The Application of Pedestrian Ways Design Concepts as an Implementation of Sustainable Urban Open Spaces

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Abstract

The main factor of the urban development in a physical aspect is the increasing of population. Semarang, Jakarta and other cities have many urban open spaces. Every government is expected to provide the urban open spaces equipped by some pedestrian ways to reduce both the traffic jams and carbon monoxide as a sustainable concept implementation. In the research methodology, the thermal comfort variables would be analyzed by quantitative methods on the time series. Meanwhile, the activity supports, design of urban open spaces and culture would be reviewed by qualitative approaches. This study will result guidelines to design the comfortable pedestrian ways.

Keywords: Urban open space; pedestrian ways; thermal comfort; sustainable city

1. Background of study

According to Carr, a city, its government and public open spaces are units that cannot be separated where all aspects are complementary. Urban space has a complex meaning associated with the activities of the city and social interaction as well as its properties. So a city needs an open space in the non-physical elements of behavior and culture. The Indonesian Ministry of Public Works regulates the percentage of open space within a spatial urban area through the regulation number: 8/2008 on the Spatial Urban Planning. Based on the government regulation, the open space is 30\% of the entire city area.
consisting of 20% public open space and 10% private open space such as open spaces in the houses or buildings. Human activities in the city public spaces consist of various purposes such as chat, bike ride, sports, relaxation, local culture performance, or even demonstration (Dobbins, 2009). On the one hand, city public spaces also reflect aspects of the users’ behaviour, on the other hand the significant influence of climate will affect the public space and designated-properties related to thermal comfort factors of users in public open space of the city. 80% of city walk in Indonesia have been failed because they neglect the climate aspect.

Shortly, the concept of sustainability in the urban open space not only tends to have the context of the natural environment but also contains how to respond to climate conditions and how to stimulate human behaviour in the social life of the city.

2. Research question and research aim

Based on the background of study, the researchers state the research question as: what kind of pedestrian the best for the tropical environment? And the aim of this study is to give the guidelines about the pedestrian criteria in the tropical environment like Indonesia.

3. Pedestrian in the urban open space

3.1. The role of sustainable open space in the city

The concept of sustainability in the urban open space not only tends to have the context of the natural environment but also contains how to respond to climate conditions and to stimulate the human behavior in the social life of the city. Every government has different policies to provide urban open spaces that are divided into passive parks and active parks.

- Active Park: Active Park is a park located in an area of town that is used either as a community gathering area or as community adhesive, and there are activities in it. So, the park is not only as a green area of the city but also a place where people do activities.

- Passive Park: Passive Park is a park that was established as a town green area of the city region in which people are not allowed to do activity. Since the purpose of this park is just as green and infiltration areas.

<table>
<thead>
<tr>
<th>No.</th>
<th>Year</th>
<th>Active Park</th>
<th>Passive Park</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2007</td>
<td>36</td>
<td>144</td>
<td>180</td>
</tr>
<tr>
<td>2</td>
<td>2008</td>
<td>37</td>
<td>149</td>
<td>186</td>
</tr>
<tr>
<td>3</td>
<td>2009</td>
<td>37</td>
<td>149</td>
<td>186</td>
</tr>
<tr>
<td>4</td>
<td>2010</td>
<td>27</td>
<td>149</td>
<td>186</td>
</tr>
<tr>
<td>5</td>
<td>2011</td>
<td>37</td>
<td>149</td>
<td>186</td>
</tr>
</tbody>
</table>

In the city of Semarang, the government tries to accommodate social interaction of Semarang people by building many different kinds of open spaces for examples KB Park, Simpang Lima Roundabout, Sri Gunting Park and many others. Since two years ago, the open spaces in the city of Semarang have been visited by many people. Open spaces in Semarang city such as KB Park, Tugu Muda Garden, Simpang Lima Square, as well as Pemuda and Pahlawan Road have become places of recreation, relaxation, places of hanging out for the citizens.
3.2. Open spaces and cultural behavior in the city

Open space in the most of big cities in Indonesia shows the elements of the local culture and religious activities based on the local wisdom. Cultural Behavior and activities are important variables in the planning of open space. The city responds them by celebrating many events intended to accommodate the interests of cultural heritage. In some parts of Indonesia, for example, most of the China ethnics in Semarang celebrate the Chinese New Year at Sam Poo Kong temple every year. Meanwhile, the Moslems in the city perform Dug-deran carnival event, the annual festival holding to welcome the holy fasting month by walking around the city. The function of the highway turns into pedestrian every year.

