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Adaptation of the Pedestrian Walkways Design along the Trans Semarang Bus Corridor to COVID-19

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ABSTRACT

COVID-19 cases continue to increase in Indonesia, with an estimated value of 719,000 and an 8.37% mortality rate, due to the severity and potency of the deadly disease. One of the provinces that mostly contributes to the high mortality rate is Central Java, especially in populous areas like Semarang City. The spread of the virus occurs through direct contact between humans, forcing physical and social distances to become more important, especially in public spaces. Based on these conditions, city planning experts reportedly suggests a public space re-design process, adaptable to the current pandemic conditions, in order to provide a comfortable, safer, and sustainable urban life. Therefore, this study aims to analyze the integration of the mass transportation system (the Bus Trans Semarang) with the readjustment and redesign potentials of pedestrian walkways, in response to the COVID-19 pandemic. For the past two years, the development of pedestrian walkways has become an integral part of the Semarang City Government, in order to realize a sustainable transportation system. Furthermore, the pandemic has presently made pedestrian walkways less functional, due to public concerns on its spread in external areas. The retrieval spatial-based data of this study focused on the bus stops for the Trans Semarang Bus Corridor, which were potential points for the emergence of walking activities. The method used in the measurement of pedestrian activity included behavioral mapping and urban design analysis. This was to identify the pedestrian design indicators that were adaptive to the pandemic conditions. The simulation methods also assisted the data visualization process, by using spatial applications such as ArcGIS and Sketchup. After this, the calculation of the capacity was carried out, to determine the maximum limit of the available spaces. The results were in the form of indicators, such as additional width, lane division, as well as provision of health and hygiene facilities. These were the main recommendations applied on the pedestrian walkways' environmental characteristics, at various points in Semarang City.

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1. Introduction

The massive global spread of the COVID-19 virus reportedly led to the stipulation of an international emergency declaration in January 2020, by the World Health Organization (WHO). This pattern of viral distribution is likely to continue due to the severity and potency of the deadly disease, as 87 million positive cases with more than 1 million deaths had been reported

(WHO, 2021). The condition is further exacerbated by the emergence of a new Covid-19 mutation, estimated to have a 70% spreading rate, which is higher than the previous variant (Nabila, 2020). This has led to a health and global economic crisis, due to many people losing their jobs (Hakovirta & Denuwara, 2020; Nicola, et al., 2020). Most global cases are found to occur in densely populated urban areas, exacerbated by the low readiness to confront disasters (Barbarossa, 2020). For example, 27% of all cases occurred within the metropolitan cities in Italy. However, it is also possible for rural areas to have similar vulnerability to COVID-19, which is often triggered by regional connectivity (Jo, Hong, & Sung, 2021).

According to WEF (2019), there were five reasons for the frequent increase of the outbreaks in urban areas, namely (1) The relatively easy human movement, (2) The density, low hygienic awareness level, and 55% of the world's population were concentrated in urban areas, (3) The problem of environmental damage due to illegal logging, (4) Climate change accelerating the process of disease transmission, (5) Poverty, conflict, and emergencies. In response to these challenges, city planners suggest that adaptive and resilient environmental design planning is essential for the sustainability of urban communities. This condition similarly leads to the opportunity to form a new paradigm, regarding the concept of city development, as an innovation used to deal with present and future crises (Secchi, 2013; Barbarossa, 2020).

The COVID-19 pandemic is a challenge to the creation of sustainable urban developments, through the consideration of three important aspects, namely health, economy, and social conditions. Furthermore, the application of new efficient planning models is being conducted in several cities, by emphasizing the 'New Normal' concept. This supports the transition to a sustainable, low-carbon, inclusive, and healthier economy (Taylor, 2020). One of the effective models being considered for high efficiency on present problems is urban mobility, especially its application on the concept of sustainable transportation. This is conducted by connecting mobility, space, and public health (Bucsky, 2020; Batty, 2020). In addition, public space and city landscape are considered as sources with high chances of Covid-19 distribution, leading to the important consideration of sustainability.

The principles applied in the creation of a sustainable space are social health guidance and local economy supports, physical distance, additional dimensions, public transport prioritization, cycling and walking, as well as responsive society development (Barbarossa, 2020). Public space planning in several cities such as New York, highly focuses on developing sustainable road capacities, which integrates public transportation modes and pedestrian walkways, in order to connect with community activity centers. This is due to these elements being considered as important opportunities, to create efficient urban community movements after the pandemic. Moreover, the applications carried out in creating sustainable road spaces include special cycling lane developments, sidewalk expansions, as well as unique transit route and pick-up zone procurements (NACTO, 2020).

The study conducted by De Vos (2020), stated that the travel behavior of urban communities should be considered in creating a sustainable city system. In addition, the behavior of people is also a potential factor in increasing the spread of the Covid-19 disease. This is related to social distance, especially in economic activities and basic human characteristics, which requires direct interactions. In this case, behavior becomes the basis for important complementary considerations, due to humans needing daily interactions. Moreover, the study of Yuen, Wang, and Li (2020), stated that there were three stages of behavioral change during the COVID-19 pandemic, namely panic, adaptation, and the new normal order. The independent and government-regulated codes of conduct were also needed to limit travel over short distances (Shakibaei, 2020).

