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Analysis of Pedestrian During The COVID – 19 Period in The Dago – Bandung Area

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Abstract

The sidewalk in the Dago - Bandung area is one of the sidewalks that is widely used by pedestrians because there are schools, campuses, hospitals, clothing stores and restaurant. This study to determine the average daily use of sidewalks in the Dago - Bandung area, identify sidewalk facilities, determine level of services sidewalks, and obtain pedestrian perceptions of sidewalk facilities. This study used the field survey to primary data and quisioner from pedestrians for secondary data. Analysis of sidewalk facilities uses the Regulation of the Minister of Public Works Number 3 of 2014 while level of service uses High Capacity Manual method. Pedestrian perceptions use the Importance Performance Analysis method. The survey showed on the largest pedestrian volume occurred on Sunday at 2.49 people/minute and it was found that the sidewalks in the Dago - Bandung area had met standards. Based on the results the level of service on the sidewalk is Standard A with the average pedestrian flow of 1.64 ppl/m/mnt and the average space for pedestrians of 34.62 m2/ppl. The results of the Cartesian diagram obtained in quadrant I. The main priority is the condition of the signage, the location of the street furniture, and the cleanliness of the channel. Overall, a few items need improvement in order to create better comfort for pedestrians.

Keywords
Dago – Bandung Area, Level of Service, Pedestrians, Sidewalks

1. Introduction

Transportation facilities and infrastructure are mutually supportive factors, in the transportation system both are the main needs. Transportation facilities are made to support the movement of people from one place to another using the available public transportation modes, transportation facilities are also intended to serve the community in their activities to achieve the goals of the movement. Transportation facilities related to traffic are terminals, traffic signs and markings, pedestrian facilities, parking facilities, and stopping places.(Hasanah 2017)

Pedestrian is a term given in transportation to describe people who are walking on a pedestrian path either on the side of the road, sidewalk, special lane for pedestrians or road crossing (Dermawan et al. 2021).Walking as one of the common transportation systems in all communities around the world and has an important role in an urban space, especially as a liaison between regional functions with one another and a liaison between modes of transportation. With more people walking, it increases clean air and reduces congestion.(Lestari 2020)

Sidewalks are pedestrian paths that are parallel and adjacent to traffic lanes that are paved with pavement construction. (Kementerian Pekerjaan Umum dan Perumahan Rakyat 2017) Sidewalks make pedestrians comfortable on foot, because they are not integrated with other modes of transportation. Sidewalks that are well built and have complete facilities will cause many people to want to walk. In addition, sidewalks can also shape the character or image of the city because it is the most important element in the image of the city (Path or path). But in reality, the sidewalk is no longer functioning as it should. The sidewalks are full of small buildings that are permanent and non-permanent, and various other types of buildings. (Mulyanto and Aziz 2020)

Around the research location there are schools, campuses, hospitals, clothing shops, restaurants, and gift shops. Many pedestrians are jostling on the existing sidewalk so that the impression is that the sidewalk is narrow or not wide enough. In sidewalk design, the standard ideal width of the sidewalk is often ignored in

pedestrian planning, so that in reality, when the sidewalk is used, a sense of security and comfort in the use of pedestrian paths is not felt by pedestrians.(Waani 2016)

2. Literature View

2.1 Sidewalk

According (Direktur Jenderal Bina Marga 1999)to what is determined by grant is the part of the highway that is specifically provided for pedestrians located in the road benefit area, whose surface is higher than the road surface, and is generally parallel to the traffic lane. Sidewalks also function to facilitate road traffic because they are not disturbed or affected by pedestrian traffic. The space below can be used as a space to place utilities and other road accessories. In accordance with the specifications of the free space the sidewalk has a free height of not less than 2.5 m, will not exceed the limit of 2.5 m, will not be less than 0.3 meters from the surface and the width of the sidewalk will not be less than 0.3 meters (Kep. Bina Marga 1999). There are 2 sidewalk slopes, namely longitudinal and transverse slopes. Ideally, the longitudinal slope of the sidewalk is 8% and the cross-slope of the sidewalk is 2% to 4% for the purpose of channeling surface water (Kementrian PU No. 3 2014). Based on Technical Guidelines No. 2 of 1999 concerning Accessibility Requirements on Public Roads, the specifications for the height of the kereb vary according to the type, ranging from 5-30 centimeters in height.

