ESTABLISHING EFFECTIVE CONTROLS FOR URBAN PARKING BASED ON ZONING AND PARKING RATES IN THE CONTEXT OF SUSTAINABLE TRANSPORTATION

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1. BACKGROUND OF STUDY

- Parking is a significant urban transportation problem, especially in developing countries such as Indonesia, according to [7,11].

- These transportation problems in a developing country are a result of inefficient traffic patterns and lack of mobility caused by the increased use of private vehicles

- The city of Semarang, chosen as the study area, had a clearly-unsolved parking problem, even though "andalalin" (traffic impact analysis) has been required from all developers as they plan to build units including housing, department stores, hotels, restaurants, hospitals, and tourist destinations.

- This population growth has been followed by urban infrastructure development such as shopping centers, five-star hotels, recreation areas, offices, and housing units [14]

CAN SEE PICTURE PROBLEM PARKING UNSOLUTION IN SEMARANG CITY

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CRITICAL REVIEW OF THE STUDY

A parking study based on zoning was performed in Solo [1,3], which used a Revenue Model for the Zoning System (Revenue), involving the use of a classification system for on-street parking according to zone [12, 13, 14], specifically divided into 5 different parking zones which in implementation resulted in five-tiered parking rates [3,18].

IN Solo Revenue Model For The Zoning System

HOB 1995

In his paper, [8] explains there are several ways to define and create effective parking zones. One method is to classify by land use, differentiating between building types. Areas which consist of commercial buildings such as hotels, stores, theaters and offices will be placed in one zone, and residential areas will be placed in a different zone. Almost all parking and zoning rules currently use this method as a base reference.

The only city in Indonesia which enforces such zoning is Jakarta, although its zoning category is still classified as special zoning which is regulated in high traffic areas only

In Jakarta, Idnonesia

This paper Base on Zonning With AHP

The difference in the scope and detail of the research presented in this paper is the specific objective: to be able to determine equitable parking rates for off-street parking by considering the related buildings as well as the overall zoning system, using the method of Process Hierarchy Analysis (AHP)

OBJECTIVE OF STUDY

The purpose of this research is to:
1) determine criteria for each zone in the study area;
2) determine the weight and scoring for every zone using the AHP method;
3) analyze and determine the rates for parking with multiple criteria based on zoning. The ultimate goal of the study is to provide a beneficial tool for the Semarang city government to use in developing sustainable transportation plans.

3. RESEARCH METHOD

This research method utilizes a field observation model along with questionnaires using one or more determined criterion in each zone, and then rate analysis is performed by prioritizing those criteria

This analysis of rate determination based on zoning uses the Process Hierarchy (APH) method, starting with zoning determinations based on area use and area divisions that have already been established in the district regulations [14] governing Space Order Planning of the Semarang City Area.