Indonesia ranks 3rd in contributing to the highest Covid-19 death rates within the Southeast Asia region (WHO, 2021), due to inadequate sustainability procedures and poor readiness to confront disease outbreaks, especially in urban areas. Furthermore, this study was conducted in Semarang city, one of the largest metropolitan provinces in Indonesia, due to the violations of health protocols and unhygienic public spaces during the pandemic. Meanwhile, massive urban community activities are still ongoing, due to the trade and service events of the city, leading to public spaces being unavoidable. The use of these spaces in Semarang City is found to be very high, especially after the commissioning of the pedestrian walkways in 2018. Based on the new paradigm, this study aims to determine an effective pedestrian walkway design, adaptive to COVID-19. The Trans Semarang Bus corridor as a transit point, is also directly connected to the pedestrian walkways in Semarang City. Therefore, this study is very important in suppressing the potential spread of COVID-19 at public spaces, such as pedestrian walkways and transit centers. Developing countries such as Indonesia, also have quite complex outdoor activities, with a high level of rule violations. In addition, the adaptation to spatial conditions is an alternative in controlling population activities.

2. Methodology

2.1 Semarang City Cases

This study was conducted in Semarang City, which is one of the most popular metropolitan provinces in Indonesia. With a density of 4.855 people/km^2, this city continues to experience yearly population growth, reaching 50% in urban areas (BPS,2020). Based on the 2011–2031 development plan, the trade and service sectors dominated economic activities, as the creation of a sustainable transportation system was massively carried out in 2018, by providing Trans Semarang Buses and pedestrian routes. In 2017, the passengers of these buses reached 10 million, with 88% of them being pedestrians (Purwanto & Manullang, 2018). There were also approximately 9 corridors with 596 bus stops, from the Trans Semarang Buses scattered in the downtown area to its suburbs (see Figure 2).

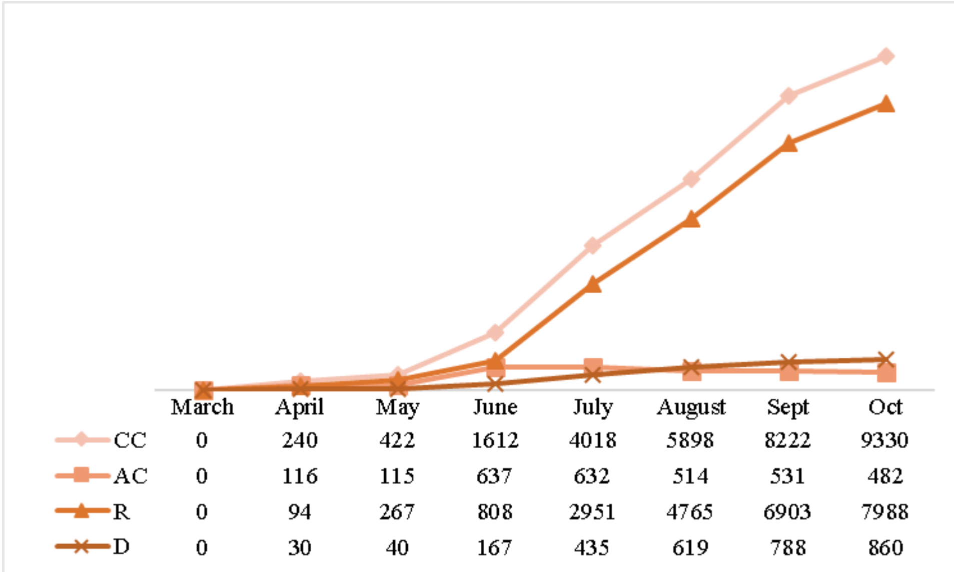


Figure 1 Semarang City COVID-19 case in 2020 ; CC (Confirmed Case); AC (Active Case); R (Recovered); D (Death), (Semarangkota, 2020).

Figure 1 showed that several cases that occurred within Semarang City increased with the highest CC (confirmed case) spikes in October 2020. Furthermore, COVID-19 cases in various parts of Indonesia, such as Semarang City, were predicted to continuously increase, due to the emergence of several variants with high transmission rates (BBC, 2021). This was triggered by the low awareness of the public in complying with health protocols (Kompas, 2020). Therefore, the determination of social distance and population density was considered, to minimize problematic impacts.

