

STUDY OF MICROCLIMATE QUALITY IN THE CAMPUS/UNIVERSITY OPEN SPACE (Case Study: Duta Wacana Christian University, Yogyakarta)

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Abstract

To support the comfort of students in the campus area, a comfortable physical environment is needed. The comfort of the physical environment in question is the comfort of air temperature, lighting, noise, wind speed, air humidity, etc. This study took the Duta Wacana Christian University (UKDW) as an example of a case study, because this campus is located in the center of the city which has a high building density and does not have enough open space. This research will also only focus on the quality of microclimate based on spatial elements that affect air temperature and humidity. The method in this study is direct observation and measurement, then compared with the theory that is considered relevant. The findings obtained from the results of this study are the quality of the physical environment in the open space at UKDW has an air temperature above the standard of comfort but this is offset by the air humidity that is relatively cool.

Keywords: microclimate 1, surface temperature 2, air temperature 3, humidity 4.

Abstrak

Judul: Kualitas Iklim Mikro pada Ruang Terbuka Kampus (Studi Kasus : Ruang Terbuka Kampus Universitas Kristen Duta Wacana, Yogyakarta)

Untuk menunjang kenyamanan bagi mahasiswa di area kampus, maka dibutuhkan lingkungan fisik yang nyaman. Kenyamanan lingkungan fisik yang dimaksud adalah kenyamanan suhu udara, pencahayaan, suara, kecepatan angin, kelembaban udara, dsb. Penelitian ini mengambil Universitas Kristen Duta Wacana (UKDW) sebagai contoh studi kasus, karena kampus ini terletak pada pusat kota yang memiliki kepadatan bangunan yang tinggi dan tidak memiliki ruang terbuka yang cukup banyak. Penelitian ini juga hanya akan berfokus pada kualitas iklim mikro berdasarkan elemen pembentuk ruang yang mempengaruhi suhu udara dan kelembaban. Metode dalam penelitian ini adalah observasi dan pengukuran pada lapangan, yang kemudian dibandingkan dengan teori yang dianggap relevan. Temuan yang diperoleh dari hasil penelitian ini adalah kualitas lingkungan fisik pada ruang terbuka di UKDW memiliki suhu udara diatas standar kenyamanan namun hal ini diimbangi oleh kelembaban udara yang tergolong sejuk nyaman.

Kata kunci: iklim mikro 1, suhu permukaan 2, suhu udara 3, kelembaban 4.

Introduction

In carrying out its activities in the campus area, especially in the outer space or open area, college students need a comfortable physical environment. The physical environment in case is air temperature, lighting, noise, wind speed, air humidity, etc. So that the existence of a comfortable physical environment is

INTERNATIONAL PROCEEDINGS

LOCAL GENIUSES GENERATE FUTURE DESIGN, 16-17 November 2018

expected to be able to support learning activities and student productivity. As stated by Sanjaya (2011: 229) that learning is basically a process of a person's mental activity in interacting with his environment, resulting in positive behavioral changes both in the aspects of knowledge, attitude, and psychomotor. The physical environment in the outer space is closely related to microclimate. Because microclimate is the climate that is closest to living things and influences them directly. The impact of the microclimate on the area around human space will affect human activity, the condition of these climatic elements will affect the behavior and metabolism that take place in the body of living things, on the contrary, the existence of these living things (especially plants) will also affect climatic conditions micro around it. Between living things and the surrounding air there will be mutual influences or interactions with each other (Lakitan, 2002: 53).

The impact of microclimate is one of them is influenced by the level of building density. Like the density of buildings in urban areas, has an impact on global temperature changes. More and more areas of pavement in urban areas along with the development of infrastructure and reduced green space, is one of the factors causing changes in climate variation. The impact of climate change that is most easily felt is the increase in air temperature. Fukui (1970) in his experiment stated that urban development could increase local temperatures in the city and the speed of temperature increase was proportional to the speed of urban development.

Therefore the quality of the microclimate in urban areas especially in the open space of campus is a matter that needs to be considered, so as to increase the enjoyment (physical) and comfort (sense) of the academic society in the campus area so as to improve the quality of learning.

