of pedestrian ways planning (The Provision and Utilization Guidelines Pedestrian ways Infrastructure in Urban Space, 2008).

According to Bandar Lampung spatial planning document 2010-2030, Enggal area will be deleveped into green space and big public spaces which accomodate community needs and activity. Enggal area's land use shows the high density activity of buildings allows community to walking and moving from one building into another (Fig. 1), but the existing pedestrian ways condition isn't able to accomodate pedestrians needs. It's shown by pedestrian ways condition such as unavailibity street furniture, disability facilities, and a lot of distraction from street vendor who sell in pedestrian ways.

II. METHODS

A. Study Area

The study area of this research are Majapahit St, Sriwijaya St, Jendral Sudirman St and Tulang Bawang St as a part of Enggal Area which located in the downtown of Bandar Lampung city. Study area land use contains open space, sports stadium, offices, settlement, and commercial buildings.

This research divided those four corridors into six observation segment. Each segment has two zone, Zone A and Zone B (Fig.1). Intersection selected as the segment boundary because due instersection, pedestrian ways connectivity is disconnected. Each zone of segment has an observation spotted by pedestrians tendency accross the corridor.

Fig. 1. **Enggal area's segment and zone**

B. Participant

In this research, stakeholder defined as an individual or groups who have a role to compose a policy [2]. Stakeholder who choosen in this research divided into two groups. The first is experts, contains five persons of government and lecturer. Experts used to obtained their perception to select the pedestrian ways design criteria to emphasized pedestrians walking experience given by questionnaire. Experts choosen are from Transportation departement of Bandar Lampung city, Urban planning departement of Bandar Lampung city, Public works departement of Bandar Lampung city, Landscape departement of Bandar Lampung city and Civil engineering lecturer of Lampung university.

The second is pedestrians, as a user. Using accidental sampling technique, sample taken from pedestrians who walk on the pedestrian ways when peak hours (Table I). The peak hours is at 7-8 AM in the morning, 12 AM - 1 PM in the afternoon and 5-6 PM in the night [3]. Based on Bernoully sampling calculation with 5% degrees of error, total pedestrians needed to get the perception as sample are 96 persons [4].

TABLE I. NUMBER OF PEDESTRIANS SAMPLES

Segment	Total	Morning	Afternoon	Night
1	16	5	5	6
2	16	5	5	6
3	16	5	5	6
4	16	5	5	6
5	16	5	5	6
6	16	5	5	6
Total: 96 Persons				

C. Procedure

It's how the research conduct to implemented a pedestrian ways re-arrangement design based on stakeholder perception in Enggal area, Bandar Lampung City, Indonesia. Started from identify the pedestrian ways problem, the process formulated ways to develop the solution (Fig. 2).
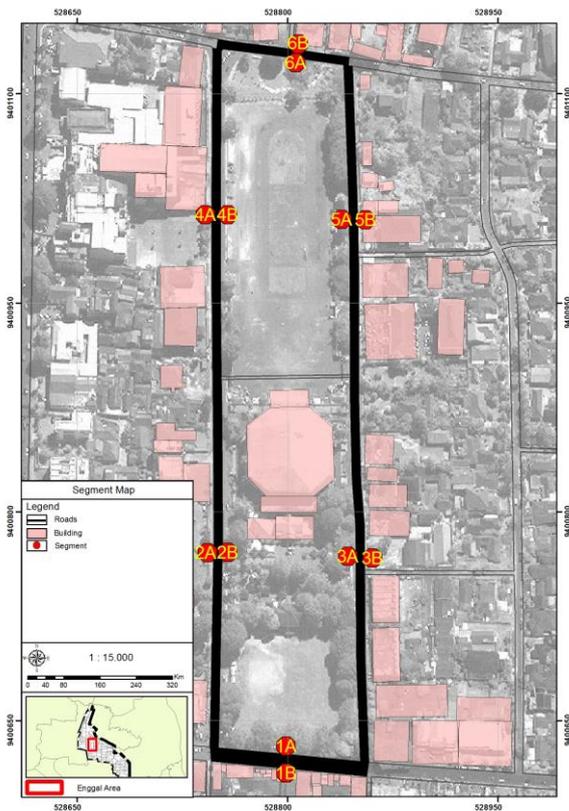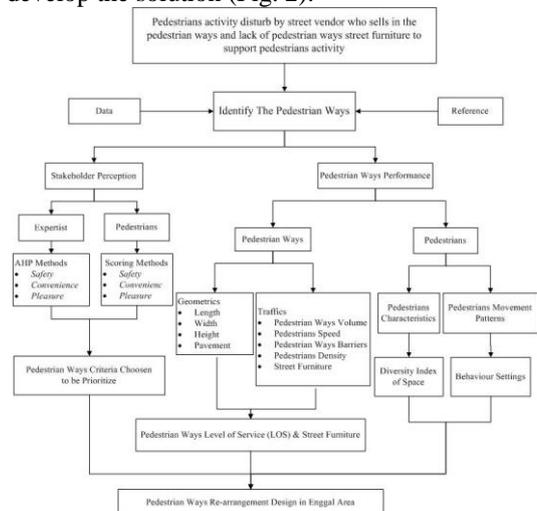