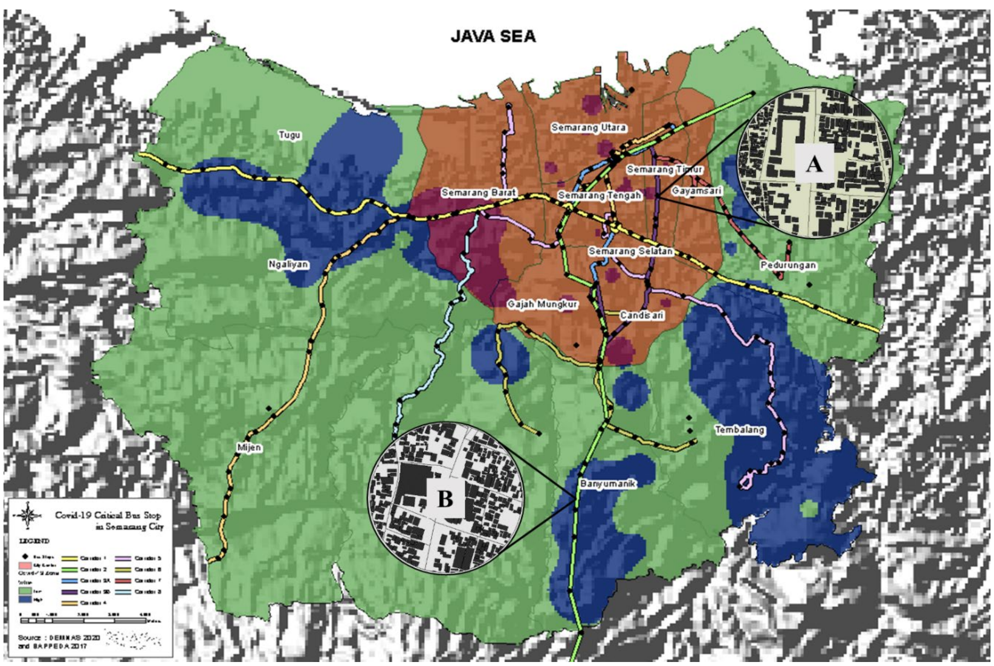


Figure 2 Study area orientation and Bus Trans Semarang Corridors (Researcher Analysis, 2021)

Based on the data obtained in 2020, West Semarang and Tembalang Districts were one of the locations with the highest positive cases in Semarang City, when viewed from the spread of COVID-19. Experts also conducted a spatial data processing method (an overlay), to determine the bus stop zone with the highest crisis level of the distribution. The results between the positive cases per village and population density, as well as the critical distributional zone (in blue) is shown in Figure 2. Therefore, this study aims to determine the pattern and needs of pedestrian movement and walkway designs, as a form of high public space in Semarang City. The various forms of topography and land use in this city, caused the consideration of two environmental areas to in this study, which consisted of the downtown and suburban areas. When observed further, several critical zones in the suburban areas were found with land use dominance as settlements. These results also showed that the SMKN 1 Semarang (city center) and Sukun Banyumanik Terminal bus stop zones had the highest risk of viral transmission, due to environmental conditions and continuous walking activities. Both of these areas had high outdoor events and pedestrian potentials on weekdays to holidays.

2.2 Study Methodology

This general analytical approach used in Barbarossa (2020) was adopted in this study, through the pre and post-pandemic condition simulation methods. These methods focused on processing and simulating the data of pedestrian walkway designs and movement patterns, respectively. Based on the spatial data process, two locations were sampled through the overlay method, to analyze pedestrian activity and design along the Trans Semarang Bus corridor. The simulations of this design were carried out by using a descriptive data processing approach, through spatial analysis applications such as ArcGIS, Autocad, and Sketchup. Meanwhile, the analysis of pedestrian movement patterns was conducted through the behavioral mapping method. To support the design implementation, this study also provided an overview of maximum capacity calculation, accommodated by each vital space along the pedestrian walkways. This was carried out by using the standard capacity design formula in Indonesia. The expected results were in the form of a design recommendation, which was adaptive to the pandemic. The data collection process was conducted using an online spatial method, through the open google street map access, for simulated analysis of pedestrian walkways. However, data collection on pedestrian movement patterns along the Trans Semarang Bus corridor was carried out by random field observations at several bus stops. The design components produced from each analysis were adjusted to the policies implemented by the Government of the Republic of Indonesia, in the Health Protocol Guidebook for 2020. The analytical process carried out in this study is shown in Figure 3.

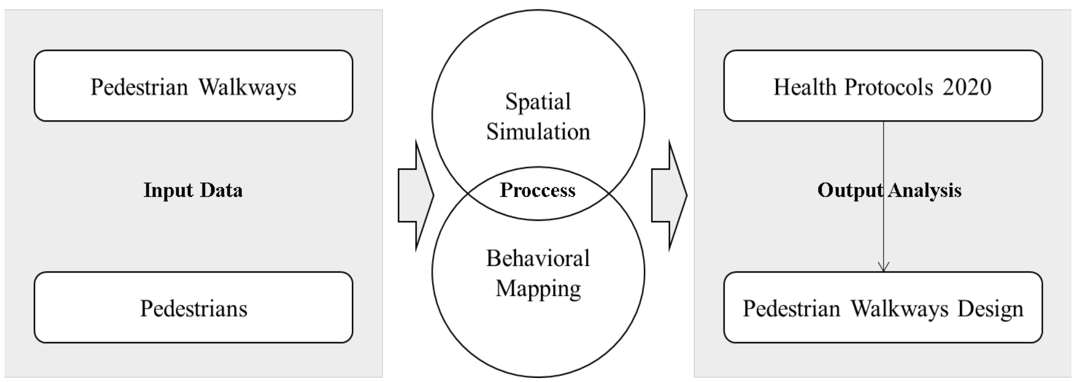


Figure 3 Research Methods Diagram (Researcher Analysis, 2021)

3. Result and Discussion

3.1 Existing Pedestrian Walkways Analysis

The overlay results showed that two bus stops were sampled as critical zones for outdoor COVID-19 transmission. These two points were generally areas of dense activity, with high pedestrian potentials for Trans Semarang Bus passengers. Furthermore, the SMKN 1 Semarang bus stop (city center) was a zone with land use dominance as education and housing. The spread of COVID-19 in this zone was quite high, although the conditions for pedestrian walkways were still relatively minimal. Based on Figure 4a, the walkways in this zone were equipped with a Trans Semarang Bus stop as a transit point, signboards, special lanes, zebra crossings, and ramps. The problem occurring in this zone was the pedestrian walkways covered by street vendor buildings, as well as motorcycle and taxi bases, which in turn narrowed the available width. Meanwhile, the behavioral mapping results showed that there were two types of walkway users in this zone, namely students and local communities. The pedestrians' movement in this zone randomly or irregularly occurred with the predominance of waiting to be picked up, as well as going home or to school.