2.2 Sidewalk Standar

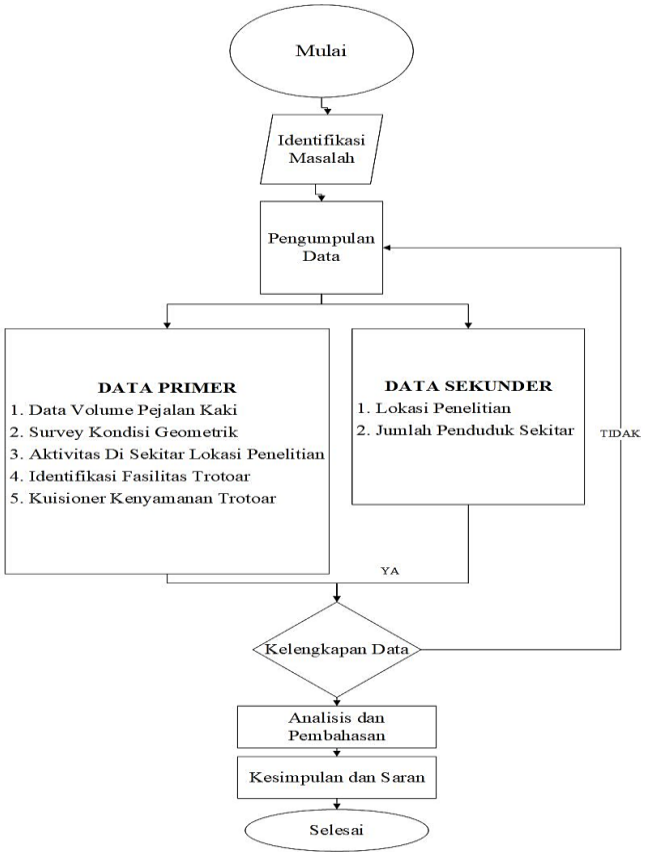
The standard provisions for sidewalks are regulated in regulations such as dimensions of width, free space, slope, curb height and sidewalks for special needs. The effective width of the pedestrian lane based on the needs of one person is 60 cm with an additional width of 15 cm for moving without carrying goods, so that the total lane requirement for two pedestrian hand in hand or two pedestrians passing by without contact occurs is at least about 1.50 cm (Kementerian Pekerjaan Umum dan Perumahan Rakyat 2017). Based on Technical Guidelines No. 2 of 1999 concerning Accessibility Requirements on Public Roads, the specifications for the height of the kereb vary according to the type, ranging from 5-30 centimeters in height. Selection of surface material for pavement facilities with special needs, which is used must be stable, strong, smooth textured but not slippery, both in dry and wet conditions. To guide people with visual impairments on the pedestrian path, the selection of materials can use the texture of the guide tiles (striped tiles) and for situations around the path that can endanger the visually impaired can use the warning tile texture (dot/round tiles). Stagnant water at the pedestrian facilities is very uncomfortable, especially since this facility is specifically for blind people, this can cause the road surface to be slippery and can be easily slipping for the user. Not only selection of surface materials but also the use of porous concrete in the guiding paving block is one effort that will be done to avoid a puddle of water on the road surface due to rainfall, beside which the slightly rough surface will make the road surface is not slippery. (Isradi, Hidayat, and Prasetijo 2020)

2.3 Level of Service

In the implementation of service standards, of course, there are service level criteria that must be met. The criteria for the service level of sidewalk facilities are contained in the Regulation of the Minister of Public Works (Ministry of Public Works No. 3, 2014), as follows:

1. Standard A, pedestrians can walk freely, including being able to determine the direction of walking freely, at a relatively fast speed without causing interference between pedestrians. The area of the pedestrian path is 12 m2 /person with a pedestrian flow of <16 people/minute/meter.
2. Standard B, pedestrians can still walk comfortably and quickly without disturbing other pedestrians, but the presence of other pedestrians has begun to affect the pedestrian flow. The area of the pedestrian path is 3.6 m2 /person with a pedestrian flow of <16-23 people/minute/meter.
3. Standard C, pedestrians can move with the current in the same direction normally although in the opposite direction there will be little contact, and relatively slowly due to limited space between pedestrians. The area of the pedestrian path is 2.2-3.5 m2/person with a pedestrian flow of <23 people/minute/meter.
4. Standard D, pedestrians can walk with a normal flow, but must change positions frequently and change speed because the opposite flow of pedestrians has the potential to cause conflict. The area of the pedestrian path is 1.2-2.1 m2/person with a pedestrian flow of <33-49 people/minute/meter.
5. Standard E, pedestrians can walk at the same speed, but movement will be relatively slow and irregular when many pedestrians turn around or stop. The area of the pedestrian path is 0, 5–1.3 m2/person with a pedestrian flow of >49-75 people/minute/meter.
6. Standard F, pedestrians walk at a very slow and limited current speed because there are often conflicts with pedestrians in the same direction or opposite. Standard F is no longer comfortable and is no longer suitable for pedestrian space capacity. The area of the pedestrian path is <0.5 m2/person with various pedestrian flows.

3. Methodology



Flowchart 1. Research

Based on the flowchart above this research using 2 types of data, are primary data and secondary data. Primary data were obtained by direct observation of pedestrian volume, pedestrian travel time, sidewalk conditions, activities around the sidewalk and filling out questionnaires. In this study, the sidewalks used are the right and left side of the road. The survey location is in the Dago Area - Bandung, on the right starting from the Police Post to SPBU and on the left starting from Bank BCA to Bank Mega. The length of the sidewalk in this study is ± 1 km.

The secondary data obtained a map of the research location and data on the population of the area, from these data will be processed to obtain the results of the level of use and service of the sidewalk facilities. Image 1 below shows the research location:

Figure1. Research Location Map

3.1 High Capacity Manual

The High Capacity Manual method is used to determine the pavement service level requirements. The requirements in determining the level of service in pedestrian spaces are used in several ways as follows:

1. Calculate the value of the pedestrian flow at the largest 15 minute interval from the value of the pedestrian flow at other 15 minute intervals.

$$Q_{15} = \frac{Nm}{15WE}$$

Q_{15} = Flow of pedestrians at 15 minutes interval (people/m/minute)
Nm = Total of pedestrians at 15 minuter interval
WE = Effective width of pedestrian space

2. To calculate the value of pedestrian space at the time of the largest 15-minute flow, the following formula is used:

$$S_{15} = \frac{1}{D_{15}}$$

S_{15} = Pedestrian space at the time of the largest 15 minute flow ($m^2/pedestrian$)
D_{15} = Density at the time of the largest 15 minute current ($pedestrian/m^2$)

3.2 Importance Performance Analysis

The use of the Importance-Performance Analysis method is to measure the level of service satisfaction that is included in the quadrants on the Importance-Performance Analysis map. The formula used is as follows:

$$Tki = \frac{X_i}{Y_i} x\ 100\%$$

Tki = Community satisfaction level
X_i = Government performance evaluation
Y_i = Community expectation evaluation

A Cartesian diagram is a shape that is divided into four parts bounded by two perpendicular intersecting lines at the points ($\bar{\bar{X}}_\iota$, $\bar{\bar{Y}}_\iota$) where $\bar{\bar{X}}_\iota$ is the average of the average implementation level scores. and (Y_i) is the average of the average importance scores of all factors that affect people's satisfaction (Purnomo 2015), the formula is as follow :

$$\bar{\bar{X}} = \frac{\sum_{i=1}^{N} \overline{X\iota}}{k} \quad \bar{\bar{Y}} = \frac{\sum_{i=1}^{N} \overline{Y\iota}}{k}$$

Furthermore, the level of these elements will be described and divided into four parts into a Cartesian diagram.