After setting basic definitions to identify the specific characteristics in Zone A, Zone B and Zone C, then the next step is to look at each zone individually, eventually assigning weight to each of the variables in its subset of criteria consistent with both the data from field observation results and with other related institution data (see Figure 1).
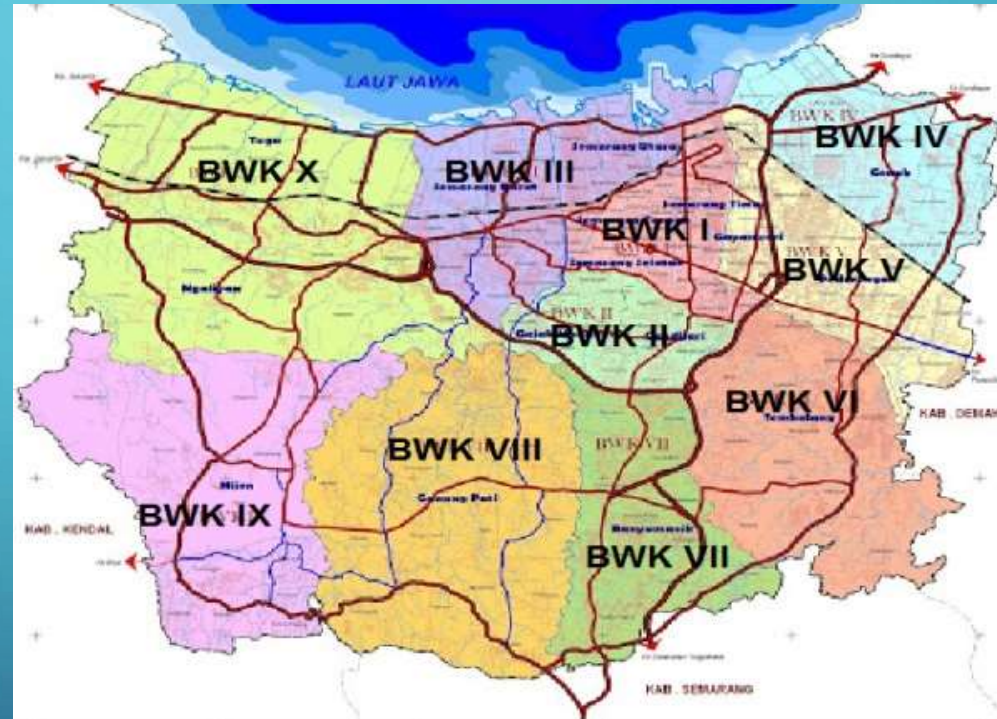
Study location