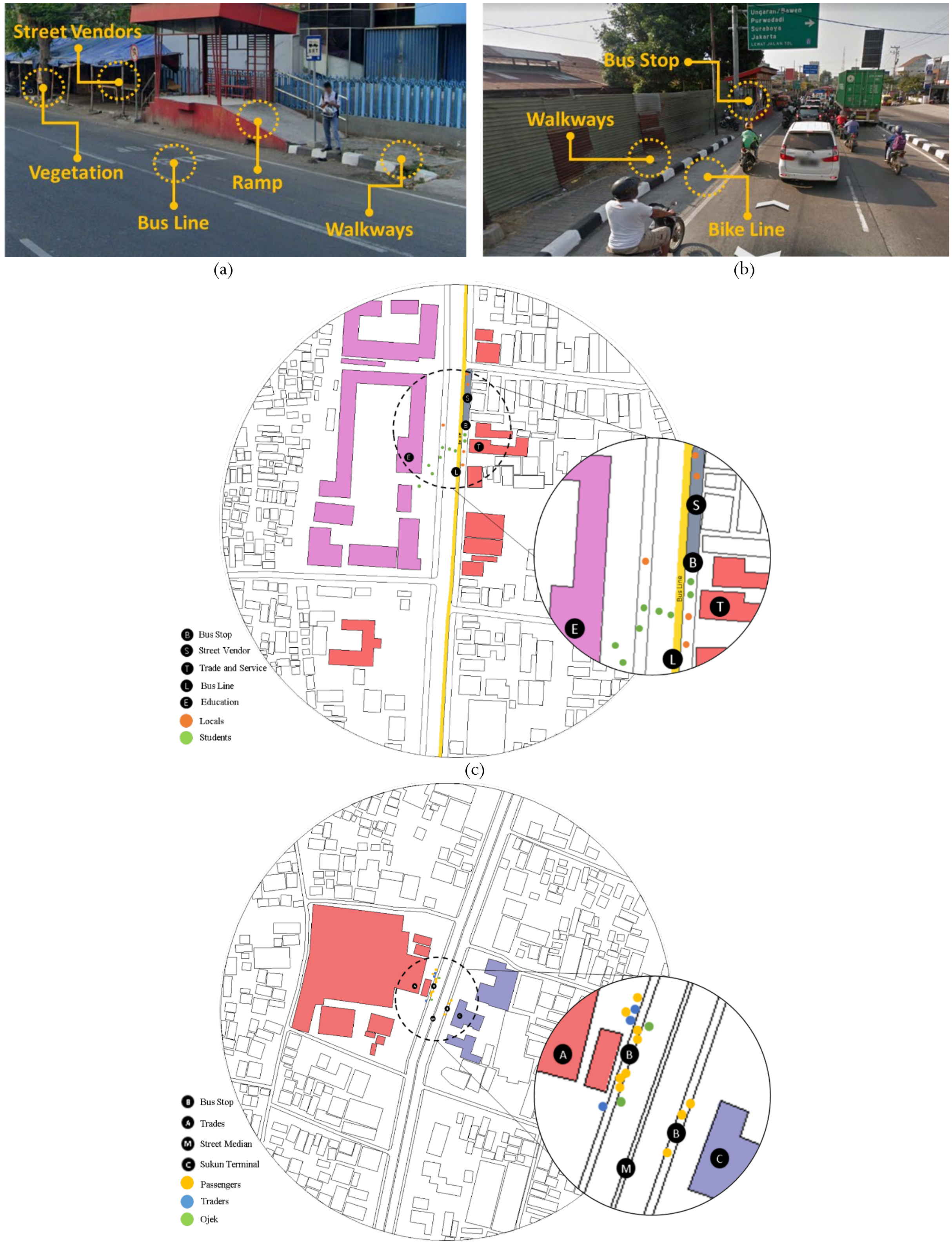


Figure 4 Pedestrian walkways ; (a) SMKN 1 Bus Stop existing; (b) Sukun Bus Stop existing; (c) SMKN 1 Pedestrian Walkways Behavioural Mapping; (d) Sukun Pedestrian Walkways Behavioural Mapping (Google Street View, 2021; Researcher Analysis, 2021)

The Sukun Terminal zone had land use characteristics dominated by trade and services. Its location on the Semarang-Yogyakarta highway caused high availability of motorized vehicles. Based on Figure 4b, the available pedestrian walkway width in this zone were only 1.5-2 m, with supporting components in the form of bus stops, motorbike lanes, and ramps. The behavioral mapping results showed that pedestrian activity in this zone was denser than the previous location, due to being close to the terminal and a shopping center. Most pedestrians were cross-regional passengers waiting for the bus to arrive.

The lack of facilities on the walkways caused several collisions of activity between pedestrians, leading to higher level of the COVID-19 distribution. This was contrary to the study of (Barbarossa, 2020), which showed the importance of maintaining social distance when travelling, especially in public spaces. Moreover, Figure 4d showed an accumulation of pedestrian activities, such as waiting for buses, selling, and picking up motorbikes at a certain point. Special motorways on the main roads were not properly used, and congestion was not uncommon due to the collisions between the Trans Semarang Bus and other transportation systems at similar zones and time. Based on these conditions, behavioral adaptation was independently or structurally needed through government regulations, in order to reduce the spread of COVID-19, especially in public spaces (Shakibaei, 2020).

