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The Influence of Vegetation Function towards the Langsep Street Thermal Comfort

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Abstract. Streetscape is an important element for character building of the environment, spatial, and visual in order to provide an urban identity, especially in Malang City protocol streets. Langsep Street is one of the protocol streets in Malang City. Langsep Street famous with central education and offices area. This study aims (1) to identify vegetation of streetscape; (2) to analyze the thermal comfort of the streetscape, and (3) to evaluate the comfort level of Langsep Street. The method used was the THI approach. THI value that obtained was analyzed using the standard of Laurie (1990). Based on observations, the THI value of Langsep Street was 27.60. This was influenced by the trees canopy density and spacing of the trees on the streetscape. It can be concluded that streetscape required (1) shaded plants that have root systems that do not damage the construction of roads, (2) the branching plants are not easily broken and easy to maintain, and (3) the combination of trees, shrubs and ground cover.

1. Introduction

Streetscape is the character of the land or walk formed on a neighborhood street, both of which are formed from the natural landscape elements such as the shape and topography of land formed from man-made landscape elements adapt to the conditions of land [2]. Simonds [7] Streetscape was instrumental in establishing the character of the environment, spatial, and visual in order to provide an urban identity.

According to Utterman in Santyo, *et al.* [6], elements that affect the comfort in a pedestrian are: circulation, accessibility, natural style and climate, security, cleanliness and beauty.

Plants in the landscape view of the road serves as a controller, a physical barrier, climate control, erosion control, wildlife habitat, and aesthetics. Distribution and diversity of tree species in a landscape are important for improving the function of vegetation for environmental stability, both biotic and abiotic [1]. According to Laurie (1986) in Rahmiati [5], the standard moisture for human comfort in activities ranging from 40% - 70% with a temperature between 15ºC-[illegible]ºC and Hadi *et al* [3], states that the index of comfort in comfortable conditions ideal for man Indonesia in the range of THI (Temperature human Index) with a value of 20-26.

Today most of the streetscape on some streets in Malang City less attention to the physical condition and social landscape of the street, pavement element that dominates, the lack of availability of facilities for the streetscape, as well as the lack of the number, type, and maintenance of the vegetation on the landscape. Maintenance of the type and amount of vegetation on the streetscape is a problem that most influence on the comfort of street users and local residents. The street users are not comfortable for moving because of the street conditions are quite hot and high levels of pollution. This article will discuss the level of comfort and its evaluation on streetscape on Langsep Street which is one of protocol street in Malang City. The comfort function is one thing that should be available on the landscape so that users can work well. Hence it is important to evaluate the comfort function of a

streetscape so it can be analyzed the factors and the comfort level that affect the comfort of the street.

2. Method

The method used in this research was quantitative method with the following technical stages:

2.1 Preparation

The preparation stage was the stage of determining the location and preparation of tools and materials. From this stage determined the location of the research is Langsep Street that is the area of education and office center. The researcher process the permission to Public Works Department and the Department of Hygiene and Park, Malang City.

2.2 Survey

At this stage conducted observation and data collection of air temperature and humidity directly from the field. Data collection was performed by measuring the temperature and humidity at the observation point in distance of 50 meters (Figure 1). Point measurement of temperature and humidity occurs on road safety threshold and median road where there are plants and paving. Data collection was performed three times in one day at 06:00, 12:00, 17:00, for three days. Intake air temperature and humidity data is carried out only when the weather is sunny with using digital termohygrometer.

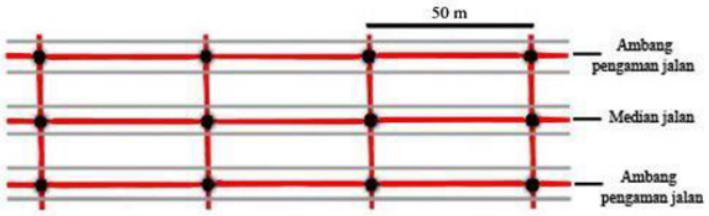

Figure 1 Illustration of observation point temperature and humidity on the streetscape

The size of the street, street structure and land use data obtained from study literature, reports, and standard regulations. The data collection of vegetation and plant spacing obtained from measurement technique, documentation, and collection of existing conditions. The social data of visitors' perception of Langsep Street used the questionnaire from 30 respondents.

2.3 Analysis

The method used in the analysis was the approach of THI comfort index. In this method, the temperature and humidity data was obtained from the measurement results then calculated by the THI formula value;

$$THI = 0{,}8T + (RH \times T)/500$$

THI: *temperature humidity index*
T: temperature (°C)
RH: humidity (%)

THI value obtained was analyzed using the standard of Laurie [4] which states that the ideal environment to have the air temperature 27-28 °C and humidity of 40-75%.

