Identification of Urban Vitality at Bus Rapid Transit (BRT) Halte in Semarang City Centre

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Abstract. The urban vitality theory is one of urban design theories from Jane Jacobs (1960) stated that a city where can live for 24 hours should be equipped with good built environment refers to pedestrians. This research has been conducted in Semarang City Centre Area which is the center of Semarang City. Semarang City Centre is Pandama area consists of Jalan Pandanaran, Jalan Pemuda, and Jalan Gajah Mada. This area consists of the central government, trade and services, residential areas, and already has public transportation, one of them is Trans Semarang BRT. However, the interest of Trans Semarang BRT users has not yet dominated can be influenced by several factors such as environmental conditions that have not supported pedestrians, affecting individual behavior on foot. This study used a quantitative method approach by first calculating values of the indicators at all Bus Rapid Transit (BRT) Halte on Semarang City Centre and then used ranking method to perform comprehensive comparative analysis to identification urban vitality. The results from this study shows that the Hotel Santika Halte has the highest urban vitality level, followed by Balaikota halte has the second rank and Theresia Halte has the third rank of urban vitality.

Keywords: urban vitality, pedestrian, Bus Rapid Transit (BRT) Halte, Semarang City Centre

1. Introduction

Urban vitality defined by H. Sung (2013) identifies the relationship between the physical environment and walking activities in Seoul, South Korea. This research based on the book The Death and Life American Cities by Jane Jacob that observes the vitality of an urban city can be restored, cared for, and supported by the elements of the pedestrian physical environment and the region that has a diversity of activities. The physical condition of the city according to Jacob (1961) which can influence to support urban vitality, including mixed land users, building plots, old buildings, accessibility, activity center points, and vacuum borders [1–3]. Y. Wenze also argues that urban vitality is a capacity of the built environment to support the life of social activities and develops because of the built environment itself, human activities, and human environment interactions [4].

A good pedestrian condition can promote people to walk because it provides a sense of security and comfort in walking. This is an important value in the movement of pedestrians in the era of modern urban transportation systems [5]. The quality of a good pedestrian environment, such as the presence of street lights, road benches, landscapes, trees, and other supporting facilities is the factors that can influence walking behavior [6]. In addition, a good pedestrian environment influences walking behavior.
towards density, diversity, design, destination accessibility, and distance to transit [7]. The better quality and complete supporting facilities in the pedestrian pathway can support positive walking behavior for each individual, especially the desire to go public, one of which is BRT [8].

Pedestrians shows walking activity that it influences the psychosocial elements, such as social interaction, health, and happiness. Social interactions are like visiting and gathering with friends. Health and happiness when walking is one of the physical activities that can improve health. In addition to the benefits of psychosocial elements, walking activities can also make it easier for people to move towards greater distances using public transportation [2]. Running activities are influenced by the surrounding physical environment, such as design, security, the existence of trade and services, and weather. One of the previous studies examines that current activities can be influenced by the built environment such as the macro physical environment which consists of six conditions of the physical environment elements of a large city to maintain urban vitality and micro physical environment, namely the road level, like road conditions. [9].

Bus Rapid Transit (BRT) as a type of public transportation is a bus that has made improvements to operating systems, technology, infrastructure and tools to improve mass transit-based bus services that can improve the accessibility [10]. Public transportation mode services, namely mass transit-based buses, are connected with various modes, one of which is non-motorized transportation modes [11]. This non-motorized transportation consists of pedestrians and cyclists that are considered easy access, at network connectivity. The pedestrian network has a major component in its development, namely increasing connectivity by walking and cycling that has good transit access. Accessibility in pedestrians can be calculated from a variety of indicators, including the structure of the road network, socio-economic conditions, characteristics of land use, and pedestrian environment security [12]. The existence of BRT Halte near school location and noticed walking distance range for students can increase the pedestrians as BRT users around BRT Halte [13].

According to the article published by Macmillan Publishers Limited about the condition of pedestrians in Indonesia, it is stated that pedestrian has not yet become a culture or lifestyle. This is evidenced by a study conducted by Stanford University researchers through an application method that can monitor walking activities using mobile phones, the result of which is that Indonesia has the laziest population on foot. The factors that caused Indonesia to have the lowest value are Indonesia did not yet thoroughly have friendly pedestrian facilities. Whereas, one of the studies related to walking activities shows the use of public transportation is very related because using public vehicles in reaching destination is one of the greatest opportunities to improve health [14].