3.3 Data Analysis

3.3.1 Validity Test

Validity test is a test that serves to see whether a measuring instrument is valid or invalid. In this study, the validity test method used the pearson product moment method. The basis for taking the validity test of the pearson product moment method can be by comparing the value of rcount with rtable as follows:

1. If value of rcount > rtable = Valid
2. If value of rcount < rtable = Invalid

3.3.2 Reliability Test

Reliability is an index that shows the extent to which a measuring instrument can be trusted or relied on. The basis for making decisions in reliability testing is as follows:

1. If value of Cronbach's Alpha > 0.60 so, quisioner is reliabel or consistent
2. If value of Cronbach's Alpha < 0.60 so, quisioner is not reliabel or not consistent

3.3.3 Normality Test

The normality test aims to determine whether the residual value is normally distributed or not. The basis for decision making in this test is to use the following significance values:

1. If significance value > 0.05, so residual value is normal distribution
2. If significance value < 0.05, so residual value is not normal distribution

3.3.4 Regression Linear Test

Linear regression test is a statistical method used to form a model of the relationship between the dependent variable and one or more independent variables. The basis for decision making in a simple linear regression test can refer to two things, namely:

1. Comparing the significance value with a probability value of 0.05
   a. If significance value < 0.05, so variable X effect on variable Y
   b. If significance value < 0.05, so variable X has no effect on variable Y
2. Comparing t value of tcount with t table
   a. If value of tcount > t table, so variable X effect on variable Y

b. If value of tcount < t table, so variable X has no effect on variable Y

4. Result and Analysis

4.1 Sidewalk Density Analysis

The pavement density level is calculated for 3 days a week, namely 2 hours in the morning, 2 hours in the afternoon, and 2 hours in the afternoon. This survey was conducted by counting pedestrians on the sidewaks. Can be seen the volume of pedestrian by graph below:

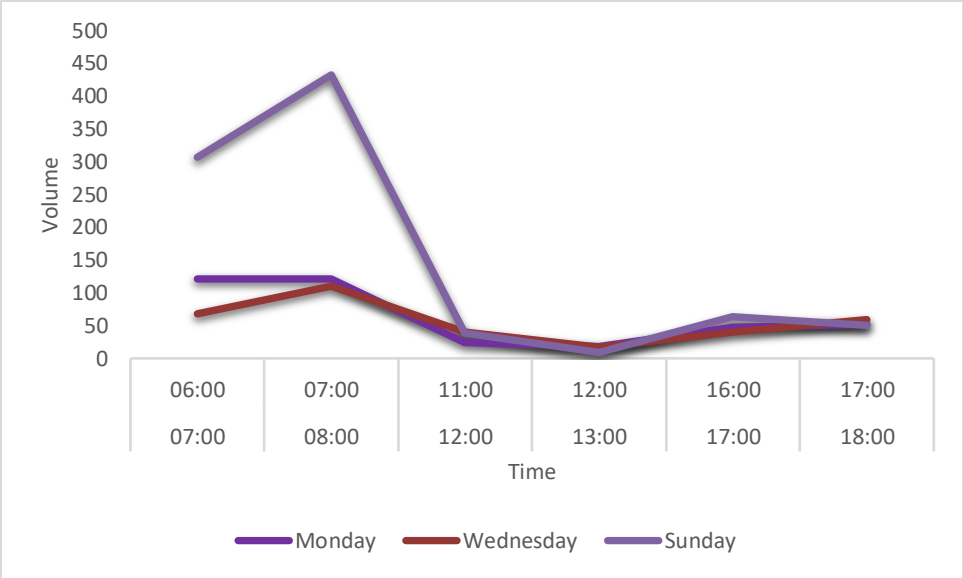


Figure 2. Pedestarians Volume on Monday, Wednesday, and Sunday

According to the results of a survey conducted on Monday, it was found that the number of people crossing the sidewalk in both directions was 419 people/6 hours or 1.16 people/minute, and on Wednesday 470 people/6 hours or 1.31 people/minute were found. Meanwhile, on Sundays the number of people crossing the sidewalk in both directions is 899/6 hours or 2.49 people/minute.