This study took a case study on the open space area of Duta Wacana Christian University (DWCU), Yogyakarta City. DWCU is one of the universities located in the center of Yogyakarta City with a campus area of approximately 18,270 m² with a total of 4007 students. The city of Yogyakarta has a high density compared to other areas in Yogyakarta Province. The amount of population density in the city of Yogyakarta with an area of 32.50 km² is 12.669 people per km² (BPS Kota Yogyakarta in figures in 2016). With a campus area that is not too large, DWCU does not have too much open space. Its position in the city center also makes the area around the campus has no open space, but is dominated by buildings and residential areas.

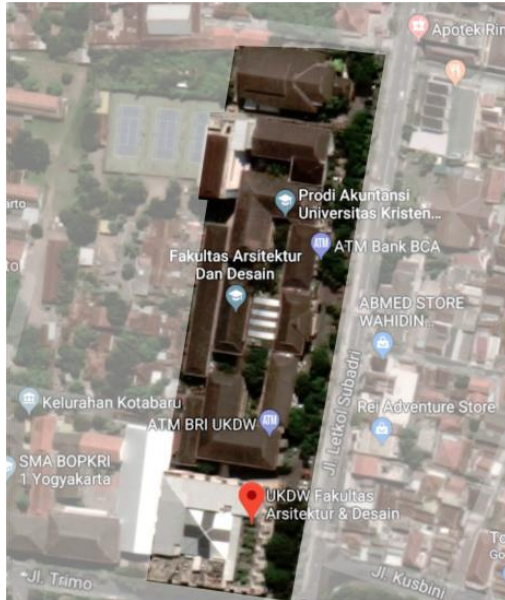


Figure 1.1 Location of Duta Wacana Christian University

Source: Google Maps & Author, 2018

According to Gray and Deneke (1978) (in Kaka, 2013) there are four main microclimate elements that predominantly affect humans, namely solar radiation, air temperature, air humidity and air movement. In this study will focus on two elements of the microclimate namely air temperature and air humidity, because these two elements are elements whose value has been measured in microclimate at DWCU, or it can be said that this research is still in the first stage, as well as the short time period of the research so that the other two elements cannot be included in this study.

Methodology

The research use primary data form the site which are collected during survey and observation with direct measurements. The research use qualitative method and use single case study as research approach (Creswell, 2015). The measurement focuses on the microclimate of open space in the campus/university area. Therefore Duta Wacana Christian University was chosen because it is one of the universities in urban areas, where the level of density in urban areas of Yogyakarta is quite high and the vegetation level is less, when compared to rural areas, so that the comfort of the microclimate in open spaces on campuses / universities in the area urban needs to be noticed. In this study try to see the impact of open space material on campus and see the effect on the microclimate that forms in the area at a certain time.

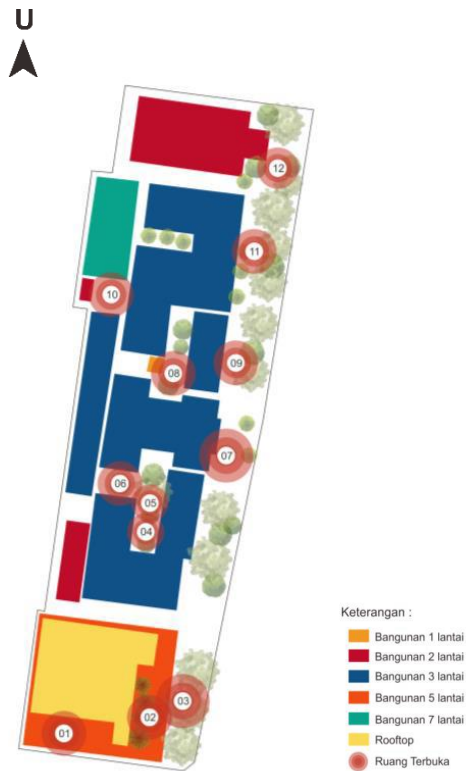


Figure 1.2 Open space areas on Duta Wacana Christian University
 Source: Author, 2018

On direct measurement, a laser thermometer (surface temperature measurement) and envirometer (air temperature, humidity measurement) is used. Then at each location measurements were taken at each point with a distance between points of 2m (figure 1.3) with a height of 1,5m from the ground. Direct measurements are carried out at 9.30-10.00am. At the time of direct measurement, documentation of the type of material or element forming space in each open area was also documented, such as the type of soil cover material, walls and vegetation and the height of the surrounding buildings.