Sampling was performed in one (1) BWK (Urban Boundaries) for each zone.

Zone A sampling was represented by BWK I,
Zone B by BWK IV and
Zone C by BWK VI, as seen in Figure 2.

Map Semarang City with BWK/Urban Boundaries

based on Perda No 14 Tahun 2011 [14], the City of Semarang is divided into 10 sections

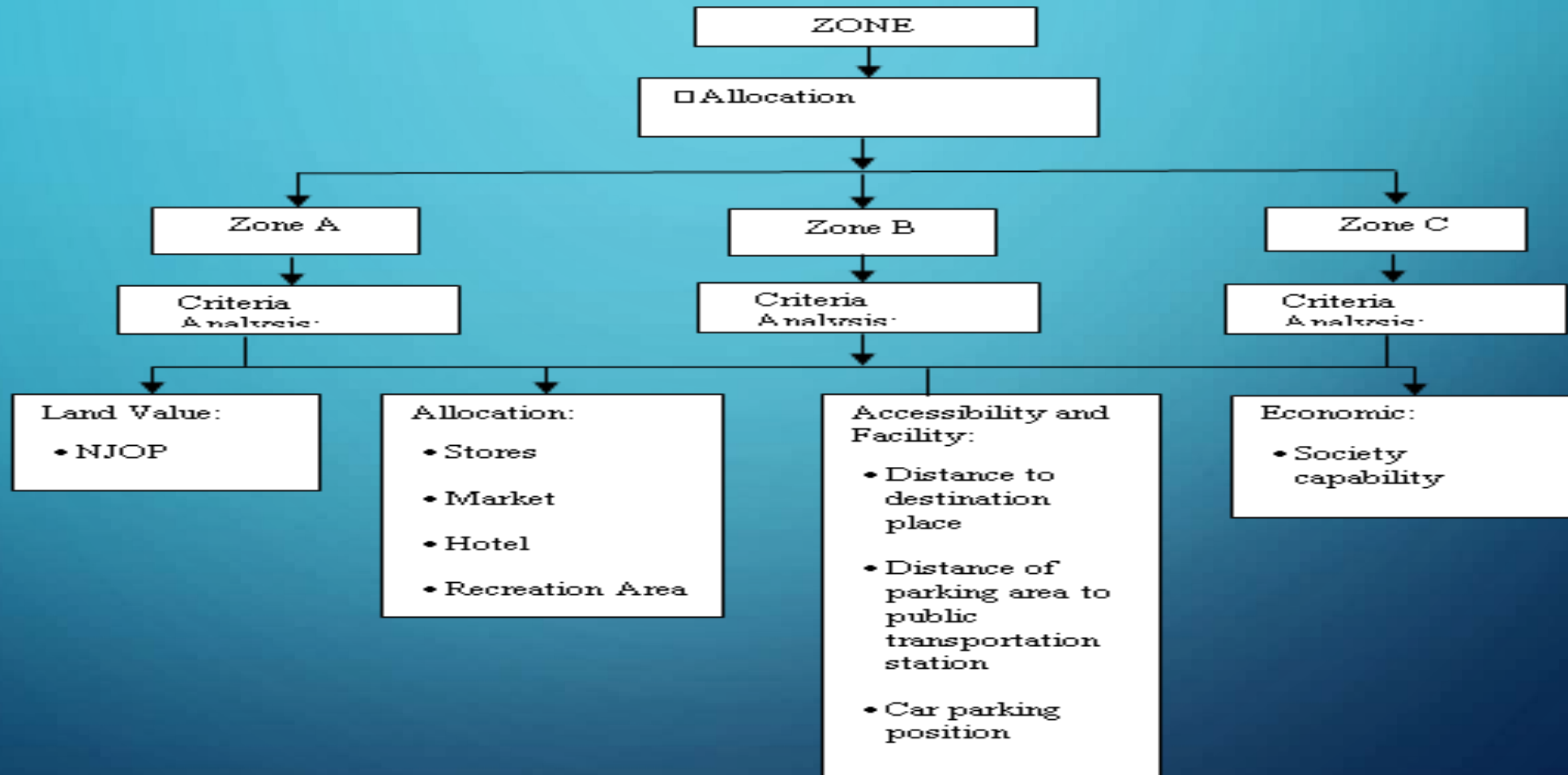**Fig. 2:** Area Classification of Semarang City based on BWK (BWK/Urban Boundaries) (*Source: http://dppad.jatengprov.go.id*)