In the humid tropical cities, where climatic condition is in high temperature, the hard blowing wind, uncomfortable humidity, and high rainfall, therefore the design of urban open spaces in tropics contrast with those in four season cities. A pedestrian facility as a part of the urban open space serves the circulation of urban open space to protect against climatic conditions. Below is a table of climatology in the five biggest Indonesian cities.

Table 2. Climate condition of the five- biggest city in Indonesia

<table>
<thead>
<tr>
<th>No.</th>
<th>City</th>
<th>Day Temperature (°C)</th>
<th>Night Temperature (°C)</th>
<th>Relative Humidity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Jakarta</td>
<td>32</td>
<td>28</td>
<td>75</td>
</tr>
<tr>
<td>2</td>
<td>Bandung</td>
<td>30</td>
<td>27</td>
<td>80</td>
</tr>
<tr>
<td>3</td>
<td>Medan</td>
<td>31</td>
<td>28</td>
<td>78</td>
</tr>
<tr>
<td>4</td>
<td>Semarang</td>
<td>32</td>
<td>28</td>
<td>76</td>
</tr>
<tr>
<td>5</td>
<td>Surabaya</td>
<td>33</td>
<td>29</td>
<td>77</td>
</tr>
</tbody>
</table>

Pedestrians of big cities in Indonesia have three types of pedestrians influenced by human behaviour in big cities in Indonesia:

- Pedestrians in open spaces
- Pedestrians connecting the buildings in urban spaces
- Streets as pedestrians in special events of festivals and carnival in the cities
The Dug-deran is an annual event organized by the city of Semarang, in welcoming the fasting month. The event is originally held in the Johar market, a market designed by Thomas Karsten, and a conservation building, but because of very rapid of the commercial development so now the government moves this event to Semarang City Hall courtyard. The mayor leads the ceremony and acts as a Prince of Semarang. This event starts at 15.00 pm and ends at 18.00 pm, exactly one day before the first day of fasting to pray for health and safety.

3.3. Properties of the urban open space

Urban open space has the properties such as landscaping, sports fields, shelters, and other facilities support activity. According to the track record of Whyte (2009) research on human behavior and civic space continues till date, and urban designers should pay attention to the details of the relationship between the three functions listed below:

Function relationship diagram above shows that there are strong links between activities, behavior, social interactions, and physical environment in urban space, particularly urban open spaces. The important thing is what people do, why and how these activities are translated into the spaces for accommodating urban space activities. City square for example is the space reserved for humans. Therefore, the circulation in the city square implemented on pedestrian space design should consider the character of the human factor (Corbett, 2004). In urban space, what men do and what they arrange will create characters of space divided into public spaces and private spaces. In the domestic life, people will lay their head to rest, to eat, and to have protection. Then, in the urban space the same things will happen. Urban open space and its pedestrians need some protections, especially in the tropics region. Reviewing these major spheres of human activity are reflected on their private and public characters. The more
public is the more associated with the design of places, the civic environment shared by all. Based on the facts above, similar to the houses, the city open spaces are places to lay down the head, a place to prepare and eat food, a way for dealing with waste, and a place for loving, procreating, nurturing, hoping, and praying or fighting and separating but usually a refuge from an often hostile and challenging world outside. Refer to the Denver City regulation that the pedestrian is a component of the most visited in urban open spaces which has an important role to the mobilization of the urban population. The benefits of providing bicycle and pedestrian facilities are enhancing personal mobility options, reducing the amount of the motor vehicle travel, reducing air pollution or carbon-monoxide, reducing fuel consumption, and improving overall health with increasing physical activities.

3.4. Pedestrian as a part of urban open spaces

Furthermore, urban design will correlate between building, human and environment as the three things that are very comprehensive and cannot be separated each other. Place should be able to accommodate human activities. Liveliness of a place is determined by movement variable from one place to another as expressed by the movement of its pedestrians (Ujang, 2010; Jacobs, 1961; Montgomery, 1998). To explain the complexities of urban space and the environment, then we need grouping from neighborhoods to the regions. The Complexity will merge and form a pattern of interaction consists of traditions, urban designers and community leaders. It can begin to formulate ideas and priorities in reading their communities or the ones they are working in, so people can bring their activities to merge with their urban environments. They will correlate each other, connect to the infrastructure that can be maintained, preserve the life, health, and comfort them including the thermal comfort in the environment. As a part of the urban open spaces, the pedestrian not only has an important role but also has a function in the people mobilization. According to Denver Council, pedestrian circulation is space to walk in. Pedestrian ways have the function to connect one place to another place, one building to another building. Cities in Indonesia have the same phenomena, when the local behavior merges with the urban environments for example traditional events, carnivals, festivals and many more.