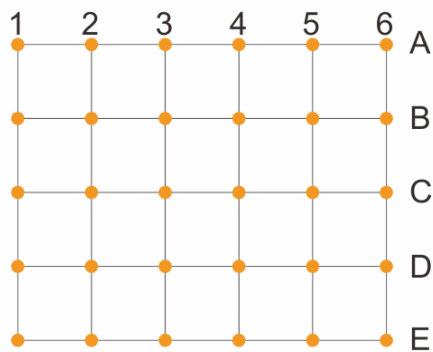


Figure 1.3 Measurement areas
 Source: Author, 2018

Results and Discussion

Open space in the DWCU area is dominated by ground cover material in the form of paving / cast concrete. From the results of measurements at the 12 open space areas in DWCU, the results show varied, as shown in the following table:

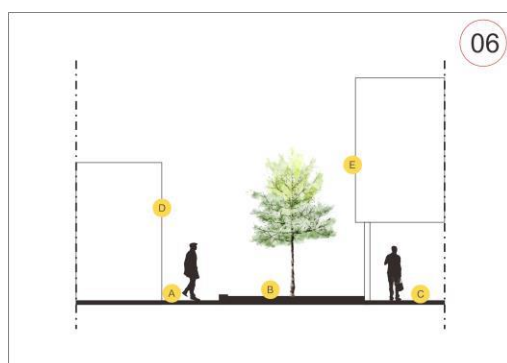
Table 1.1 Results of measurements of temperature and humidity

Areas	Average Surface Temperature (°C)	Average Air Temperature (°C)	Average Humidity (%)
1	27,6	31,5	62,8
2	25,1	31	59,1
3	28,3	29,2	71,7
4	24,4	29,1	77,6
5	25,4	30,6	65,6
6	23,3	28,3	80,6
7	32	31,8	57,2
8	29,3	30,6	64,6
9	29,8	31,2	65,4
10	26,7	31,8	69,3
11	27,8	32	65,4
12	30,2	31,1	60,3

Information :

- there is no ground cover material (dominan soil/grass)
- ground cover material in the form dominan of concrete
- ground cover material in the form dominan of paving

Source: The result of the direct measurement, 2018

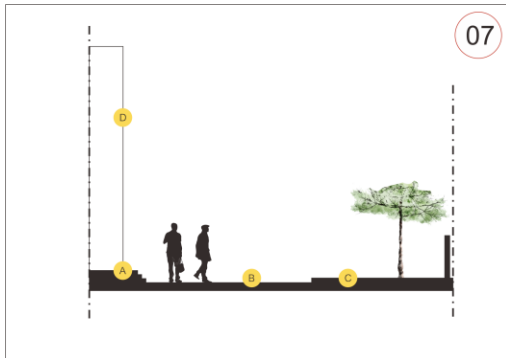


Materials :

- A. Paving
- B. Soil
- C. Paving
- D. Concrete
- E. Concrete and glass (window)

Figure 1.4 Open space 06

Source: Author, 2018

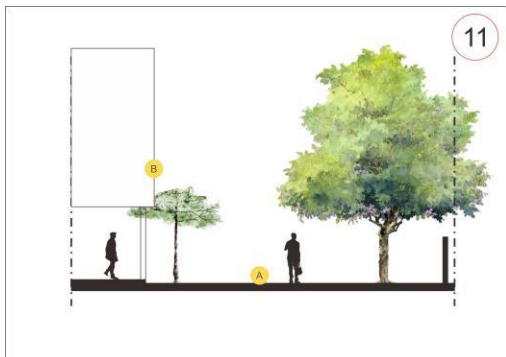


Materials :

- A. Ceramics
- B. Paving
- C. Soil
- D. Concrete and glass (window)

Figure 1.5 Open space 07

Source: Author, 2018



Materials :

- A. Paving
- B. Concrete and glass (window)