4.Analysis and Discussion

Flow chart of criteria determination for each zone

Zone A is considered an expensive zone with land use primarily identified as trading/mercantile, offices, and business areas, and it covers the areas of BWK I, BWK II, BWK III and BWK V.

Zone B is considered a middle zone with land use designated as industrial, and covers the areas of BWK IV, BWK IX and BWK X (BWK or Urban Boundaries).

Zone C is considered an inexpensive zone with land uses including educational areas and military offices, and covers the areas of BWK VI, BWK VII and BWK VIII.

Scoring Determination

The scoring determinations from data collection results by questionnaire and observations follow in Figure 4:
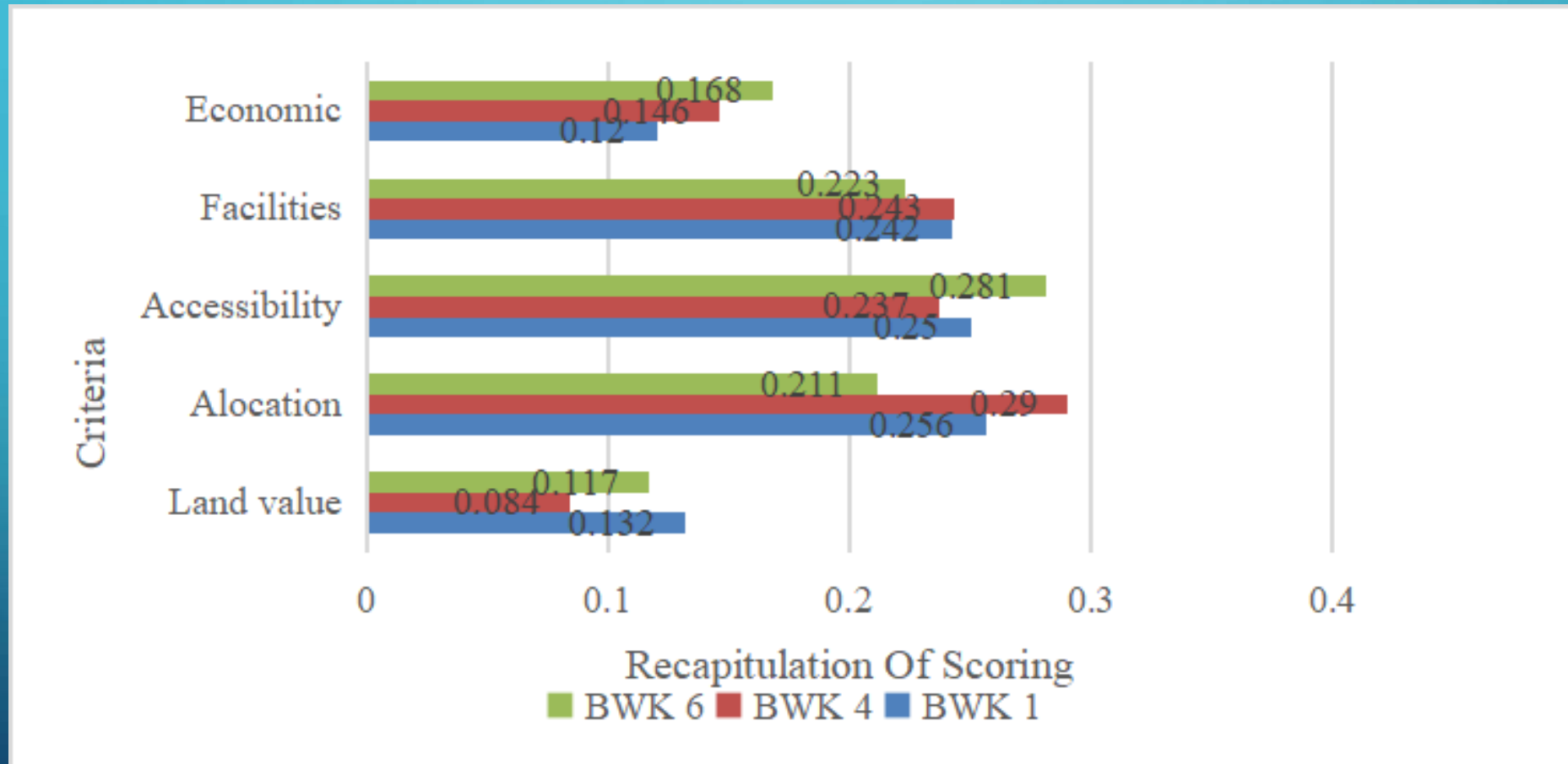

Fig. 4: Scoring results in Zone A, Zone B and Zone C

Analysis Result of Scoring

The recapitulation of scoring results for each zone in BWK can be seen in Figure 4, and the results of land use valuing can be seen in Table 1. Value comparisons for each criterion in the representational sample BWK for each zone can be seen in Figure 3.

Table 1: Recapitulation of the valuing result

No.	Land Function		Weight				
			K1	K2	K3	K4	K5
1	Trading		0.132	0.256	0.25	0.242	0.12
2	Industrial		0.084	0.2895	0.2373	0.243	0.1475
3	Educational		0.1172	0.2109	0.2811	0.223	0.1675

Source: [10]
  K2 = Criterion 2 is Allocation
  K3 = Criterion 3 is Accessibility
  K4 = Criterion 4 is Facility
  K5 = Criterion 5 is Economic

TABLE : 3.RECAPITULATION OF SCORING

Criteria	Value		
	BWK 1 (Urban Boundaries)	BWK 4 (Urban Boundaries)	BWK 6 (Urban Boundaries)
Land value	9	5	3
Allocation	9	5	1
Accessibility	7.667	3.67	1.667
Facility	9	1	3
Economic	9	5	1

After valuing and scoring for each criterion in every zone was determined, then those values were multiplied by the scoring to calculate the quality value for each zone. The quality value establishes the value of the parking rate for each zone by multiplying the comparison value with the base rate in every zone. The multiplied result of value and scoring is in Table 3.