3.2 *Simulation of Pedestrian Walkways Design*

The simulation phase and recommendations for the design of an adaptive walkway were carried out with the spread of COVID-19, after analyzing the existing spaces and behavioral mapping of pedestrians in the two zones. Based on Table I, the recommendations for each zone were derived from the incorporation of existing conditions, sustainable space variables from Barbarossa (2020), and the need for handling the pandemic from the Health Protocol Handbook 2020.

The suitable recommendations applied to the SMKN 1 bus stop as an educational and residential area, included space expansion, procurements of special pick-up, automatic temperature detectors, and portable handwashing zones, as well as one-way route signals. These routes were provided to minimize physical contact between pedestrians, due to the accumulation of activities. Meanwhile, the recommendations provided for the Sukun Terminal bus stop included the procurements of automatic temperature detectors and portable handwashing places, as well as special pick-up zones, one-way route signals, and adequate acquisition for hawkers. These recommendations were adjusted to each road capacity zones, described through the design simulation model in the Sketchup application.

Table 1 Pedestrian Walkways Design Analysis Standard

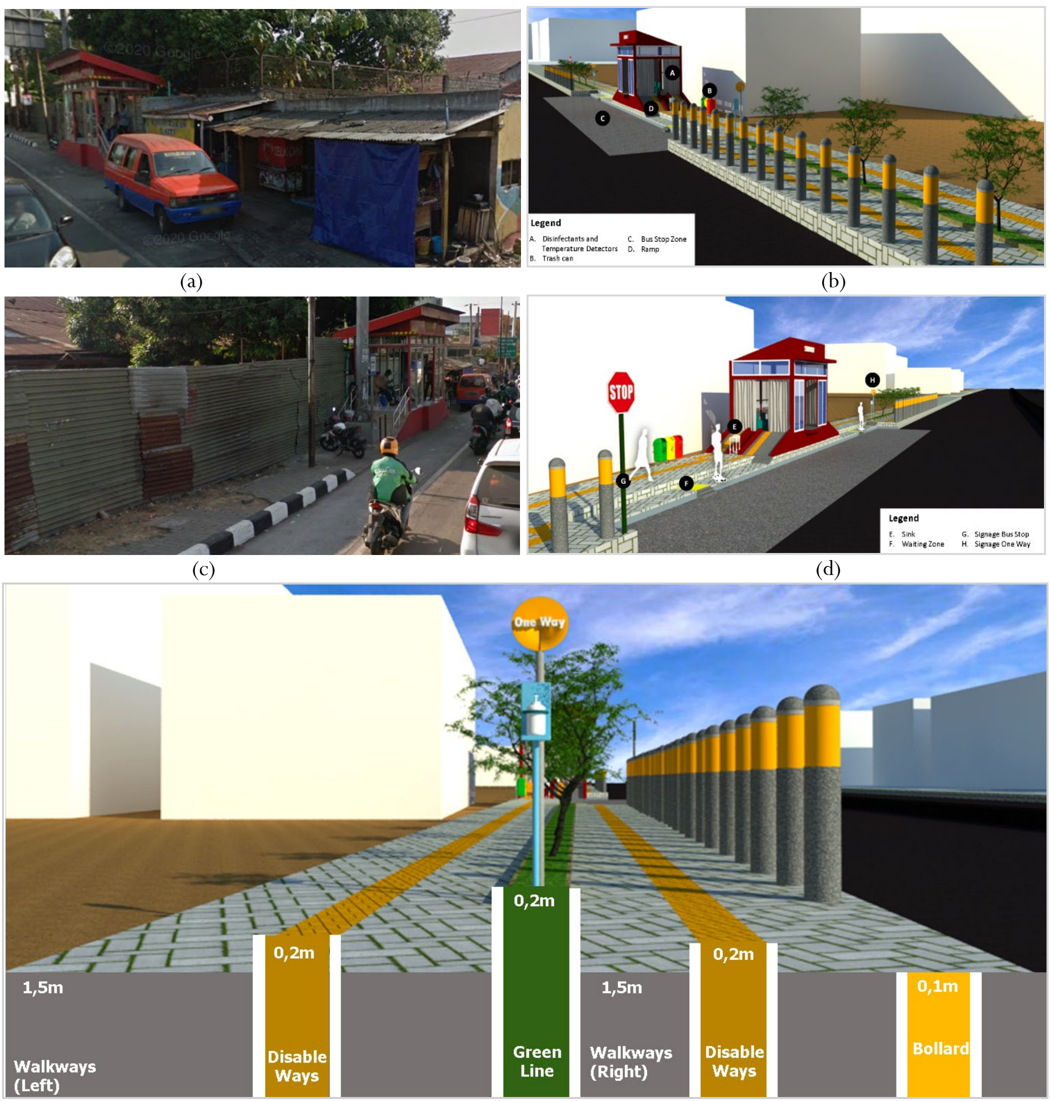
Num.	Location	Existing Conditions	Variable	Needs*	Recommendation
1.	SMKN 1 Bus Stop	✓ 2m x 3m bus stop. ✓ Pedestrian ramp and bus stop. ✓ 2.5m pedestrian walkways. ✓ Street vendors building and *ojek* post. ✓ Shade vegetation. ✓ Bus-only lane. ✓ Bus stop signboard.	✓ Cycling walkways. ✓ Pedestrian walkways expansion. ✓ Procurement of special transit lines. ✓ The procurement of special lanes has been slow. ✓ A special zone for loading. ✓ Special zone for commercial space.	✓ Hand washing place. ✓ Body temperature detection. ✓ Minimum physical distance of 1 meter. ✓ Space per person: 0.75m. ✓ Space plus physical distance of 0.75m + 1m = 1.75m. **Pedestrian Walkways Capacity Formula:** $Vt = \sqrt{35(W - N)}$ **Where:** Vt: volume of pedestrian/mete/minute. W: the effective width of the sidewalk. N: additional width according to local requirements. **Bus Stop Capacity Formula:** $Vh = \frac{\text{Bus Stop Large}}{\text{Space per Person}}$	✓ Relocation of street vendors to expand pedestrian access. ✓ Procurement of a special pickup zone. ✓ Procurement of automatic temperature detectors and portable hand washing stations. ✓ Signing for one-way pedestrian walkways.
2.	Sukun Bus Stop	✓ 2m x 3m bus stop. ✓ Pedestrian ramp and bus stop. ✓ 2m pedestrian walkways. ✓ Motor-only lane. ✓ Street vendors building and illegal parking.			✓ Relocation of street vendors to expand pedestrian access. ✓ Procurement of automatic temperature detectors and portable hand washing stations. ✓ Procurement of a special pickup zone. ✓ Signing for one-way pedestrian walkways.