This study aims to see the urban vitality conditions of Semarang City Centre, especially at Bus Rapid Transit (BRT) Halte as one of the attractions of pedestrians as walking activity. This research is expected to be a recommendation for the needs and opportunities for the development of pedestrian facilities in the physical environment of the road system in the city of Semarang, and also of people as users of the Trans Semarang BRT. This can increase the accessibility of Trans Semarang BRT users to their destination locations that can support the vitality of a city supported by pedestrian-oriented city development. This is what supports the increasing vitality of the city where it can make sustainable transportation.

2. Data and Methods

2.1. Case Study Area

The selection of this location area is based on the principles of urban vitality theory: (a) the location has friendly pedestrians, (b) the location is close to area settlements and contributes to daily resident activities, such as work and school [1,3]. The scope of the area in this research activity is the central business district (CBD) area which is close to the residential area in Semarang City Centre, namely on the road corridor in Pandama Area (Pandanaran, Pemuda, Gajahmada). The characteristics of the use of buildings at Bus Rapid Transit (BRT) Halte in a buffer of 200 meters from the point of the BRT Halte. Pandanaran street is mostly consist of daily commercial areas, offices, and settlements behind the
building on the road. Likewise on Pemuda street, this street is dominated by government offices, trade and services, education, and the least number of settlements. Meanwhile, Gajahmada has the highest settlement area and trade as well as offices on the road. Pandama area was chosen because it has the best pedestrian path conditions in the main corridor compared to the pedestrian lane on the road corridor in Semarang City. The Pandama area on the road corridor has also provided a variety of public transportation, one of which is the Trans Semarang BRT. The area of this study in the road corridor would be observation points for conducting research, which are eight observation points of Trans Semarang BRT Halte. The road corridors in Pandama Area are five Trans Semarang BRT corridors that pass through this route, namely Corridor I, Corridor II, Corridor III, Corridor IV, and Corridor V. The following is an overview of the scope of the region in Figure 1.

Figure 1. Map of the function of buildings in Semarang City Centre

2.2. Data
Number of pedestrians as walking activity criteria were carried out in research in Seoul, South Korea by seeing through pedestrian volume based on the number of pedestrians on weekdays, on holidays, and on weekdays and holidays. This is based on the more walking means that the conditions of the environment support the activity of walking, so people are interested in walking and use public transportation (H. Sung & Lee, 2013; H. Sung & Lee, 2015). In addition, in the case of street vitality in China use the average number of pedestrians at peak hours in the morning, afternoon, and night (Xu et al., 2018; Yue et al., 2019). This research will use the number of pedestrians calculated on weekdays with three times on the morning peak hours (07.00 - 08.00), afternoon (12.00 - 13.00), and afternoon (15.30 - 16.30) due to consideration of the relationship between the physical environment and running activity. Urban Vitality indicators consist of elements of the physical environment at the road level and urban vitality elements. The following is how to calculate field observations on elements of the physical environment at the road level and urban vitality elements.
Table 1. Measurement data of urban vitality at Bus Rapid Transit (BRT) Halt in Semarang City Centre