No	Zona	Nilai										Total
		K1=0,132		K2=0,256		K3=0,25		K4=0,242		K5=0,12		
1	A	S	N	S	N	S	N	S	N	S	N	8,49
		9	1,02	9	2,30	7,66	1,92	9	2,18	9	1,08	
		K1=0,084		K2=0,2895		K3=0,2373		K4=0,243		K5=0,1475		
2	B	S	N	S	N	S	N	S	N	S	N	3,71
		5	0,42	5	1,45	3,67	0,87	1	0,24	5	0,73	
		K1=0,1172		K2=0,2109		K3=0,2811		K4=0,223		K5=0,1675		
3	C	S	N	S	N	S	N	S	N	S	N	1,868
		3	0,35	1	0,21	1,667	0,469	3	0,669	1	0,168	

Note
  S = Score of each criterion in every BWK
  N = Final score of criterion after multiplied by the value of each criterion
 The results of the scoring and valuing analysis can be seen in Table 3, indicating that Zone A has the highest value, followed by Zone B in the middle, and Zone C is the lowest, based on the criteria. When the final result of the scoring and valuing analysis is calculated, the total value of the three zones is equal to 14.23.

Analysis Result of Parking Rate Determination

For parking areas connected with a building structure, the parking rate taken from the research of [2] is about Rp. 4,000.00/hour.

The price for a parking rate in an area without a permanent building or structure, also taken from the research of [6], is about Rp. 2,589.34/hour. This price was then multiplied by the BI rate of 4,75 percent, adjusting the rate in relation to the Indonesian economy as measured by indexes in July 2017 [2]. Parking rate prices after being multiplied by the BI Rate can be seen in Table 4.

Table 4. Parking rate adjustments by year 2015-2017

Location	Parking rate		
	2015	2016	2017
Mall of paragon	Rp 4,000.00	Rp 4,190.00	Rp 4,389.03
Sampangan market	-	Rp 2,589.34	Rp 2,712.33

Table: 6. Parking base rate analysis for each zone

Zone	Land function		Rate	
			First hour	Next hour
A	Trading	Building	Rp 4,500.00	Rp 2,250.00
		Non-building	Rp 3,000.00	-
B	Industrial		Rp 2,000.00	-
C	Educational		Rp 3,000.00	

Source : [10]

Table: 7. Analysis of parking rate adjustments based on 25% of tax assessments and 4,75% interest rate

Zone	Base rate		25 % of Tax	4,75 % of rate interest
Trading	Building	Rp 4,5000.00	Rp 5,625.00	Rp 8,946.66
	Non building	Rp 3,000.00	Rp 3,750.00	Rp 5,964.46
Industrial		Rp 2,000.00	Rp 2,500.00	Rp 3,976.31
Educational	Campus	Rp 3,000.00	Rp 3,750.00	Rp 5,964.46

Source: [10]

Table: 8. Final analysis of parking rates using quality values for each zone

Area		Base rate	Valuing	Zone		
				A	B	C
Trading	Building	Rp 8,946	8.66	Rp 5,444	Rp 2,419	Rp 3,629
	Non-building	Rp 5,964		Rp 3,629	Rp 1,612	Rp 2,419
Industrial		Rp 3,976	3.71	Rp 2,332	Rp 1,036	Rp 1,554
Educational		Rp 5,964	1.86	Rp 1,171	Rp 477	Rp 779

Source: [10]

Table: 8. Final analysis of parking rates using quality values for each zone

After the result of parking rate adjustments is determined (Table 7), it is then multiplied by the quality value (Table 3). In each zone this yields three (3) different parking rates.