Answers about the purpose and motivation of respondents in each of the paths were analyzed descriptively. A questionnaire containing questions about the data themselves in general respondents (gender, age, education, place of residence), goals, motivations, and perceptions of respondents about the micro-climate comfort. Analysis of the results using chi-square questionnaire to determine the relationship between the answers perception of comfort microclimate street with the factor of gender, place of residence, education, and age of the respondents. Answers about the purpose and motivation of respondents in each park were analyzed descriptively. The results of the questionnaire and the calculation results are analyzed so that it can be used as material comfort evaluation and formulated ways to improve comfort microclimate in each street.

Result and Analysis

Langsep Street is one of busy street in Malang City, famous for its central areas of education such as schools and colleges. There are many offices scattered along the Langsep Street. Maintenance of plants on the Langsep street generally suitable with criteria plantings there are sufficiently shade plants on the street. The amount of shade plants on Langsep street enough and planted with appropriate spacing between trees that form a canopy shades helped influence the microclimate. Based on observations of Langsep streetscape have different types of shade trees include mahogany (*Swietenia mahagoni*), and Trembesi (*Samanea saman*).

Langsep street has a length of 1355 meters with an average spacing of trees 8 meters, 6.40 meters of street width, 2.50 meters of pavement width and 3.20 meter of median width. Surrounding Langsep streetscape are very few trees with rarely spacing, so high air circulation. In Alfian [1] stated Vegetation very useful to manipulate the environment in urban aesthetic, controlling erosion and groundwater, reduce noise, waste water control, traffic control and glare, reduce light reflection, and reduce smell.

3.1 Micro climate Langsep Street

From mapping point observation of the street with a distance of 50 meters gained 27 points of data retrieval air temperature and humidity, based on the observations of temperature and humidity for three days of observation on Highway Langep obtained the following data (Figure 2, 3 and 4).

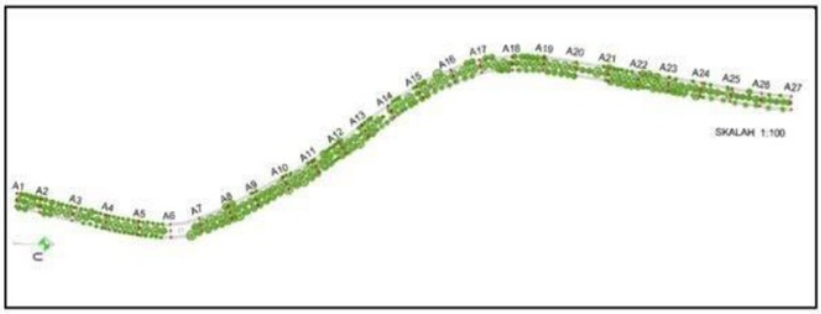

Figure 2. Observation point of temperature and humidity on Langsep Street

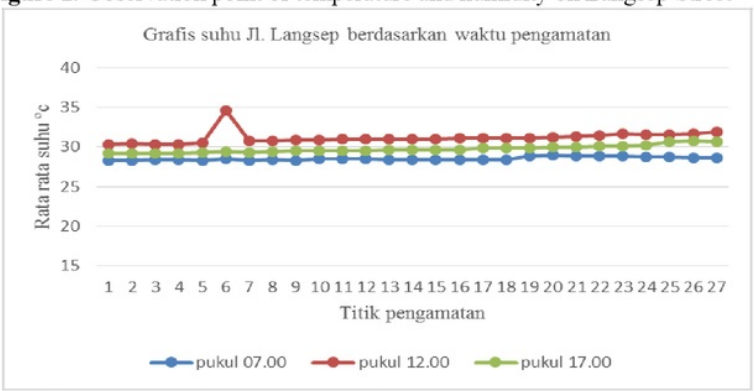

Figure 3. Graph of temperature observations on Langsep Street

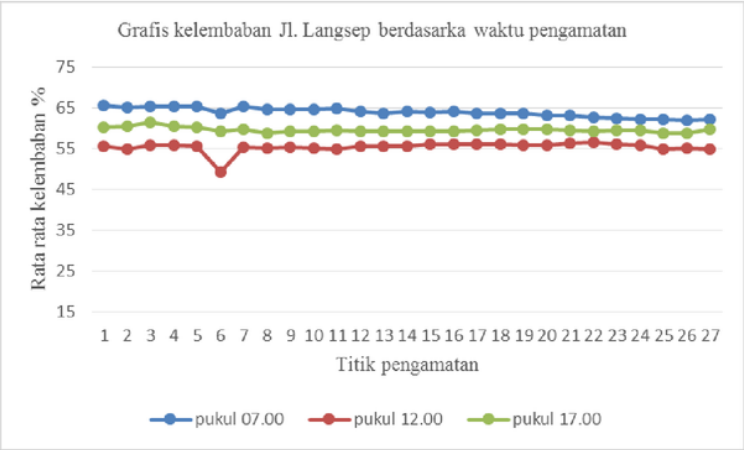

Figure 4. Graph of Humidity observation on Langsep Street

Based on the results of temperature measurements at Langsep street, the highest air temperature is at a point 6 at 12 pm. This point is located close to the intersection area or turn directions, and there is no trees so the air temperature becomes higher because the sunlight received directly in this area. In addition, the region is dominated form of asphalt pavement and road. Humidity value at a point 6 at 12 pm, have a low value because the area is dominated pavement so that direct sunlight reaches the road and cause higher evaporation rates as well as the wind factor that removes moisture evaporation results.

