The Effect of Thermal and Natural Lighting on The Working Environment in Heritage Building Case Study: The Batik Artisans in The Canting Workstation of Go Tik Swan

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Abstract

The process of batik using canting is essential in producing handwritten batik and requires supportive space conditions because it requires skill and takes a long time to process. This study aims to see how the characteristics of space affect the process of batik with canting in a semi-open canting workstation in the traditional batik house of Go Tik Swan, Surakarta. Observations of changes in behavior and space characteristics are carried out within a specific time using the Time and Motion Study method. The characteristics of the space observed are lighting, thermal, and humidity. At 14.00 WIB, the recorded natural lighting level was 562 lux, and the temperature was 35.3 ^{0}C, while the humidity factor was 55.7%. As a result, there was a shift of batik artisan from the front area to the back area of the workstation. Changes in batik artisan behavior occur due to thermal discomfort, which causes batik artisan to move to a lower temperature area with lower lighting levels. Therefore, it can be concluded that lighting and thermal factors directly affect the behavior of batik when doing their work.

Keywords
canting, handwritten batik, heritage building, natural lighting, thermal.

1. Introduction

Batik is an intangible world cultural heritage originating from Indonesia. The process of making batik, both written and stamped batik, requires skill and time (Ishwara et al. 2012). In producing a piece of batik cloth, a series of processes are required, starting from designing the motif, making the motif (klowongan) and filling the motif (isen) with canting and hot wax, making the background of the motif (nembok) on the cloth, dyeing or coloring and drying it (Kudiya 2019). This process is repeated until the desired result is achieved. The process of batik with canting is essential in the whole batik process because making batik with canting is the key to translating the design of the motif maker (designer) into a handwritten batik. The batik process with canting takes a relatively long time, according to

the design. The time required varies from a matter of days to a matter of years. Therefore, producing a batik that is produced traditionally takes a long time. However, batik houses that produce traditional batik are now sporadic. Due to the lengthy production process, the workspace of the batik artisans needs to be examined more deeply. Making batik with canting is the crucial process that distinguishes batik tulis products from stamped batik (batik cap) or printed batik (Liong 2014). In this study, the workspace that will be examined more closely is the workstation for the canting process.

1.1 Objectives

This study aims to see the relationship between space and users. This study observes how space characteristics affect user behavior and how these changes affect the traditional batik tulis process, in the canting process, especially in workspaces with semi-open buildings such as traditional Javanese houses, Joglo. This research will occur in a traditional batik tulis house, the Go Tik Swan batik tulis house.

2. Literature Review

The literature study is divided into two, namely the study of the batik house of Go tik Swan and the study of the literature on the characteristics of the space.

2.1 The Go Tik Swan Batik Workshop

One that still produces batik traditionally until now is the Go Tik Swan batik house. (Figure 1) Panembahan Hardjonegoro or Go Tik Swan is known as the creator of Batik Indonesia (Widyaningrum 2018). Batik Indonesia has the characteristics of bright colors typical of the coastal batik combined with symbolic motifs of the Javanese Keraton or a combination of the opposite. Batik Indonesia was created to show the spirit of the Unity in Diversity of the Indonesian, which had just become independent(Wronska et al. 2016).

Go Tik Swan batik house is located on Yos Sudarso no 176, Surakarta. The Go Tik Swan batik house is a heritage building consists of several mass buildings or multi-mass building type, as seen in Figure 1, which are then grouped into three areas according to their function. The front area functions as a residential and retail area, the middle area functions as a performance area and a private museum, while the back area functions as a batik and keris workshop area. The architectural style is also different for each area. The residential and retail areas are styled with Art Deco architectural style (Sakinah et al. 2020), performance areas, and museums in traditional Javanese architectural style, marked by two pavilions with high historical value. The workshop area is adopted from Balinese architecture with the characteristics of a semi-open and multi-mass building arranged according to a grid system. At the open area of this building complex, there is a collection of historical objects in reliefs and sculptures made of stone. The Paris Declaration on Heritage as a Driver of Development stated a need to position cultural heritage building as a vital component of sustainable development, especially in a heritage that has historical, cultural, social, and economic aspects (Shetabi 2015). This reason makes the existence of the Go Tik Swan batik house even more valuable. Recently, developing countries such as Indonesia and Malaysia have focused on sustainable development. As a result, there has been a shift from building new buildings to renovating old buildings or adaptive reuse in the last ten years. These old buildings are then studied more deeply to apply energy efficiency, especially in the lighting aspect (Kamaruzzaman and Zulkifli 2014).