Fig. 4. Pedestrian as Human mobility in the City; (a) Pedestrian linking each other between street and cafe, in Semarang; (b) Culinary Center equipped by pedestrian, in Semarang; (c) Sitting group under a big tree, in Simpang Lima Square Semarang; (d) Pedestrian for disabilities in Semarang

Elderly and disabilities people are users who should not be left on pedestrian planning in the public space of the city (Wijayanti, et al., 2012). The picture above is one application of a pedestrian who has noticed it. Then, in the urban pedestrian space, many people who want to relax under a tree are leading to large trees in a city park. Space under the trees provides a bench that circles it (Fig. 4c).
3.5. Climate reviews of pedestrian in the urban open spaces and analyses

In the humid tropics, there are specific weather conditions and quite different to the conditions in the dry tropical climate. In dry tropical climates, the daily temperature difference can be very unstable. However, in humid tropical areas, daily temperatures have means of difference at about 8°C. And the difference in annual temperature is not really high.

At high humidity, the temperature is always much pretty the same throughout the year. Climatic conditions will affect the convenience of users in urban open spaces. Climatic variables on the design of urban open spaces are temperature, humidity, wind speed and solar radiation. Researchers observed thermal aspects in some urban open spaces in Semarang, Jakarta and Solo.

Semarang is one of the major cities in Indonesia. It is the capital of Central Java province located in the northern coast of Java. Similar to other cities, Semarang has both hot tropical climate and high humidity especially at noon. The tables below show climatic conditions at some points of urban open spaces.

Fig. 5. Human activities in urban cafe or culinary at night

Fig. 6. Pedestrians and their properties in Semarang; (a) Green pedestrian and trash box facility in an urban open space; (b) Green pedestrian and shelter; (c) Urban cafe as a supporting facility in urban open spaces; (d) Newspaper board and street pedestrian in Semarang
Table 3. Temperature and humidity of pedestrian in Indonesian urban open spaces

<table>
<thead>
<tr>
<th>No</th>
<th>Time</th>
<th>Street Pedestrian</th>
<th>Pedestrian Under Shelter</th>
<th>Sitting Group</th>
<th>Circle Sitting Group</th>
<th>Fountain and Pedestrian</th>
<th>Therapical Pedestrian</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>T (°C)</td>
<td>RH (%)</td>
<td>T (°C)</td>
<td>RH (%)</td>
<td>T (°C)</td>
<td>RH (%)</td>
</tr>
<tr>
<td>1</td>
<td>06.00</td>
<td>24.30</td>
<td>95.00</td>
<td>24.60</td>
<td>85.60</td>
<td>24.45</td>
<td>94.30</td>
</tr>
<tr>
<td>2</td>
<td>07.00</td>
<td>26.30</td>
<td>75.00</td>
<td>26.60</td>
<td>65.60</td>
<td>26.45</td>
<td>74.30</td>
</tr>
<tr>
<td>3</td>
<td>08.30</td>
<td>30.20</td>
<td>70.00</td>
<td>30.45</td>
<td>68.20</td>
<td>30.00</td>
<td>69.80</td>
</tr>
<tr>
<td>4</td>
<td>10.30</td>
<td>32.51</td>
<td>66.09</td>
<td>30.54</td>
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<td>32.30</td>
<td>65.06</td>
</tr>
<tr>
<td>5</td>
<td>13.30</td>
<td>31.71</td>
<td>71.22</td>
<td>31.88</td>
<td>71.57</td>
<td>31.07</td>
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</tr>
<tr>
<td>6</td>
<td>21.00</td>
<td>25.64</td>
<td>93.29</td>
<td>25.80</td>
<td>87.79</td>
<td>25.56</td>
<td>92.74</td>
</tr>
</tbody>
</table>

Table 4. Wet bulb temperature and wind speed of pedestrian in Indonesian urban open spaces

<table>
<thead>
<tr>
<th>No</th>
<th>Time</th>
<th>Street Pedestrian</th>
<th>Pedestrian Under Shelter</th>
<th>Sitting Group</th>
<th>Circle Sitting Group</th>
<th>Fountain and Pedestrian</th>
<th>Therapical Pedestrian</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>WBT (°C)</td>
<td>WIN (°C)</td>
<td>WBT (°C)</td>
<td>WIN (°C)</td>
<td>WBT (°C)</td>
<td>WIN (°C)</td>
</tr>
<tr>
<td>1</td>
<td>06.00</td>
<td>24.04</td>
<td>2.10</td>
<td>24.55</td>
<td>1.90</td>
<td>23.90</td>
<td>2.10</td>
</tr>
<tr>
<td>2</td>
<td>07.00</td>
<td>25.20</td>
<td>1.90</td>
<td>25.00</td>
<td>1.75</td>
<td>25.10</td>
<td>1.90</td>
</tr>
<tr>
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<td>1.60</td>
<td>25.00</td>
<td>1.80</td>
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<td>4</td>
<td>10.30</td>
<td>26.67</td>
<td>1.54</td>
<td>26.29</td>
<td>1.08</td>
<td>27.90</td>
<td>1.20</td>
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<td>1.70</td>
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<td>24.04</td>
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<td>24.55</td>
<td>2.00</td>
<td>23.90</td>
<td>2.00</td>
</tr>
</tbody>
</table>