Fig. 2. **Research framework**

D. Behaviour Settings

This analysis conducted to determine pedestrians behaviour when walking through study area. Identify pedestrians behavour leads us to know the relationship between physical environment of pedestrian ways spatially space with the activities of individual or group of pedestrians for a certain time. Pedestrians behaviour presented in the form of tabulation and translation done for each segment of study area. Time to observe choose in the morning, afternoon and night peak hour. The steps for this analysis started from identify pedestrians behaviour, analyze pedestrians movement based on the standing pattern criteria of behaviour, milleu and temporal time [5].

Then it's associated with indicators criteria of pedestrian ways design criteria in order to emphasize pedestrians walking experience (Table II).

TABLE II. INDICATORS OF PEDESTRIANS MOVEMENT PATTERNS ANALYSIS

Criteria	Indicators
Safety	Do not tripped due pedestrian ways height differences
	Do not fall into hole/ pedestrian ways damage pavement
	Do not hit by vehicles passing
	Able to crossing easily without getting hit
Convenience	Walk slowly over 0,5 sec
	Able to walk in a row up with partner, do not have to line up or titting when walking
	No disturbance from street vendors who sells in pedestrian ways
Pleasure	Walk in the pedestrian ways, not the roads
	Not affected by rain, there are shading trees

E. Statistical Analysis

1) Diversity index of space

The existence of people and it's role in space is important to review a space publicity. Good public space should be contains three instrinsic value; democratic, meaningful and responsive. One important aspect of democratic public space is availability

and good accessibility. Then it will encourage the utilization of public space by diverse users. Diversity can be measured from diversity of age, gender and others.

$$D = \sum \left(\frac{n}{N}\right)^2 \qquad (1)$$

D = Diversity,
n = number of person in specified category,
N = number of person of all category.

Simpson diversity index is a common technique used in biological diversity realm of environmental science despite, this technique can be used in public space utilization measurement because it has a similiar principle[6]. Diversity principle used as the basic principle of public space nature. Public space everness have to accommodate diverse activities and user. Public space shouldn't be domininated by any individuals or group. Result of this analysis is an index range 0-1. Maximal value indicates the public space has a high level of diversity. Essentially, public space should have a high heterogeneity due the role as place for society interaction and communication.

2)   Analytical Hierarchy Process

This analysis basically designed to capture stakeholder perception. Strongly associated with various alternatives preference, this methods widely used to make a decision from several criteria, plans, resources allocation, and prioritize strategies in conflict situations.