The Go Tik Swan batik workshop consists of a canting workstation, a dyeing workstation, a nglorod (cleaning) workstation, a drying area, a storage room, and a pavilion that functions as a room for receiving guests who come to the batik and keris workshop (Widyasari 2021). The canting workstation consists of two semi-open buildings located on the east and west sides of the pavilion. Meanwhile, three buildings located on the grid side next to the canting workstation function as storage rooms. The dying and nglorod workstations are located to the north of the pavilion and are a two-story building. The second floor of the building serves as an area for drying batik through the cleaning process (nglorod). The entire workshop building is semi-open and made of wood, with a gable roof structure with a simple truss. The roof covering is made of tiles and without a ceiling. Floors made of cement stucco without ceramics keep the floor cool even in open spaces. With the semi-open nature of the building, it can be assumed that environmental or spatial characteristic factors affect the activities of users. Natural lighting, thermal, and humidity are characteristic factors of space that will be discussed in more depth in this study. To what extent do these characteristics of spatial affect the activities and behavior of space users when doing their job? In this case, it is the batik artisan making batik with canting on a canting workstation.

Figure 1. Multi-mass building at The Go Tik Swan batik workshop
Source: Widyasari, 2021

2.2 The Spatial Characteristic

The batik artisan at the Go Tik Swan batik house works in a semi-open workstation, so they tend to interact directly with changes in the natural characteristics of space in a tropical climate. Working in hot environmental conditions, batik artisan requires adaptation of physiological processes rather than psychology. For the temperature factor, the recommended room temperature for this type of sedentary work is in the range of 19 to 23 C. For the room humidity factor, and it is recommended to be in the range of 50% to 60% (Bridger 2008). For the lighting factor, the standard lighting level for extensive visual activities or high contrast levels is at the point of 322,917 Lux (Lechner 2014).

No standard characteristic covers natural lighting, room temperature, and humidity for this type of batik work with canting on workstation canting. However, several previous studies have discussed the recommended artificial lighting in the canting workstation area. Research on artificial lighting in the canting workstation area includes the variables of glare, shadow, color contrast, detail size, work speed, color rendering, bright contrast, room reflectance, and lighting combinations. The results of his research conclude that the quality of the batik work area is influenced by the position of the luminaire, photometry, space reflectance, the color of the fabric used as the work area, light intensity, and lighting combinations (Nurwidyaningrum 2010). In another study, there was also a box-shaped artificial lighting design using LEDs hung from the ceiling. The design of this lighting system is almost the same as task lighting aimed at the canting workstation area to produce focused light, no glare, and reduced object shadows (Fauzi 2017).

3. Methods

This study uses an ethnographic (Spradley 2016) and time and motion study (Wignjosoebroto 2003) method through interviews and observations and takes data gradually to the object of research, namely the Go Tik Swan batik house located in Surakarta. The first data collection stage was an unstructured interview with the Go Tik Swan batik business owners, Mr. Suwarno and Mrs. Supiyah. In this first stage, we also observe the batik-making process from the beginning to the end. Documentation is through audio recordings, photos, and videos with the cameras and cellphone. The second stage is collecting data on buildings and sites and data on the characteristics of the canting workstation, which was carried out on November 21, 2017, from 13.03 to 15.00 WIB. In this second data collection stage, unstructured interviews were also held with the batik artisans. The equipment used at this stage of data collection is three cameras that function to record the behavior of batik in making batik with canting and record changes in environmental influences on the behavior of batik, as seen in Figure 2. The following tool is an environment meter to record lighting, thermal, humidity, and noise parameters. The physical data of space and changes in its environment were reconstructed using the Sketch Up software and analyzed using The Time and Motion Study method.

Figure 2. The collecting data was done simultaneously between behavioral and spatial characteristics
Source: Widyasari, 2021

4. Results and Discussion

Based on the results of space observations and the behavior of the batik artisan during the process of produce batik with canting, there are several discussions and findings regarding the influence of thermals and natural lighting on the behavior of batik artisan, namely:

4.1 Spatial Data and Analysis of Canting Workstation

There are two canting workstations at Rumah Batik Go Tik Swan. The canting A workstation is the workstation that became the object of initial research because the batik makers who work in it do their work with small cantings. The batik artisan involved in the canting workstation A consist of five batik artisans with two types of work. The Klowongan type of work uses minor canting consisting of four batik artisans, while the Nembok type of work uses more significant canting consists of one batik artisan. Each batik artisan is equipped with a gawangan and a chair without a backrest or dingklik. They sat around a stove filled with hot wax and formed a specific sitting pattern. There are two stoves on this canting workstation, the first is used together, and the second is used specifically for a batik artisan who sits separately. The following is a picture of the canting workstation A, used as the object of observation in this study, as seen in Figure 3.