![Graph](image-url)
Figures comfort in the tropics for the average daily temperature is about 25-28°C, and the humidity level ranging from 55-75%. Therefore, based on table 3 and table 4 above, the lowest temperature conditions are in the sheltered pedestrians and the highest ones are in the street pedestrians. The lack of pedestrian in protective components against local weather conditions caused discomfort condition of pedestrians. Shortly, that climate is an important aspect in the design of pedestrians in the tropics as shown on the quantitative analysis graphs above (see Fig. 7).

4. The application of pedestrian design in Indonesia

The comfortable pedestrian design in urban open spaces has some requirements according to some references:
- In all urban and suburban areas, continuous sidewalks should be provided on both sides of all streets and roadways (except freeways), and where possible, detached from the roadway (preferred). Connections through developments and to the entrances of businesses, stores, schools, parks and other activity centers should be established and maintained.
- To avoid the danger of landslides and climate, the pedestrians need to be equipped with pedestrian refuges, such as fences and roofs.
- Pedestrian must pay attention to the level of user comfort, for example the disabilities people, so that its usefulness can be felt by the whole community.

The presentation of climatic data in table 3 and 4, prove that the comfortable pedestrians are designed to anticipate the negative impacts of local climate. Pedestrians in Jakarta and Semarang have roofs to
protect them from the weather. Pedestrians in Solo, a small and a cultural city in Central Java Province in Indonesia, have plantation roofs that can reduce temperature in several Celsius degrees. The conditions cause a comfortable atmosphere for the city dwellers when they are walking in the pedestrian spaces. Furthermore, some cultural finishes in the pedestrians in Solo make the performances more attractive and richer of aesthetics than the designs in other cities. The Pedestrian designs show the shelter designs in many ways in the Ancol Dreamland and Central Park Jakarta. The pedestrians in Central Park use anti-radiation glass materials, so that people who walked in keep comfortable and feel convenience. The Orthopedic Hospital in Solo has not had some pedestrians connecting the highway to the main gate. Because of the need for both old and disable people circulations, then the hospital is making green pedestrians equipped by shelter and vegetation. The pedestrians have the same concept with the development of the Hospital that has a concept of Green Hospital, see Fig. 8c. Based on the facts, we can resume that the more shelters in pedestrians, the more comfortable conditions for the people to walk in them. The applications of pedestrian in Indonesia are as follows:

Fig. 8. Design of Sustainable Pedestrian in Indonesia, (a) Pedestrian in Ancol Jakarta; (b) Pedestrian in Central Park, Jakarta; (c) Pedestrian in Orthopedic Hospital, Solo
5. The conclusion

The population growth in the city causes the increasing need for land to grow, need for housings, a number of public facilities and urban open spaces. Pedestrian ways are the most frequented destination area in urban open spaces. They have an important function as a means to mobilize people in the city. In the tropics, pedestrian functions have a meaning associated with the comfort aspects. These convenience factors will relate to the tropical climate. Therefore, the design of pedestrian facilities supporting urban open spaces in tropical areas must have some protective solutions and barriers associated with climate and the thermal comfort factors. Based on the description and explanation of this paper, the application design of pedestrian in the tropics as the implementation of sustainable urban open space can be concluded as follows:

- Open spaces in Indonesia show the elements of the local culture and religious meanings. Therefore, the local wisdom and people activities become the important variables in the open space planning.
- Pedestrian as a component of the most visited destinations in urban open spaces has an important role to mobilize the urban population. The benefits of providing bicycle and pedestrian facilities are enhancing personal mobilization options, reducing the amount of the motor vehicle travel, reducing air
pollution of carbon-monoxide, reducing the fuel consumption, and improving overall health with the physical activities.

- Street pedestrian and other pedestrians which are unsheltered kinds usually take uncomfortable conditions because of the unfriendly weather. They exposure not only to the high radiation but also to the very hot temperature.
- A comfortable pedestrian design should be able to anticipate the negative impacts of local climate, such as heat, humidity, rainfall and wind speed.

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Reference