Analytical hierarchy process is a simplification of unstructured complex problem into an arranged hierarchy. Importance level of each variabel subjectively rated in numerical significance.

Using analytical hierarchy process, aloows stakeholder to soften their definition on problems and improve their consideration and in repetition. Comparative scale used for calculate variabel prioritized.

3)   Multi Criteria Analysis

This analysis is one of the decision making methods used to compare alternative solution as well choosen the best alternative. It is also consider a criteria may relatively less or even more important than other criteria. Relative nature called weight or weighting criteria specified by planners and policy makers at the local, regional or even national level. Simple steps suggested to develop the result are determine and classify the criteria, measurement of criteria who have been grouped by score, and standardizing existing scores.

III. RESULTS

A. Pedestrians Characteristics

Identifying pedestrians characteristics provide an overview about pedestrian ways utilization. About 41,7% pedestrians age are 16-2- years old. It's shows teenagers loved to visit Enggal area. Enggal area being so crowded in the night because most of people tends to walking in the night (5-6 PM) **(Table III).**

Enggal area is one of the popular destination in downtown of Bandar Lampung city because of the malls, public space, art market, food restaurant and street vendors existence. Usually, pedestrians who visited intends to visiting Enggal area as their main purpose or destination. Therefore, much pedestrians starting point of walking begins inside Enggal area itself. Pedestrians who visited usually comes using motorcycle, car, public transportation or walking**.**

Fig. 3. **Pedestrian ways existing conditions**

However, because numbers of street vendor who sells above pedestrian ways and the broken pavement, causing about 59,4% pedestrians avoid to walking and move into roads to walks **(Fig 3).** Mostly pedestrians interest to walk on the roads indicate pedestrian ways condition need to be improved so it can attract pedestrians to walking in pleasure and do not endanger their safety.

TABLE III.   PEDESTRIANS CHARACTERISTICS OF ENGGAL AREA

Pedestrians Characteristics	
Age:	
0-5	6,3%
6-10	11,5%
16-20	41,7%
21-35	20,8%
36-55	13,5%
56-65	6,3%
Gender:	
Male	64,6%
Female	35,4%
Origins:	
Inside Enggal Area	79,2%
Outside Enggal Area	20,8%
Destination:	
Commercial Buildings	9,4%
Recreation/ Walking Around	28,1%
Accross	13,5%
Working	3,1%
Enggal Open Space	34,4%
Others	11,5%
Place to Walking:	
Pedestrian ways	59,4%
Roads	40,6%

Based on pedestrians characteristics questionnaires result, we can identify Enggal area space health. Using simpson diversity index shows the the result is 0,86. It means Enggal area has a fairly high heterogeneity. It is good, because shows us Enggal area able to facilitate people to interact and communicate without any group dominate. Enggal area as a public space, one of essential elements made the city works.

B. Pedestrian Ways Characteristics

Enggal area's pedestrian ways has 1,5 meters width and 20 centimeters height. Generally, pedestrian ways existing condition is poor. Mostly the pedestrian ways pavement was broken and lack of street furniture.

Geometric conditions of existing pedestrian ways in Enggal area analyzed and compliance with existing standards and it's level of service. This analyis aims to assess geometric pedestrian ways performance conditions. The following

calculation is to obtain the pedestrian ways level of service in Enggal area.To identify pedestrians density, first we have to know the number of pedestrians and the effective pedestrian ways width.

1)   Level of service

Pedestrian ways level of service shown mostly activity and pedestrians increase from morning to night also weekdays to weekend (Table IV) and cause the pedestrian ways crowded in the night. For the example is pedestrian ways in Segment 2A, Sriwijaya St. The level of service is being worse from morning to night (Table V). This condition happened because of the effective width decreasing. Effective width of pedestrian ways is decreasing because mostly street vendors started to open and

selling above pedestrian ways at 5 PM **(Fig. 4).** This condition potentially raise intersection between pedestrians when walking or moving. Pedestrians usually walking slowly because the space is limited.