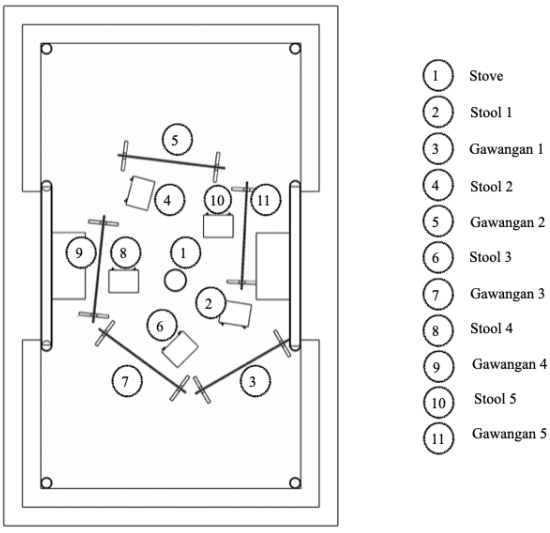


Figure 3. The layout of workstation canting A
Source: Widyasari, 2021

The batik artisan at the workstation canting A sit in a specific order with the stove at the center. With the same type of work, sharing the hot wax in one stove is a typical pattern at the batik canting workstation, especially at Rumah Batik Go Tik Swan. The behavior of batik artisan in batik making process in this centralized pattern becomes a symbol of sharing and working together, which is continuously preserved through the canting process today.

The canting workstation is a semi-open pavilion made of a wooden column structure and a traditional wooden roof structure, as seen in Figure 4. Free-standing walls located on the east and west sides and the placement of storage cabinets on the sidewalls function to control the airflow in this canting workstation. In addition, through this research, it is also known that the function of the free-standing wall is as a barrier to sunlight so that it does not directly enter the canting workstation area, which can interfere with the comfort of the batik artisan. For more details, the movement of sunlight can be seen in the section on the analysis of space characteristics on the canting workstation. The wooden roof structure with a simple truss and no ceiling adds to traditional architecture in this building. The selection of chandeliers and profiles of storage cabinets made of wood, profiles of gawangan, and dingklik, which are all almost the same size, assumes that the canting workstation and the equipment used are well planned.

Figure 4. Workstation canting A at the Go Tik Swan traditional batik workshop
Source: Widyasari 2021

4.2 Space Characteristics Data and Analysis on Canting Workstation

The measurement point was taken from the nearest batik artisan who carried out the canting process using a small canting, from now on referred to as batik artisan A, who sit in stool number one on Canting Workstation A, and the following are the data that were successfully collected:

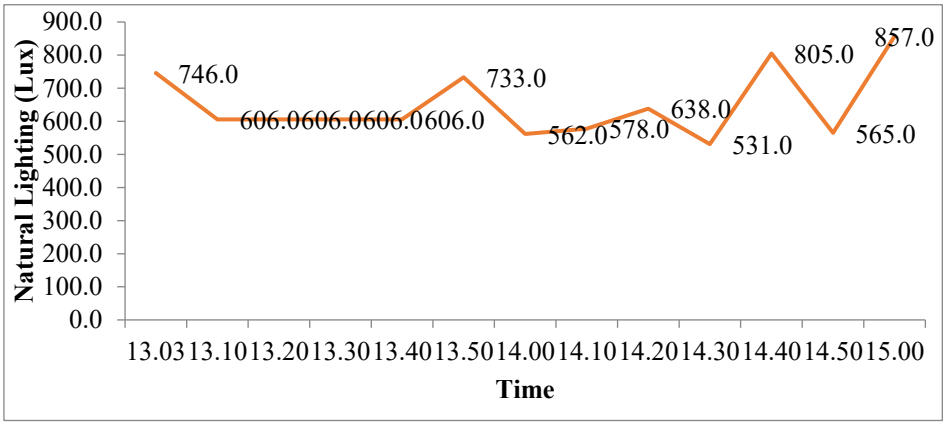


Figure 5. The Natural lighting in Canting Workstation A

From Figure 5, the highest luminance measured is 857 lux at 15.00 WIB, and the lowest luminance point is 531 lux at 14.30 WIB. This data is above the exposure threshold for significant visual work, according to Lechner (2007), which is 322 lux.