4.2 Sidewalk Condition Survey

Table 1. The Result of Survey

Indicator of Research	Survey Points				Average	Standart
	Police Post	Bank BCA	SPBU	Bank Mega		
Widtht of Sidewalks (m)	4	3.9	3.6	4	4 m	4 m
Free Space (m)	0.3	0.3	0.3	0.3	0.3 m	0.3 m
Height of Kerb (cm)	13.5	14	11.5	14	13.25 cm	5 cm – 30 cm
Facility Line (m)	2.6	2	2	1.9	2.1 m	1.2 m
Slope (%)	3.9	3.8	3.6	3.8	3.8 %	2% - 4%

Based on the survey, it is known that the facilities for disabled and non-disabled people are good. The size is large enough to be used for people with special needs with wheels, sticks or crutches. The survey showed, the sidewalk had the guiding paving block.

4.3 Analysis of LOS

The analysis of level of service, it can be seen from calculations using the Highway Capacity Manual with data from survey results that have been carried out both on weekdays and weekends.

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Table 2. Calculation of HCM

The Day of Research	Flow (ppl/m/mnt)	Speed (m/snd)	Density (ppl/m2)	S_{15} (m2/ppl)
Monday	1.19	0.83	0.024	41.67
Wednesday	0.82	0.70	0.020	50.00
Sunday	2.91	0.59	0.082	12.20
		Average		34.62 m^2/ppl

4.4 Respondent Characteristics

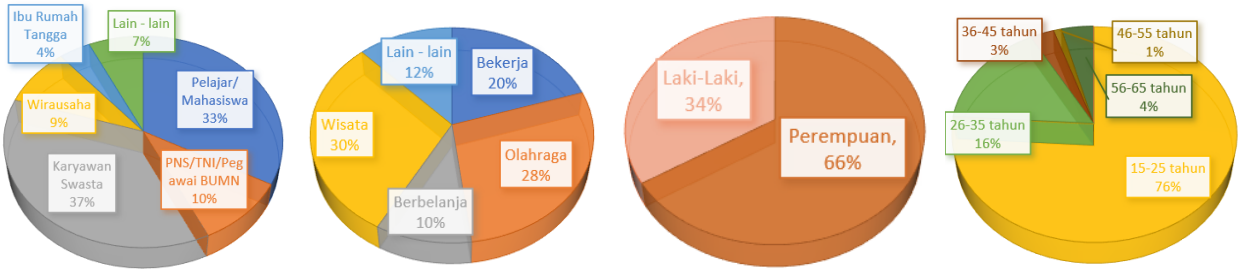

Figure 3. Characteristics of Respodent Based on Profession, Purpose, Gender, and Age

The picture above is obtained from 100 respondents with each criteria. The first picture shows the criteria based on work, the second picture shows the criteria based on the respondent's purpose of walking on the sidewalks in the Dago area of Bandung, the third picture shows the criteria based on gender, and the last picture is based on the age of the respondent.