Figure 1.6 Open space 11

Source: Author, 2018

From the results of direct measurements and documentation of the 12 open spaces at DWCU, the highest average surface temperature is found in open area number 07 which is 32⁰C, in this open space is dominated by ground cover material in the form of paving. The open space number 07 is an area in the east, so that in the morning this area is 100% exposed to direct sunlight. While the highest average air temperature is in open space number 11, which is 32⁰C. The area is also the area that is in the eastern part of the building and the land cover material is dominated by paving. Compared to open space number 7, this open space has more vegetation which can make open space more shady 40% or only directly exposed to the sun by 60%. Furthermore, the highest air humidity is found in open space number 06, which is 80.6%. In this area there is no ground cover material, the surrounding buildings are dominated by concrete and there are enough trees, the location of the open space number 06 is surrounded by buildings as high as 3

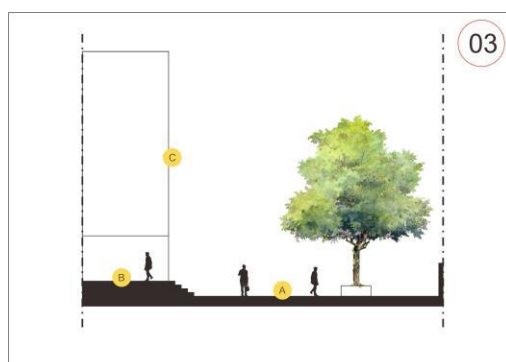
floors (about 10-12 meters) and also vegetation, so this can reduce exposure to direct sunlight and produce open space that is 100% shady.

According to SNI T-14-1993-03, the comfortable air temperature for human activities is divided into three criteria, namely:

- 1.) Comfort Cool 20,5-22,80C, relative humidity 50-80%
- 2.) Optimal Comfort 22.8-25.80C, relative humidity 70-80%
- 3.) Almost Comfortable 25.8-27,10C, 60-70%.

Based on the results of the direct measurement and the theory, the open space that has a fairly good air temperature in the DWCU area is open space number 06, with an average air temperature of 28.3⁰C. But in this area it has high humidity, which is 80.6%. According to Karim (1985), the influence of plants on open space, can reduce the temperature to be lower, but the humidity will increase. This is caused by the process of evaporation from plants. In areas where the soil surface is dominant, the air temperature obtained ranges from 28.3-30.6⁰C and humidity is 57.2-80.6%. Then in areas where the land surface is dominantly covered with paving, the air temperature obtained is 29.2 to 31.8⁰C with humidity of 60.3-71.7% and in the open space the dominant soil surface is in the form of concrete, has an air temperature of 31 -32⁰C with air humidity 59.1-69.3%.

Microclimate quality in campus open spaces (focusing on temperature and humidity), can be enhanced by the addition of vegetation elements and soil cover material that does not absorb heat, or even better without ground cover. Paving materials have properties that can penetrate and release (reflectivity) heat from the absorption quickly enough, so that paving has a high enough temperature, especially during the day. Soil material consisting of nutrients can absorb heat, but releases heat quite slowly, because the surface temperature is not too high. Concrete stores and reflects heat by releasing the highest temperature among other materials which can reach 53.8⁰C during the day and blazing.



Materials :

- A. Paving
- B. Concrete with ceramics
- C. Concrete

Figure 1.7 Open space 03

Source: Author, 2018

INTERNATIONAL PROCEEDINGS

LOCAL GENIUSES GENERATE FUTURE DESIGN, 16-17 November 2018

This can be seen in open space number 03, where in the area the ground cover material is dominant by paving material, but with the presence of vegetation in the form of large trees, the humidity in the area is 71.7% with an average air temperature of 29,2⁰C. In contrast to other open spaces where the ground cover material is predominantly in the form of paving (open space number 07,09,11 & 12) which has an average air temperature of 31,1-31,8⁰C and humidity of 57,2-65,5%.

Conclusion

Based on the results of direct observation and measurement, the overall air temperature ranges from 28.3-32⁰C. Based on existing theories, this number indicates that the results of measurements of air temperature are above the comfort standard. However, humidity data is in the range of 57.2-80.6%. This figure shows that based on the humidity level the measurement results are classified as comfort cool criteria. So it can be concluded that the open spaces at DWCU are still quite comfortable, because the density of buildings and vegetation that make high temperatures can be reduced by the humidity of the air which is classified as comfort cool.

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