Air temperatures on Langsep street ranged between 28.28 - 34.59 °C with humidity ranged between 49.36 - 67.89%. The landscaping around Langsep street such as schools and shops. Schools and shops are neatly arranged with a shade tree titled big enough. The majority of the vegetation at Langsep street a Trembesi tree (*Samanea saman*) which has a fairly large tree canopy. Heading between trees that touch each pose shade that provides thermal comfort.

3.2. Analysis Humadity Temperature Index (THI) Langsep Street

To find the comfort of air temperature and humidity quantitatively used Temperature Humidity Index (THI). This method uses a factor of air temperature and humidity. The comfort level is a series of conditions on several factors. The results of some of these factors that affect the value of THI. Based on field observations THI value for Langsep street (27.60) with average temperatures ranging from 28.28 - 34.59 °C with humidity ranging between 49.36 - 67.89%. If analyzed according to the standard Laurie[4]. The value of THI at Langsep street out of the standard comfort. THI value by Laurie[4] categorized comfortable is between 21-27, and ideal climate for humans is the air temperature to the value of 27-28 °C and humidity 40-70%.

3.3. Analysis Questionnaire Results Highway langsep.

From the results of questionnaires on Langsep Street obtained street users is 56.67% men and 43.33% women. Street users education is at 13:33% secondary school, 30% high school, 6.67% Academic, 43.33% under graduate school and 6.67 the others.

Hypotheses for comfort relationship with the respondents' gender factor in Langsep Street are as follows:

H_0: Comfort road is not related to gender factor

H_1: There is a relationship between the comfort of roads with gender factor

Chi-table = 3.82 Chi-count

= 0.54

Obtained chi-count <Chi-table accept H_0

The calculation is known that the comfort of the road on Langsep Street not related to the gender of street users (Table 1).

Table 1. Comfort respondent data by gender

No	Answer Choice	Gender		
		Man	Woman	Total
1	Comfort	17	10	27
2	Not Comfort	1	2	3
	Total	18	12	30

Table 1 shows that 90% of respondents (27 respondents) feel comfortable with a microclimate Langsep street. The proportion of the perception of comfort in terms of gender is quite comparable. Percentage opinion of a sense of comfort by male respondents was (94%) greater than female respondents (83%).

3.4. Leisure relationship with Respondent Education Factor

Hypotheses for comfort relationship with the respondents' education factor in Highway langsep are as follows:

H_0: Comfort road is not related to educational factors

H_1: There is a relationship between the comfort of roads by a factor of education

Chi-table = 3.82 Chi-count = 2,64

Obtained chi-count <Chi-table accept H_0

The calculation is known that the comfort of the street on Langsep street not related to street user education (Table 2).

Table 2. Data respondent convenience by education.

No	Education level	Comfort	Not Comfort
1	Secondary school	3	1
2	High School	8	1
3	Academic	2	-
4	Undergraduate school	12	1
5	The other	2	-
	Total	27	3

Table 2 shows that the percentage of respondents think that a sense of comfort by junior high school education by (75%) less than high school (89%), Academic (100%), universities (92%), and the others (100%).

4. Conclusion

Termal comfort on Langsep Street influenced by several factors, namely air temperature, humidity, wind and solar radiation. The results showed that the air temperature of the Langsep street ranged between 28.28 - 34.59 °C with humidity ranged between 49.36 - 67.89%. Average of air temperature on Langsep street 30.2 °C and an average humidity of 60%. Langsep street has a value of THI (27.60) that out of the comfort standards set by Laurie [4] at 21-27. In the street area that has a dense spacing of the plants tend to lower air temperature and humidity tends to be high. Vice versa on street area with rarely spacing of plants shows air temperature tends to be high with low humidity.

5. Suggestion

Air temperature and humidity can be modified by selecting the appropriate type of vegetation shade. To scale street in the city, can be used by the plant canopy of shade plants that have root systems that do not damage the construction of roads, branching plants are not easily broken and easy to maintain. Necessary to add more vegetation such as Tanjung (*Mimusops Elengi*), Kencana Ketapang (*Terminalia mantaly*), glodokan tiang (*Polyalthia longifolia*), trembesi (*Samanea saman*), Kiara Payung (*Fellicium Decipiens*)

and Angsana (*Pterocarpus indicus*). By selecting the appropriate shade of vegetation and treatment is expected to help increase the level of comfort in every way. In addition to using vegetation shade, combining different types of landscape plants that have different growth patterns such as the use of groundcover and shrubs, manipulate the environment on the way to be more comfortable.

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