4.5 Validity Test

Validity test function to determine the validity of the questionnaire that has been carried out. This test was carried out using SPSS software version 25. The output of SPSS obtained was Pearson Correlation or as rcount and significance value (Sig). In this study, a method that compares the value of r_count is used. If rcount > rtable, then the data from the questionnaire is declared valid or true. The value of rtable can be seen in table R where the value of N is the number of respondents, namely 100 people and a significance value of 5% is 0.195. The results of the Convenience Level validity test can be seen in the following table:

Table 3. Value of R Count for indicator of Convenience

Indikator	r_{hitung}	r_{tabel}	Keterangan
The hight of kerb between sidewalk and road (min : 5-30 cm)	0.566	0.195	Valid
Condition of Signage ex. Evacuation Road Board	0.690	0.195	Valid
Condition of sidewalk for disability ex.be found guilding block)	0.698	0.195	Valid
Guardrail on the side of sidewalk	0.676	0.195	Valid
Width of sidewalk (min : 4 m)	0.502	0.195	Valid
Sidewalk surface condition (standart : not slippery)	0.721	0.195	Valid
Location of Street furniture (ex. Street light and rubbish bin)	0.722	0.195	Valid
Condition of trees (to take shelter)	0.529	0.195	Valid
The slope of sidewalk (water doesn't stagnate)	0.615	0.195	Valid
The channel cleanliness around the sidewalk	0.707	0.195	Valid
Location of street lighting (min. each 10 m)	0.658	0.195	Valid
The sidewalk cleanliness	0.670	0.195	Valid
Condition of sidewalk location (reachable)	0.605	0.195	Valid

Table 4. Value of R Count for Indicator of Importance

Indikator	r_{hitung}	r_{tabel}	Keterangan
The hight of kerb between sidewalk and road (min : 5-30 cm)	0.537	0.195	Valid
Condition of Signage ex. Evacuation Road Board	0.728	0.195	Valid
Condition of sidewalk for disability ex.be found guilding block)	0.713	0.195	Valid
Guardrail on the side of sidewalk	0.565	0.195	Valid
Width of sidewalk (min : 4 m)	0.764	0.195	Valid
Sidewalk surface condition (standart : not slippery)	0.720	0.195	Valid
Location of Street furniture (ex. Street light and rubbish bin)	0.719	0.195	Valid
Condition of trees (to take shelter)	0.525	0.195	Valid
The slope of sidewalk (water doesn't stagnate)	0.608	0.195	Valid
The channel cleanliness around the sidewalk	0.712	0.195	Valid
Location of street lighting (min. each 10 m)	0.700	0.195	Valid
The sidewalk cleanliness	0.735	0.195	Valid
Condition of sidewalk location (reachable)	0.599	0.195	Valid

4.6 Reliability Test

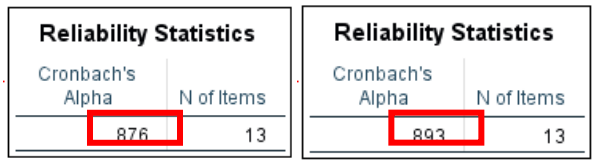

Figure 4. Value of Cronbach's Alpha for Convinience Indicator and Importance

Refer from the table above, the convinience indicator with Cronbach's Alpha value of 0.896 and importance with Cronbach's Alpha value of 0.89. From the 13 data, 13 have Cronbach's Alpha values > from 0.6, so it can be said that each of these variables is declared reliable / trustworthy.

4.7 Reliability Test

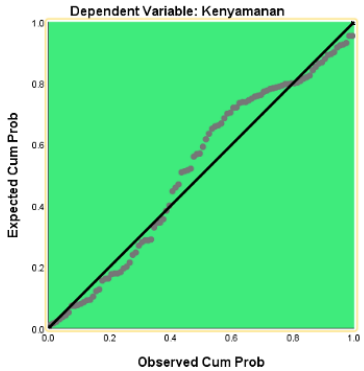

Figure 4. Graph of Normality

From the graph above, the points which are the result of the respondent's questionnaire data spread around the diagonal line and follow the direction of the diagonal line, so it can be said that the data is normally distributed.