Each zone has a different level of service because of the pedestrians number and width differences. Therefore, adequate pedestrian ways width is needed to be implemented by increasing width and reguated non-pedestrians presence activity which barrier and reduce pedestrian ways width. So it can accomodate pedestrians properly. In addition, street furniture provision is needed to facilitate pedestrians and provide a great walking experience.

TABLE IV. **ENGGAL AREA PEDESTRIAN WAYS'S LEVEL OF SERVICE (WEEKDAYS)**

Segment	Location	Density			Pedestrians Space			Level of Service		
		Morning	Afternoon	Night	Morning	Afternoon	Night	Morning	Afternoon	Night
1A	Jendral Sudirman St.	0,25	0,35	0,36	4,01	2,87	2,79	B	C	C
1B		0,10	0,04	0,11	10,40	22,27	9,22	A	A	A
2A	Sriwijaya St	0,24	0,31	0,42	4,09	3,26	2,39	B	C	C
2B		0,23	0,41	0,83	4,40	2,44	1,20	B	C	D
3A	Majapahit St.	0,08	0,41	0,78	12,51	2,47	1,28	A	C	D
3B		0,17	0,22	0,72	5,93	4,47	1,39	A	B	D
4A	Sriwijaya St.	0,15	0,31	0,85	6,52	3,27	1,18	A	C	D
4B		0,11	0,29	1,16	9,02	3,47	0,86	A	B	C
5A	Majapahit St.	0,08	0,34	0,57	12,10	2,95	1,75	A	C	D
5B		0,15	0,31	0,42	6,67	3,23	2,40	A	C	C
6A	Tulang Bawang St.	0,03	0,21	0,23	34,87	0,21	0,23	A	B	B
6B		0,05	0,2	0,2	20,56	5,01	5,1	A	B	B

TABLE V. **ENGGAL AREA PEDESTRIAN WAYS'S LEVEL OF SERVICE (WEEKEND)**

Segment	Location	Density			Pedestrians Space			Level of Service		
		Morning	Afternoon	Night	Morning	Afternoon	Night	Morning	Afternoon	Night
1A	Jendral Sudirman St.	0,26	0,36	0,36	3,91	2,77	2,75	B	C	C
1B		0,10	0,06	0,11	9,82	16,04	8,74	A	A	A
2A	Sriwijaya St	0,25	0,32	0,44	3,97	3,16	2,30	B	C	C
2B		0,23	0,41	0,88	4,27	2,46	1,13	B	C	D
3A	Majapahit St.	0,08	0,42	0,81	12,31	2,39	1,23	A	C	D
3B		0,18	0,23	0,75	5,69	4,27	1,33	A	B	D
4A	Sriwijaya St.	0,16	0,32	0,86	6,31	3,13	1,17	A	C	D
4B		0,12	0,3	1,2	8,65	3,35	0,83	A	C	E
5A	Majapahit St.	0,09	0,37	0,61	11,22	2,67	1,65	A	C	D
5B		0,16	0,33	0,44	6,37	3,05	2,29	A	C	C
6A	Tulang Bawang St.	0,03	0,22	0,23	20,54	4,5	4,27	A	B	B
6B		0,05	0,2	0,2	18,74	4,91	5,07	A	B	B

Fig. 4. **Enggal area's existing condition**
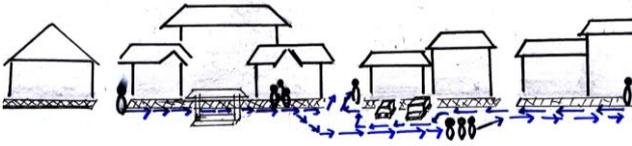
C. Pedestrians Movement Patterns

Fig. 5. **Milleu of Segment 3**

1) Standing Pattern of Behaviour

Researcher find pedestrian ways utilization by 5 persons, 2 in pairs and 3 in groups. Pedestrians dominated by man ages 16-20 years old. Pedestrians behaviour pattern in Segment 3 when night (5-6 PM) are:

a) Pedestrians walking up and down.

b) Pedestrians changing their position when walking.

c) Pedestrians walking on the road.

d) Pedestrians stop for a while and look around when walking.