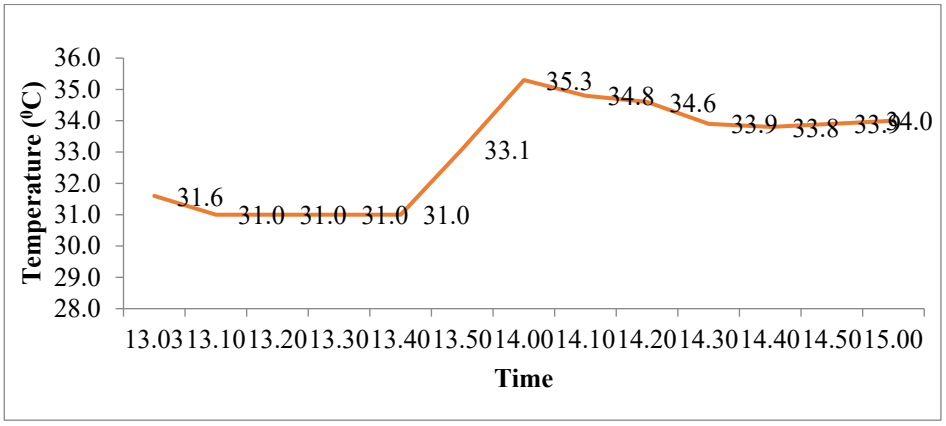


Figure 6. The Temperature in Canting Workstation A

As shown in Figure 6, the lowest thermal point is 31 ^{0}C at 13.40 WIB, and the highest point is 35.3 ^{0}C at 14.00. Both are above the thermal comfort threshold, according to Bridger (1995), which is 23 ^{0}C for the type of sedentary work.

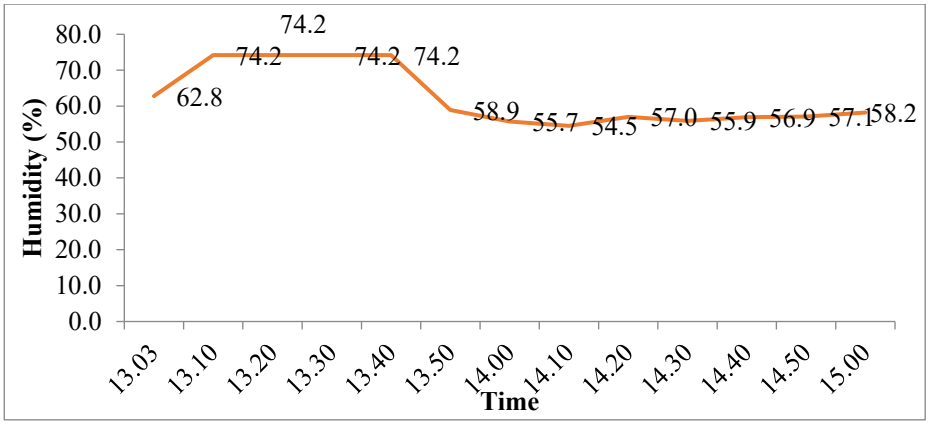


Figure 7. The Humidity in Canting Workstation A

The measured humidity level is slightly above the average threshold, according to Bridger (1995), where the lowest point is 54.5% at 14.10 WIB, and the highest is 74.2%, from 13.10 until 13.40 WIB, as seen in Figure 7.

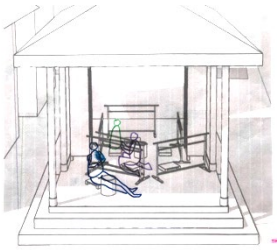
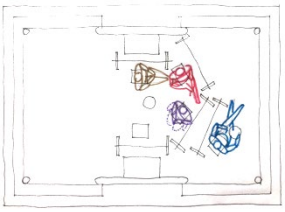
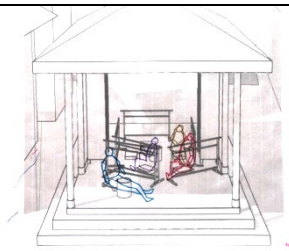
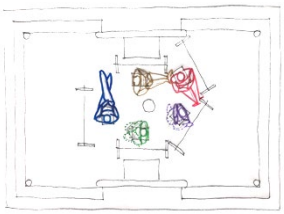
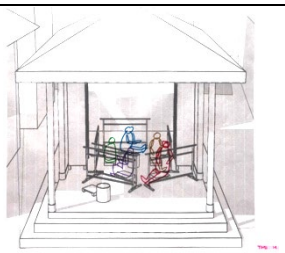
Based on the graphs above, the natural lighting standards are well met, and even overexposed. The influence of the semi-open building form is also felt in the smooth air circulation. There is a treatment on the intensity of light entering the workstation and air circulation by adding free-standing walls on the west and east sides of the building. Good air circulation, but unable to withstand the heat generated by direct sunlight on the southwest side of the building. Therefore, batik artisan B exposed to direct sunlight, decided to move at 14.08 to a lower temperature work area with a lower lighting level. In this case, batik artisan B, who sit in stool number two, prefers thermal comfort over visual comfort. The north area of the building became the choice of batik artisan B to continue her work. The reason is that there is sufficient space to continue the activity of the canting process. The recorded temperature reached its highest level at 14.00 WIB with 35.3 ^{0}C and slightly decreased at 14.10 WIB to 34.8 ^{0}C. This temperature level is the highest point in the documentation on the Go Tik Swan canting A workstation. The humidity level was recorded slightly