4.8 Regression Linear Test

Table 1. Value of Significance and Value of t

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	18.194	5.471		3.326	.001
	KEPENTINGAN	.532	.099	.478	5.390	.000

a. Dependent Variable: KENYAMANAN

From the output of the coefficients table above, a decision can be made in a simple regression test as follows:

1. Based on the significance value
   From the coefficient table, obtained a significance value of 0.000 <0.05 so it can be concluded that the variable interest of sidewalk facilities (X) affects the pedestrian comfort variable (Y)
2. Based on the value of t:
   T table = (α/2 : n-k-1)
   = (0.05/2 : 100-1-1)
   =(0.025:98) [Viewed on the distribution of t-table values]
   =1,984

   It is known that the value of tcount is 5.390 > ttable of 1.984 so it can be concluded that the variable interest of sidewalk facilities (X) has an effect on the variable of pedestrian comfort (Y).

4.9 Importance Performance Analysis

In this study, it will be carried out to measure the level of satisfaction and the level of importance of the facility on the performance of the pedestrian path in the Dago - Bandung area which is felt by pedestrians. The level of importance and satisfaction will be described and plotted into four parts on the Cartesian diagram where the horizontal axis (X) is the level of satisfaction while the vertical axis (Y) is the level of importance.

4.10 Level of Compatibility

The level of compatibility analysis is the first stage in the analysis of the IPA method. The level of compatibility serves to determine the level of compatibility between the level of importance and the level of performance of the quality of the facility under study by comparing the performance score with the importance score.fttyio

Table 6. Level of Compatibility from Convenience dan Importance

No. Quisioner	Convenience	Importance	Compability	Explanation
1	388	428	90.65 %	Very Good
2	305	426	71.60 %	Good
3	367	441	83.22 %	Very Good
4	278	413	67.31 %	Good
5	376	392	95.92 %	Very Good
6	365	413	88.38 %	Very Good
7	361	430	83.95 %	Very Good
8	382	426	89.67 %	Very Good
9	363	420	86.43 %	Very Good
10	359	438	81.96 %	Very Good
11	377	422	89.34 %	Very Good
12	388	436	88.99 %	Very Good
13	394	412	95.63 %	Very Good

4.11 Priority Level Analysis

From the data, the results of a questionnaire about the perception of pedestrians walking analyzed using methods IPA seen that the graph IPA matrix as follows:

1. Quadrant I, which is the main priority, is the indicator condition of signage (2) location of the street furniture (7) and the channel cleanliness (10)
2. Quadran II achievement is maintained on indicators width of sidewalks, the height of kerb, condition sidewalk for disabilitas, condition of shelter, an the cleanliness of sidewals
3. Quadrant III, with low priority in handling, has an indicator guardrail on the side of sidewalk
4. Quadrant IV, which is categorized as excessive, width of sidewalk, sidewalk surface condition, the slope of sidewalk, the location of the street lighting, and the location of sidewalk.