Area		Base rate	Valuing	Zone		
				A	**B**	**C**
Trading	Building	Rp 8,946	8.66	Rp 5,444	Rp 2,419	Rp 3,629
	Non-building	Rp 5,964		Rp 3,629	Rp 1,612	Rp 2,419
Industrial		Rp 3,976	3.71	Rp 2,332	Rp 1,036	Rp 1,554
Educational		Rp 5,964	1.86	Rp 1,171	Rp 477	Rp 779

Source: [10]

For example, in Zone A, determined to be the most expensive zone based on the criteria values, the final rates are:

Trade and Office Areas

Rate price = (quality value of trade zone/total value) x Zone A rate

= (8,4982/14.23) x Rp 8,946.66

= Rp 5,444.00

Industrial Areas

Rate price = (quality value of industrial zone/total value) x Zone A rate

= (3,71/14.23) x Rp 8,946.66

= Rp 2,332.00

Educational Area

Rate price = (quality value of educational zone/total value) x Zone A rate

= (1,868/14.23) x Rp 8,946.66

= Rp 1,171.00

Table 9. Recapitulation of final parking rates in Zone A

Zone A		Parking rate	
		First hour	Next hour
Trading	In-Building	Rp 5,500.00	Rp 2,500.00
	Non-building	Rp 4,000.00	-
Industrial		Rp 4,000.00	-
Educational	Campus	Rp 4,000.00	-

Source: [10]

Table 10: Recapitulation of final parking rates in Zone B

Zone B		Parking rate	
		First hour	Next hour
Trading	In-building	Rp 3,500.00	Rp 2,000.00
	Non-building	Rp 3,500.00	-
Industrial		Rp 3,500.00	-
Educational	Campus	Rp 3,500.00	-

Table 11: Recapitulation of final parking rates in Zone C

Zone C		Parking rate	
		First hour	Next hour
Trading	In-building	Rp 4,000.00	Rp 2,000.00
	Non-building	Rp 3,500.00	-
Industrial		Rp 3,500.00	-
Educational	Campus	Rp 3,500.00	-

5 CONCLUSION AND RECOMMENDATIONS

5.1. CONCLUSION AND RECOMMENDATIONS

A. The City of Semarang as a study city consisting of 10 BWK (Bagian Wilayah Kota/Urban Boundaries) is divided into 3 Zones: they are Zone A with the allocation for trading represented by BWK I, Zone B with the function for industrial represented by BWK IV and Zone C with the function for educational represented by BWK 6. By using multi-criterion method, it is found that factors influencing rate determination is created as criterion used in scoring and valuing analysis, they are land value, land-used/allocation, accessibility, facility and economic. Each zone shows that they have different value. In Zone A and Zone B, the allocation criterion becomes the highest criterion, but in Zone C, facility is the highest one. The different of this value influences the parking rate in each zone.

B. The formula which determines parking rates in each zone uses a coefficient calculated using value analysis, multiplied by scores established for each zone. The coefficient result for Zone A is equal to 8,66; for Zone B it equals 3,71; and in Zone C it is equal to 1,86.

C. Parking rates in Zone A (BWK I/Urban Boundaries 1)

a. Trading/mercantile in-building parking for first hour costs Rp 5,500 and next hour costs Rp 2,500

b. Trading non-building parking costs Rp 4,000

c. Industrial area parking costs Rp 4,000

d. Educational area parking costs Rp 4,000

Parking rates in Zone B (BWK 4/Urban Boundaries 4)

a. Trading/mercantile in-building parking for first hour costs Rp 3,500 and next hour costs Rp 2,000

b. Trading non-building parking costs Rp 3,500

c. Industrial area parking costs Rp 3,500

d. Educational area parking costs Rp 3,500

Parking rates in Zone C (BWK 6/Urban Boundaries 6)

a. Trading/mercantile in-building areas for first hour costs Rp 4.000 and next hour costs Rp 2,000

b. Trading non-building parking costs Rp 3,500

c. Industrial area parking costs Rp 3,500

d. Educational area parking costs Rp 3,500

5.2. Recommendations

5.2.1. When setting parking rates based on zoning models in order to establish effective parking controls in urban areas, it is strongly recommended to use a comprehensive set of criteria, applying each criterion to all existing BWK zones in every urban area, which will enable the most accurate parking rates to be obtained.

5.2.2. For the most beneficial results, the preference would be to compare the parking rates derived from multi-criterion analysis with the residents' ATP (ability to pay) who live and work in the urban area being studied, since every urban center has different socio-economic characteristics.

Thank You

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