Note: * Barbarossa, 2020; ** 2020 Health Protocol Handbook & 2017 Pedestrian Facility Guidelines.

Figure 5 was a simulation of the design recommendation implementations at the SMKN 1 bus stop in Semarang City. This location was traversed by one of the Trans Semarang Bus busiest lines, namely corridor 3B. To regulate individuals' distance, a walkway design having directional markers was implemented with a one-way system. This was in line with the guidelines for health protocols in Indonesia, which required a physical distance of 1-2 m between individuals, especially in open spaces. The provision of a waiting zone was also arranged through the availability of chairs along the route, in order to implement a 1 m single seat from one another. Furthermore, the provision of sinks, hand-sanitizers, and portable trash cans at every bus stop and walkway corners was also implemented, for health and hygienic needs. Inspired by the Yogyakarta City government's implementation, the entrance to the bus stop buildings (left and right) and walkways were provided with a disinfectant spray and automatic body temperature detector, to minimize the spread of Covid-19 (Indah, 2021). Other additional facilities included the provision of bollards, special bus/bicycle lanes, and bus stop markers, to ensure safety and comfort for residential mobility. Besides the elements of health, cleanliness, and comfort, focusing on the environment and social needs of pedestrians were also very important. Based on the SMKN 1 bus stop, the provision of similar sense to the pedestrian walkways was highly recommended. One of these recommendations was the application and provision of attractive colors and several greeneries to travelers and pedestrian walkways, respectively. An inclusiveness element such as the provision of a special disabled lane, was also important to implement, in order to create sustainable pedestrian walkways. Furthermore, Figure 5e showed that the available pedestrian walkways were widened up to 2 m, because street vendor buildings and motorcycle-taxi posts in the northern area previously disturbed the circulation of the public spaces.

Figure 5 SMKN 1 Bus Stop ; (a) Before (North); (b) After Design (North); (c) Before (South); (d) After Design (South); (e) Structures of Pedestrian Walkways (Google Street View, 2021; Researcher Analysis, 2021)

Based on similar applications on the SMKN 1 zone, the implementations in the breadfruit bus stop also collaborated the health, cleanliness, environmental comfort, and social components of the community. However, this zone had higher transportation activity and population mobility than the previous location. Moreover, street vendors' activities, illegal parking, congestion, air pollution, and irregular population movements caused potential higher levels of COVID-19 distribution. The location of this zone on the main arterial road connecting the two provinces caused larger available space, and suppressed the width of the pedestrian walkways. Unlike the previous walkway recommendations, lane separation in this zone was carried out by providing a path median, in the form of vegetation. In this system, the placement of the vegetation was a catchment area, and a source of clean water channeled to the sink. This container was used as input for landscape experts or environmentalists, to create a natural sanitation system, which recycled used handwashing water in other public spaces. Based on Figure 6c, the width of the pedestrian lane increased by 1 m, through a special bus/bicycle route on the existing road. Furthermore, the 2017 development guidebook stated that the minimum width for the pedestrian walkways on the arterial roads should be 5 to 6 m. The bus stop building was found to be inwardly protruded, due to the observation of a 14 m long zone accommodating passengers' loading and unloading on Trans Semarang Corridor 5 Trans-Provincial Buses. This helped to reduce the illegal loading and unloading of passengers on the road side, which often created traffic jams. Similar to the previous recommendations at SMKN 1 stop, the use of disinfectant spray and body temperature detector on entrances was also recommended for this zone. After this, the provision of hand sanitizers and portable trash was implemented, to support the health, hygiene, and environment of the pedestrians. Besides congestion, air pollution, illegal parking, and more, this area was also prone to traffic accidents. For this reason, the provision of bollards and signage along the pedestrian walkways was also recommended, to create safety and comfort in carrying out walking activities.