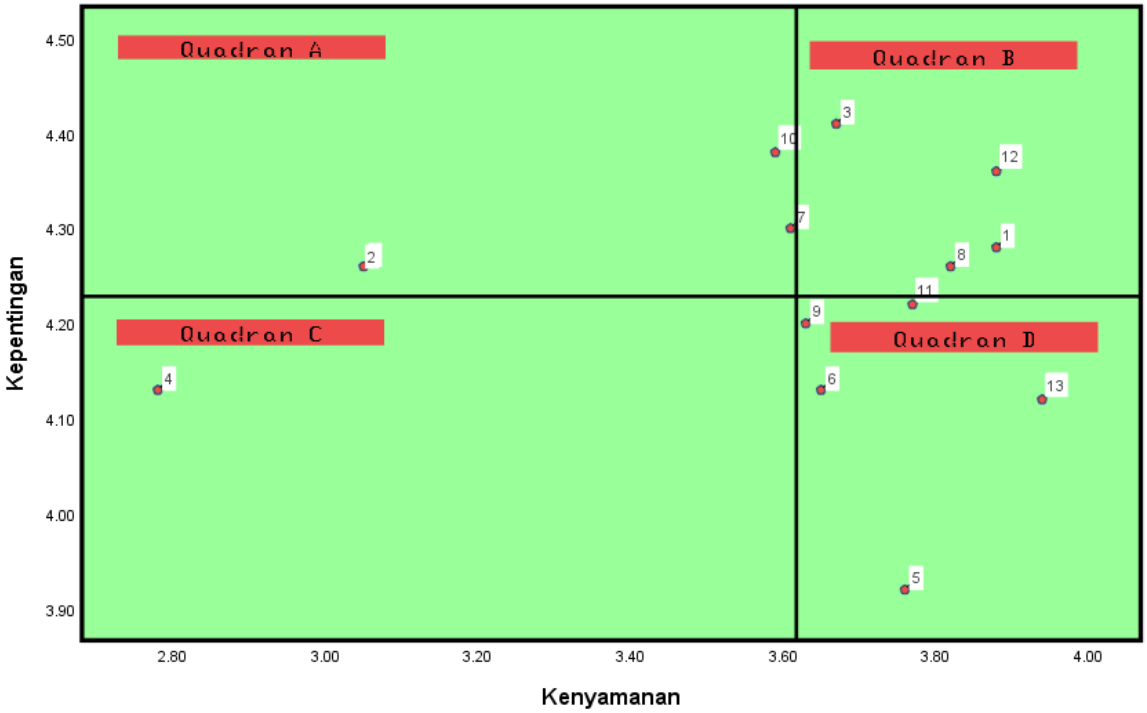

Figure 5. Cartesian Diagram of Importance and Comvenience

5. Conclussion

According to the survey results, on Monday it was found that the number of people crossing the sidewalk in both directions was 419 people/6 hours or 1.16 people/minute, and on Wednesday it was 470 people/6 hours or 1.31 people/minute. Meanwhile, on Sundays the number of people crossing the sidewalk in both directions is 899/6 hours or 2.49 people/minute. From the results of this survey, it can be seen that there is a high density of pedestrians on Sundays.

From the survey results, it can be seen that the sidewalks in the Dago - Bandung area have met the standards for pedestrians without special needs or with special needs.

According to the calculation of the Highway Capacity Manual, the average pedestrian flow at 15minute intervals is 1.64 people/m/minute and the average pedestrian area is 34.62 m^2/pedestrian. From this data, it can be seen that the criteria for the level of service for sidewalk facilities contained in the Regulation of the Minister of Public Works, sidewalks in the Dago - Bandung area are included in Standard A.

From the questionnaire data on pedestrian perceptions that have been analyzed using the Importance Performance Analysis (IPA) method, it shows that in Quadrant A the main priority is on indicators of information system conditions (signage), location of street furniture, and channel cleanliness. Quadrant B, which is a sidewalk facility whose performance must be maintained, is found in the indicators of the height of the ker between the sidewalk and the road, the condition of the sidewalk for people with disabilities, the condition of the trees as shade, and the cleanliness around the sidewalk. Quadrant C, which is a sidewalk facility with low priority in handling, is only found in 1 indicator, namely the guardrail on the side of the sidewalk. Finally, quadrant D, which is excessive sidewalk facilities, is found in indicators of the width of the sidewalk, the condition of the pavement surface, the slope and slope of the sidewalk, the location of the lighting and the condition of the sidewalk. From the quadrants of the IPA method, it can be seen that the condition of the information system, the location of the street furniture and the cleanliness of the channel need improvement in order to create better comfort for pedestrian users.

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Biographies

Muhammad Isradi., born in Kandangan on 18 August 1972. He is the secretary of the Civil Engineering department at Mercu Buana University. He earned a degree in Civil Engineering from Universitas Muhammadiyah Malang in 1998 with the thesis entitled "One-Way Flat Plate Planning at Ratu Plaza Madiun. He then obtained a Master's degree in Civil Engineering, Transportation Concentration from Brawijaya University in 2001 with a thesis entitled "Family Movement Awakening Model in Sawojajar Housing Area, Malang". He also teaches several subjects such as Pavement Planning, Geometric Road Planning, Transportation Planning and Environmental Engineering.

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