| Elements                  | Code | Sub-Elements                                      | Measurement Methods         | Data Sources                                          |
|---------------------------|------|---------------------------------------------------|----------------------------|------------------------------------------------------|
| Pedestrians               | A    | Number of pedestrians                             | Number (Average/Hour)       | Field Observations                                   |
| Pedestrian Ways           | B    | Pedestrian ways width                             | Length (Meters)             |                                                      |
|                           |      | Crossing line and Pedestrian bridges              | Number (Units)              |                                                      |
|                           |      | Ramps                                              | Number (Units)              |                                                      |
|                           |      | Trees                                              | Number (Units)              |                                                      |
|                           |      | Bench                                              | Number (Units)              |                                                      |
|                           |      | Dustbins                                           | Number (Units)              |                                                      |
| Urban Vitality: Mixed Use | C1   | Balancing Index Neighborhood Daily Use (Education, Trade and Small Services, Health) | RNR (Neighborhood Daily Use) = \(1 - \frac{Res - Nonres (Neighborhood Daily Use)}{Res + Nonres (Neighborhood Daily Use)}\) | Google Earth 2018 and Administration and Land Use Map from Bappeda 2018 |
|                           | C2   | Balancing Index Nondaily Use (Large Trade and Services, Worship and Tourism) | RNR (Non Daily Use) = \(1 - \frac{Res - Nonres (Non Daily Use)}{Res + Nonres (Non Daily Use)}\) |                                                      |
|                           | C3   | Balancing Index Office Use                         | RNR (Office Use) = \(1 - \frac{Res - Nonres (Office Use)}{Res + Nonres (Office Use)}\) |                                                      |
| Urban Vitality: Concentration | D1 | Net Density Nondaily Use and Neighborhood Daily Use | Net Density = Total Area Nondaily Use and Neighborhood Daily Use | Field Observations                                   |
|                           | D2   | Net Density Office Use                             | Net Density = Total Area Office Use |                                                      |
|                           | D3   | Number of commercial buildings                     | Number (Units)              |                                                      |
| Urban Vitality: Block Size | E    | Crossing road                                      | Number (Units)              | Google Earth 2018 and Administration and Land Use Map from Bappeda 2018 |
| Urban Vitality: Accessibility | F    | BRT Trans Semarang                                | Number (Units/hour)         | Field Observations, Regulations of Cultural Heritage in Semarang, |
| Urban Vitality: Old Buildings | G    | Number of old buildings                            | Number (Units)              |                                                      |
2.3. Methods
The flow of research conducted in this study is related to the identification of urban vitality at Bus Rapid Transit Halte in Semarang City Center, known as Pandama Area, which has three main roads with eight BRT Halte as observations points. This study identifies urban elements of vitality and walking activities using seven main elements and eleven sub-elements consisting of pedestrian activity, pedestrian ways conditions, and built environments conditions. The data needed is collected through field observations and calculated according to their definitions and calculations. Finally, a ranking method analysis was conducted to compare the three conditions of influence of urban vitality elements on the eight Bus Rapid Halte at three roads, namely Jalan Pandanaran, Jalan Pemuda, and Jalan Gajahmada. So, the results can be done to suggest sustainable development and development of BRT in Semarang City.

3. Results
The following are the results of identifying of urban vitality at Bus Rapid Transit (BRT) Halte in Semarang City Centre.

3.1. Analysis of Urban Vitality Conditions at Bus Rapid Transit (BRT) in Semarang City Centre
This following observations are based on the table of measurement data to identification of urban vitality conditions at Bus Rapid Transit (BRT) Halte in Semarang City Centre.

| Table 2. Measurement data of urban vitality elements at Bus Rapid Transit (BRT) Halte in Semarang City Centre |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Observation Points | Halte | A | B | C1 | C2 | C3 | D1 | D2 | D3 | E | F | G |
|:---|---|:---|---|---|---|---|---|---|---|---|---|---|
| 1 | Balaikota, Pemuda | 149 | 66 | 0.687 | 0.687 | 0.682 | 20566 | 33241 | 3 | 1 | 62 | 3 |
| 2 | BCA, Pemuda | 21 | 29 | 0.209 | 0.209 | 0.172 | 31424 | 37582 | 5 | 5 | 22 | 3 |
| 3 | PLN, Gajahmada | 4 | 39 | 0.709 | 0.709 | 0.063 | 46281 | 814 | 9 | 13 | 17 | 0 |
| 4 | Theresia, Gajahmada | 24 | 34 | 0.912 | 0.912 | 1.000 | 46020 | 22 | 18 | 18 | 0 |
| 5 | Hotel Gumaya, Gajahmada | 7 | 35 | 0.635 | 0.635 | 0.223 | 58523 | 5150 | 23 | 8 | 12 | 1 |
| 6 | Hotel Santika, Pandanaran | 32 | 52 | 0.781 | 0.781 | 0.432 | 39886 | 5350 | 10 | 10 | 16 | 2 |
| 7 | Agusta, Pandanaran | 8 | 31 | 0.949 | 0.949 | 0.068 | 36852 | 2031 | 12 | 7 | 20 | 0 |
| 8 | Pandanaran I, Pandanaran | 17 | 40 | 0.894 | 0.894 | 0.151 | 22571 | 2031 | 9 | 5 | 19 | 2 |