(a) (b) (c) (d) (e)

Figure 6 Sukun Bus Stop ; (a) Before (North); (b) After Design (North); (c) Before (South); (d) After Design (South); (e) Structures of Pedestrian Walkways (Google Street View, 2021; Researcher Analysis, 2021)

Veitch and Arkkelin (1995), stated that the provision of good space was to adapt to the activity patterns and needs of its users. The effectiveness of public space constructions such as pedestrian walkway, was observed from its success in resolving environmental problems, and changing negative to positive walking attitudes (Joh, Nguyen, & Boarnet 2012). The present pandemic condition really required order and high awareness of each individual, to help minimize the spread of the virus, especially in public spaces. Based on Figure 7, there was possibility of changes in pedestrian behaviors, towards a positive walking attitude. This was due to the arrangement of the walkways, especially the existence and provision of lane separation and complementary facilities. In the existing conditions, public transport passengers accumulated at one point within this zone, and produced irregular and overlapping movement patterns. With the existence of lane separation and distance application in all aspects of pedestrian walkways design, the creation of order and comfort in carrying out walking activities was expected.

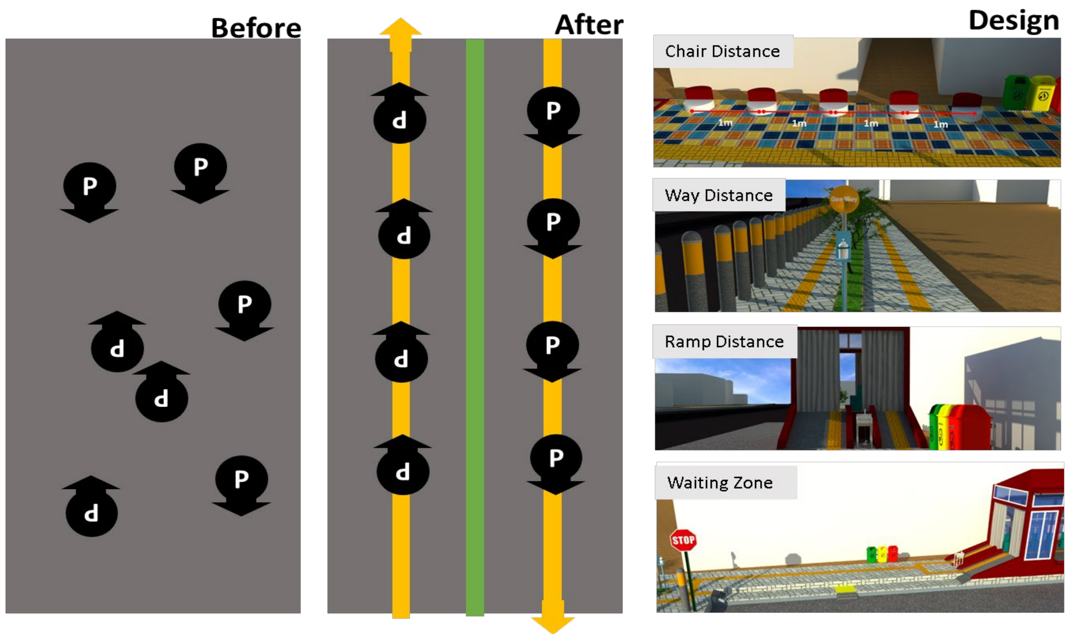


Figure 7 Pedestrian activity patterns before and after recommendations (Researcher Analysis, 2021)

Setting the pattern of movement on pedestrian walkways and in facilities such as bus stops, required an estimate of the user's capacity calculation. This aims to maintain a safe distance between humans, when in public spaces. Based on Figure 8a, the provision of care dimensions was implemented for human basic activities in public spaces, such as sitting, standing, and wheelchair users (disabled). The 2017 pedestrian facilities standard book stated that the width of an adult human walking with objects in both hands was 0.75 m, equivalent to the that of a wheelchair user. The adaptation of social distancing due to the condition of COVID-19 caused an increase in the minimum width of each individual by 1 m. Therefore, the minimum width of each person in a standing position is accumulated at 1.75 m, when in an open space. Based on Figure 7d and Figure 8e, the pedestrian walkways and bus stops had a certain division of spaces, as an effort to control the movement of users. However, each facility or zone had a maximum safe capacity for its users. Moreover, Table 2 showed the results of each facility capacity along the walkways, within a radius of 400 m from the bus stop point. The pedestrian capacity in the SMKN 1 zone achieved 35 people/m/min (one lane), when the calculation was accumulated with the physical distance between pedestrians. Meanwhile, the capacity of the bus stop covering an area of 2 x 3 m with two types of zone division (waiting for chairs and loading zone), had a maximum capacity of 7 people. Unlike the SMKN 1 zone, the Sukun bus stop only had a pedestrian capacity of 16 people/m/min with two divided lanes. The capacity of the bus stops only accommodated 5 people, due to the division of three points, namely pedestrian walkways, waiting, and loading zones. This capacity limitation was due to the addition of physical distance and bus stop buildings included in this type of small-scale construction. The existence of a waiting zone also created additional space for transportation activities. For example, the waiting zone at the SMKN 1 and Sukun stops had capacities of 6 and 12 people, respectively. This is likely to change based on the area and shape of the space provided along the pedestrian walkways.