above the Lechner (2007) average, with a high point of 74.2%, it is because the building system is semi-open, thereby increasing the humidity of the room.

4.3 Solar Movement Data and Analysis on Canting Workstation

The sun's movement is an essential factor in the type of semi-open space, such as a pavilion for canting workstation A. In this case, the direction of the sun's movement is used to determine whether the area is exposed to direct sunlight or not. Based on the data described, there is a relationship between the sunlight and changes in the behavior of batik artisan, which causes a shift in position. This shift in the position of the batik artisan affects the layout of the canting workstation. Due to the addition of batik artisan to a pre-existing layout, it is necessary to adjust the position/location so that the batik artisan remains comfortable doing their work.

Table 1. Simulation of postural changes and the movement of sunlight on a canting workstation A per unit of time

No.	Time (WIB)	Top View	Perspective View
1.	13.50		
2.	14.00		
3.	14.10		

The Table 1 describes the postural changes of the batik artisan, the sun's movement, and the shadows on the canting workstation A setting in units of time. At 14.08 WIB, the sun moved westward, causing the sunlight to fall into the canting workstation A and impacting batik artisan B. Due to the high temperature, batik artisan B decided to move to a shadier area. The movement of batik artisan B caused changes and adjustments to the layout of the canting workstation A.

4.4 Aspects of Sustainability in The Batik Tulis Process and Its Relation to The Workstation Canting

The comfort factor of the body of the batik artisan becomes important when workers do the task for an extended time with a posture that tends to be static and gets a direct effect from natural lighting and thermal changes. Anticipation of excessive lighting and thermal factors has been carried out with two free-standing walls on the east and west sides of the canting workstation building. However, the circular layout of the canting workstation is organic and flexible,

sometimes causing direct exposure to the body of the batik artisan. In this case, the batik artisan can quickly adapt positionally by moving from place to place and re-adjusting its place in a circular layout without disturbing other batik artisan workspaces.

As part of the Go Tik Swan batik workshop, the canting workstation can function adequately by optimally accommodating canting activities. The process of batik with canting is critical in a traditional batik business. If the process of making batik with canting occurs well, then the effort to produce traditional written batik may continue. This process will take place continuously to support the environment of the traditional creative industry.

5. Conclusion and Future Research

Based on the analysis of spatial factors, space characteristics, and the solar movement, it can be concluded that there is a relationship between thermal and natural lighting on changes in the behavior of batik artists, as follows.

- The division of zones and functions of space in the Go Tik Swan batik house is well structured, namely residential and retail, performance areas, and workshops and services. The well-planned concept is also reflected in the division of workshop space following the production flow. A building is a pavilion type (semi-open), making the wall opening optimal for natural lighting and air circulation. A free-standing wall in the workstation area is an anticipation of natural factors such as sunlight. Thus, it can be concluded that the Go Tik Swan batik house is well planned.
- The batik artisan work and sit in a specific order with the stove at the center. Because they have the same type of work, sharing the hot wax on one stove is common. Sharing and collaborating in traditional batik work continues to be preserved, one of which is through the canting process.
- Environmental factors influence batik artisan's behavior. For example, when the thermal comfort of the batik artisan is disturbed, she prefers to move her position and distance (displacement) to a work area that is more acceptable to her body, even though the work area has a lower level of lighting than the previous work area. As a result, batik artisan is better able to adapt visually well.

However, this research is only a case study taken and observed in a specific time frame. Thus, more in-depth observations and analyses of other cases are still needed in Go Tik Swan batik house or other batik houses with the same type of typical buildings. Nevertheless, this research is the basis for further research that explores the problem of batik artisan posture and the minimum required area for batik artisans in a canting workstation. This study also states that the Go Tik Swan batik house is a cultural heritage building those functions as a traditional batik workshop, aims to preserve the architecture and the intangible cultural heritage, traditional batik tulis process, and Batik Indonesia motif.

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