In Table 2 Column A, based on the results of the field observations, the highest number of pedestrians is at the Balaikota Halte at Pemuda street as many as 446 people or 149 people / hour. This is because the Balaikota Halte is a type of transit stop in the Semarang City Centre. The highest number of pedestrians according to time is at the Balaikota Halte in the morning. It can be assumed that there are activities for going to school and going to work activities, because the dominating function of the building around the Pemuda street corridor is offices and there are two upper secondary schools, namely SMAN 3 Semarang and SMAN 5 Semarang. In addition, Jalan Pemuda also has a Semarang City government center, the Semarang City Hall Building. Around the Balaikota Halte there are also two large commercial areas around the Balaikota Halte, namely Paragon Mall Semarang and DP Mall, as well as one historical tourist area, namely Lawang Sewu. Based on measurement data results the
conditions of the urban vitality above. Then it will be processed in the analysis to see the highest urban vitality conditions at BRT Halte in Semarang City Centre.

3.2. Ranking Analysis of Urban Vitality Conditions at Bus Rapid Transit (BRT) in Semarang City Centre

The following results from the measurement data to identify urban vitality conditions were carried out by doing ranking methods by sorting from 1 to 8 on each factor at eight observation points with a 200 meter buffer based on statistical counts. Based on the results of the table above, Hotel Santika Halte has the highest rank of urban vitality conditions, Balaikota Halte has the second rank of urban vitality conditions, and the third rank is Theresia Halte.

Table 3. Ranking analysis of urban vitality at Bus Rapid Transit (BRT) Halte in Semarang City Centre

| Observations Points | Halte                  | A1 | B  | C1 | C2 | C3 | D1 | D2 | D3 | E1 | F1 | G1 | Total | Rank* |
|---------------------|-----------------------|----|----|----|----|----|----|----|----|----|----|----|-------|-------|
| 1                   | Balaikota, Pemuda     | 1  | 1  | 6  | 2  | 8  | 2  | 8  | 1  | 1  | 39 | 2   |       |       |
| 2                   | BCA, Pemuda           | 4  | 8  | 3  | 8  | 5  | 6  | 1  | 7  | 6  | 2  | 2  | 52    | 5     |
| 3                   | PLN, Gajahmada        | 8  | 4  | 7  | 5  | 8  | 2  | 7  | 5  | 2  | 6  | 6  | 60    | 8     |
| 4                   | Theresia, Gajahmada   | 3  | 6  | 8  | 2  | 1  | 3  | 8  | 2  | 1  | 5  | 8  | 47    | 3     |
| 5                   | Hotel Gumaya, Gajahmada| 7  | 5  | 4  | 7  | 4  | 1  | 3  | 1  | 4  | 8  | 5  | 49    | 4     |
| 6                   | Hotel Santika, Pandanaran | 2 | 2  | 2  | 4  | 3  | 4  | 4  | 3  | 7  | 3  | 38 | 1     |       |
| 7                   | Agusta, Pandanaran    | 6  | 7  | 6  | 1  | 7  | 5  | 5  | 3  | 5  | 3  | 7  | 55    | 6     |
| 8                   | Pandanaran I, Pandanaran | 5 | 3  | 5  | 3  | 6  | 7  | 6  | 7  | 4  | 4  | 56 | 7     |       |

Notes:
*) Rank 1 shows that built environment around BRT Halte has the highest of urban vitality conditions at Semarang City Centre Area and Rank 8 shows that built environment around BRT Halte has the lowest of urban vitality conditions Semarang City Centre Area.

Hotel Santika Halte has the highest rank of urban vitality conditions based on amount of pedestrian, pedestrian ways conditions, number of old buildings, balancing index of neighborhood daily use, balancing index of office use and amount of crossing roads. Hotel Santika Halte has the highest score on amount of pedestrian because there are many pulls in amount of pedestrians from buildings in the surrounding area, especially close to SMAN 1 Semarang, SMKN 7 Semarang and SMKN 8 Semarang. Then, pedestrian ways conditions in Hotel Santika Halte have good conditions, because the complete pedestrian attributes are available in the area to support the comfort of pedestrians. There is an old building in the area, that has a 1960s style building design, but it is not used often. The buildings around the Hotel Santika Halte have diverse types of building for trade and service on the main road, education, and offices. This causes quite a number of pedestrians come to the Bus Rapid Transit Halte which makes the area of high vitality conditions. Lastly at Hotel Santika Halte has high rank on amount of crossing
road. The higher the amount of crossing roads, the easier it is for pedestrians to reach one building to another. Hotel Santika Halte conditions can be seen in figure 2 and figure 3.