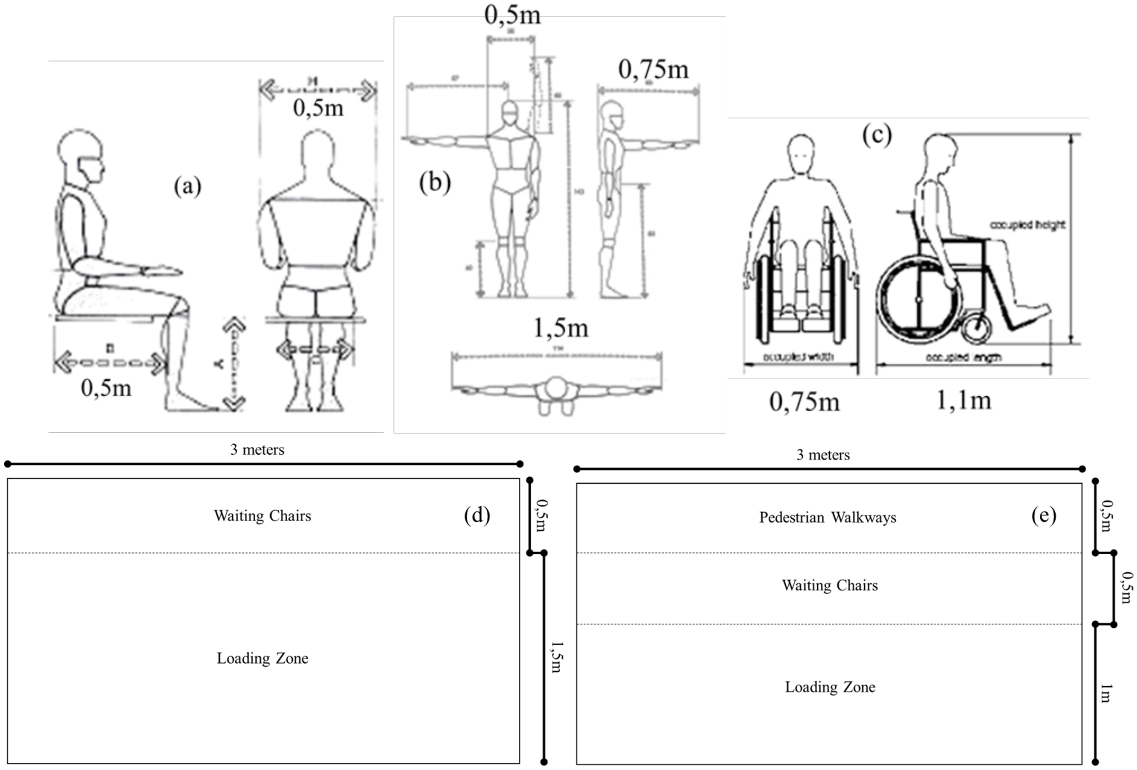


Figure 8 Dimension Calculation; (a) sit; (b) stand up; (c) wheel chair; (d) SMKN 1 Bus Stop; and (e) Sukun Bus Stop (Researcher Analysis, 2021; Suprapta, 2009; Kulkarni, Dandavate, & Chamnalli, 2017)

Table 2 Calculation of the Recommended Capacity of Pedestrian Walkways

Num.	Location	Facilities*	Dimension*	Formula**	Capacity (Max)
1.	SMKN 1 Bus Stop	Pedestrian walkways	1.5m wide	Vt = 35 (W – N) Vt = 35 (2 – 1) = 35 person/meter/minute	35 people/m/min
		Bus stops	2m x 3m : ✓ 0.5m x 3m (chair) ✓ 1.5m x 3m (loading zone)	$Vh = \frac{\text{Bus Stop Large}}{\text{Space Per Person}}$ $Vh^1 = \frac{1,5m2}{0,625m}$ = 2 Person (Chair) $Vh^2 = \frac{4,5m2}{0,875m}$ = 5 Person (loading zone)	7 people
		Waiting zone	0.5m x 8m wide	$Vz = \frac{\text{Bus Stop Large}}{\text{Space Per Person}}$ $Vz = \frac{4m2}{0,625}$ = 6 Person	6 people
2.	Sukun Bus Stop	Pedestrian walkways	3m wide	$Vt = \sqrt{35(W-N)}$ $Vt = \sqrt{35(3-1)}$ Vt = 8 person/meter/line/minute	16 people/m/min
		Bus stops	2m x 3m : ✓ 0.5m x 3m (pedestrian walkways) ✓ 0.5m x 3m (chair) ✓ 1m x 3m (loading zone)	$Vh = \frac{\text{Bus Stop Large}}{\text{Space Per Person}}$ $Vh^1 = \frac{1,5m2}{0,625m}$ = 2 person (chair) $Vh^2 = \frac{3m2}{0,875m}$ = 3 person (loading zone)	5 people

Num.	Location	Facilities*	Dimension*	Formula**	Capacity (Max)
		Waiting zone	0.5m x 10m	$Vz = \frac{Area\ Large}{Space\ Per\ Person}$ $Vz = \frac{5m2}{0,875}$ = 6 person (one side)	12 people

Note: * design recommendations; ** based on 2017 Indonesian pedestrian guidelines

4. Conclusion

Based on the results, the focus on two important factors was necessary, namely the existing environmental conditions and the activity patterns of the surrounding communities. Health aspects, such as sinks or body temperature detectors, were observed to be flexible, and depended on each location needs. The differences in mobility and land use characteristics were also considered in planning a sustainable pedestrian walkway design, to minimize the spread of COVID-19. Furthermore, the inclusiveness concept was important in designing sustainable spaces, by providing special facilities for the disabled, elderly, children, and all groups. Critical zones in this study, such as the SMKN 1 and Sukun stops were used as recommendations for the Semarang City government, based on setting the priorities of pedestrian development. However, it is advisable to redesign the entire pedestrian lane, especially on all Trans Semarang Bus routes, to increase passenger comfort and community enthusiasm towards using public transportation.

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