2) Synomorphic

a) Pedestrians walking up and down because the pedestrian ways pavement has a different height and disconnected.

b) Pedestrians change their position from walking in row into line up because of street vendors who occupied mostly pedestrians width.

c) Street vendor obstacle pedestrian ways around in front of the mall and made pedestrians should down into the road and walking on the road to continue their journey.

d) There are street vendor and good atmosphere around Enggal's public space made pedestrians looking around meanwhile walking and sometimes stopped for a moment to buy something.

3) Observation Time

Night (5- 6 PM). Dominated by people who walking for evening walk and enjoying the Enggal area's atmosphere.

4) Indication

a) Height differences condition of pedestrian ways made pedestrians walking carefully to avoid strumble or fall. It's indicating the less safety criteria.

b) The existance of street vendor on the pedestrian ways classified as an obstacle. Because it's made pedestrians move down into the road. It made pedestrians do not pleasure to walking and indicating the less pleasure criteria.

5) Planning

a) Adding ramp on the pedestrian ways which the pedestrian ways had a different height

b) Negation of obstacle by controlled street vendors to do not occupied pedestrian ways, so pedestrian ways is free and pedestrians able to walking easily.

D. Stakeholder Perception

Analytical hierarchy process find out choosen criteria prioritized of pedestrian re-arrangement in Enggal area. Criteria prioritized done based on stakeholder perception because in planning, development and maitenance of pedestrian ways made by the related stakeholder both municipilities, planners and any other parties.

Based on five experts opinions, prioritized criteria for pedestrian ways re-arrangement in Enggal area is pleasure because it has highest number of vector priority **(Table VI).** Experts perception revealed consistent because the consistency ratio is below 0,1.

Pleasure defined everything that shows space utilization in harmony, related with environment physical condition which could be seen on pedestrian ways facilities and space arrangements.

TABLE VI. PRIORITY VECTOR OF STAKEHOLDER PERCEPTION

Criteria	Total Score	Vector Priority	Ratings
Safety	1,17	0,391	II
Convenience	0,46	0,152	III
Pleasure	1,37	0,456	I

Collaborating with analytical hierarchy process analysis result, the multi criteria evaluation result as the final result shows the biggest priority to be implemented in pedestrian ways re-arrangement result in Enggal area is pleasure concept **(Table VII).**

TABLE VII. TOTAL CRITERIA'S SCORE AND WEIGHT BASED ON STAKEHOLDER PERCEPTION

Criteria		Weight	Score	Weighted Score
Safety	Pedestrian ways circumstances (not slippery/broken)	0,391	2,99	1,17
	Pedestrian ways don't stumbling pedestrians		3,05	1,19
	Separation between Pedestrian ways space and road		3,08	1,20
	Separation availibility		3,07	1,20
	Plants availibility as a physical separation		3,06	1,20
	Lightning availibility		3,09	1,21
	Markers availibility for difable pedestrians		3,07	1,20
Convenience	Pedestrian ways circumstances (not slippery/broken)	0,152	3,07	0,39
	Pedestrian ways don't stumbling pedestrians		2,58	0,42
Pleasure	Pedestrian ways availibility for pedestrians	0,456	4,02	1,83
	Flat pedestrian ways (not steep)		3,90	1,78

| Criteria		Weight	Score	Weighted Score
	Seating area availibility for pedestrians		4,20	2,91
	Shelter availibility		3,65	1,67
	Ramp availibility		4,21	1,92
	Tree/plants availibility		3,79	1,73
	Tree/plants locatiom		3,96	1,80
	Shading plant availibility		3,87	1,76
	Shading plants location		3,81	1,74
	Trash availibility		4,24	1,93
	Trash location		3,60	1,64
	Drainage availibility		4,23	1,93
	Drainage location		4,26	1,94
	Signage/information board availibility		4,29	1,96
	Signage/information board location		4,40	2,10
Result		1	87,19	36,75