![Figure 2](image1.png)  
**Figure 2.** Urban vitality conditions at Hotel Santika Halte, Pandanaran Street. (a) Hotel Santika Halte, (b) pedestrian conditions, (c) old building, (d) Merbabu as a commercial building.

![Figure 3](image2.png)  
**Figure 3.** Map of the function of buildings at Hotel Santika Halte, Pandanaran Street, Pandama Area

The second rank is Balaikota Halte, Balaikota Halte has the second of urban vitality based on amount of pedestrians, pedestrian ways conditions, balancing index of neighborhood daily use, balancing index of office use, net density of office use, frequency of BRT’s bus per hour, and amount of old buildings. Amount of pedestrians at Balaikota Halte has the highest number from all the observation points at Pandama Area. It is because Balaikota Halte has a good built environment, like pedestrian ways conditions and buildings around Balaikota Halte at Pemuda Street. Pedestrian ways conditions at Balaikota has a good pedestrian ways to support pedestrian, because it has pedestrian attributes that are complete with good conditions and served comfort and safe pedestrian ways. Built environment around Balaikota Halte is dominated by office buildings (goverment offices), trade and services buildings (Paragon Mall and DP Mall), and education buildings (SMAN 3 Semarang and SMAN 5 Semarang).
The buildings in Pemuda Street on average are included in the type of old buildings, one of them is the Balaikota Semarang building.

![Image](image1.png)

**Figure 4.** Urban vitality conditions at Balaikota Halte, Pemuda Street. (a) pedestrian ways conditions, (b) Balaikota Halte at peak hour, (c) SMAN 5 Semarang, (d) Balaikota Semarang as old building.

![Image](image2.png)

**Figure 5.** Map of the function of buildings at Balaikota Halte, Pemuda Street, Pandama Area

The third rank is Theresia Halte, Theresia Halte has the third score of urban vitality based on amount of pedestrians, pedestrian ways conditions, balancing index of non daily use, balancing index of office use, net density of neighborhood daily use and non daily use, amount of commercial buildings, and amount of crossing roads. The amount of pedestrians has the third rank because Theresia Halte location is very close to education area (Yayasan Pendidikan Theresia) and settlement area around Theresia Halte. The pedestrian ways near to Theresia Halte has not a complete pedestrian ways attributes, which is not available like bench and dustbin. The buildings around Theresia Halte is dominated by settlement area (Pekunden Town Village), trade and service area (small shops and services), and education area (Theresia School). The existence of old buildings is not available in the buffer area at Theresia Halte.
Figure 6. Urban vitality conditions at Theresia Halte, Gajahmada Street. (a) pedestrian ways conditions, (b) Theresia Halte at peak hour, (c) Theresia School, (d) Swalayan Bali as a commercial building.

Figure 7. Map of the function of buildings at Theresia Halte, Gajahmada Street, Pandama Area

The most influential sub-element of urban vitality in the influence of urban vitality elements on the number of pedestrians of BRT users is the availability of neighborhood daily use buildings or supporting buildings for residential areas, such as shops, small clinics, and schools. These three types of buildings are often visited because they meet human daily needs, such as shopping for food at small shops or shops, visiting clinics when sick, and going to school to get knowledge as a compulsory education for children aged 7-18 years. Hotel Santika has a high vitality because it has a high number of pedestrians, has a high office use index balancing value, a net density of office use buildings and has a fairly complete pedestrian track attribute.

4. Conclusions
This study observed urban vitality conditions at Bus Rapid Transit (BRT) Halte in Semarang City Centre. Several studies have been found, the conditions of urban vitality in the Pandama area of Semarang City is on the Hotel Santika Halte. Whereas, then the number of urban vitality in Pandama
Area, Semarang City is on Balaikota Halte, and the third rank is on Theresia Halte. Result of analysis shows the relationship between urban vitality elements and amount of pedestrians in Semarang City Centre has the highest value in Pandama Region on the sub element because it has office use index balancing value, net density office use, frequency of Trans Semarang BRT Bus, pedestrian lane conditions, and number of pedestrians. The lowest ranks of urban vitality conditions at Bus Rapid Transit Halte in Semarang City Centre is on PLN Halte, Pandanaran Halte, and Agusta Halte, that these Halte should improve the vitality conditions, especially on pedestrian ways conditions and maintain another variables of urban vitality, such as existence of buildings supporting residential areas.

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