E. Pedestrian Ways Re-arrangement Design
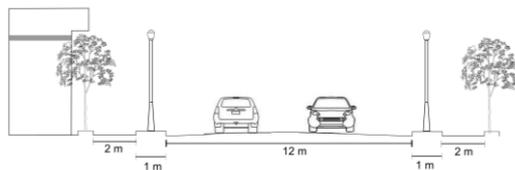
Fig. 6. **Enggal area's section**

Fig. 7. **Enggal area's pedestrian ways re-arrangement design**

Re-arrangement design will be implemented in Enggal area to emphasize pedestrians experience when walking. Re-arrangement contains adding pedestrian ways width from 1,5 into 2 meters without any street vendors occupation **(Fig. 6)**, fix and changes the pavement into an unslippery and equipped with difable lane, placing a seating area every 10 meters, adding ramp in intersection or building entrance to avoid pedestrian ways disconnected, adding shading plants every 10 meters, adding trash every 20 meters, adding lightning every 20 meters, re-designing Jendral Sudirman St.'s shelter and adding zebra cross to avoid pedestrians crashed by cars when accrossing from one zone to another **(Fig. 7).**

IV. CONCLUSION

Pedestrian ways performance based on pedestrians condition as the pedestrian ways users and pedestrian ways existing condition, we can conclude pedestrian ways utilization is dominated by 16-20 years old pedestrians. 64,6% pedestrians gender who dominated Enggal area is male. 79,2% pedestrians started to walking from the inside Enggal area itself because Enggal is their main purpose to walks. Mostly pedestrians choose their favourite time to walking is 5-6 PM but 59,4% pedestrians choose to walks in the roads than pedestrian ways because it's occupied by street vendor. From movement pattern indicated safety, convenience and pleasure criteria still uncomplete. Pedestrians behaviour settings result shows pedestrian ways pavement, ramps, pedestrian ways width, pedestrian ways street furniture and pedestrian ways separation from roas should be improved. All of pedestrian ways condition still can't fullfill pedestrian ways standard such as pedestrian ways effective width, pedestrian ways pavement etc. Based on stakeholder perception, priority vector of pleasure is 0,456 and prioritized as the criteria to be developed. So, pedestrian ways re-arrangement design to emphasize users walking experience in Enggal area contains adding pedestrian ways width from 1,5 into 2 meters without any street vendors occupation, fix and changes the pavement into an unslippery and equipped with difable lane, placing a seating area every 10 meters, adding ramp in intersection or building entrance to avoid pedestrian ways disconnected, adding shading plants every 10 meters, adding trash every 20 meters, adding lightning every 20 meters, re-designing Jendral Sudirman St.'s shelter and adding zebra cross to avoid pedestrians crashed by cars when accrossing.

REFERENCES

[1] Richard K Untermann, Accomodating the pedestrian: adapting towns and neighbourhood for walking and bicycling. New York: Van Nostrand Reinhold Company, 1984.

[2] William N. Dunn, Pengantar analisis kebijakan publik, Yogyakarta: Gadjah Mada University Press, 2003.

[3] Ofyar Z. Tamin, Perencanaan dan permodelan transporrtasi. Bandung: Penerbit ITB, 2000.

[4] Yuliver," Strategi peningkatan penggunaan terminal bingkuang di kota padan dengan menggunakan analisis kesenjangan", unpublished.

[5] Joyce Marcella Laurens, Arsitektur dan perilaku manusia. Jakarta: PT Grasindo, 2005.

[6] Johannes Parlindungan, "Good public space index", unpublished.