

Assessment Of Natural Lighting And Visual Comfort Of Library. (Case Study: Library Of Universitas Bandar Lampung And Universitas Teknokrat Indonesia)

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Abstract— Sunlight is a natural resource that as renewable energy. Exploiting sunlight as a natural lighting in the library can reduce the electrical energy in the library and can provide visual comfort of the library users. This study aims to: determine the effect of opening vast library to the library lighting quality, knowing the condition of natural lighting intensity in the room of the library, know the level of users comfort of the natural lighting; and know how to optimize natural lighting in the library. The research method used is descriptive qualitative. Performing two approaches, namely the study of literature and case studies. The study of literature includes a review of the theory of natural lighting, visual comfort theory and the theory of the campus library standards. The case study consists of two data, that is primary data and secondary data. Primary data is data from the measurement results on the two objects. Secondary data consists of literature, the Indonesian National Standard data and questionnaire results to the user. The result is that the size of the aperture affects the natural lighting in buildings, as happened in Universitas Bandar Lampung library, the library is located on the 2nd floor in the direction of many building facing east and west so that the sun in the morning and afternoon very high. Unlike the library, Universitas Teknokrat Indonesia although this library also has a large opening, but the design of window boxes with lines and coated wood material iron bars on the windows to reduce light entering the building. The intensity of natural light in the library of the Universitas Bandar Lampung better than Universitas Teknokrat Indonesia. Because of the results of the data visible number of dots that already meet or approach the Indonesian national standards Daylighting. In addition to the openings possessed direction toward the building, the library of the Universitas Bandar Lampung intensity of light coming into the building lot. The comfort level of library users against natural lighting in the library of Universitas Bandar Lampung higher than at the library Universitas Teknokrat Indonesia. The intensity of light in the library of the Universitas Bandar Lampung is better and the results of the measurement was up to standard. As for the Universitas Teknokrat Indonesia library user comfort at lower use of natural lighting for the room A does not get direct sunlight while room B is more convenient for getting direct sun light makes the room brighter. To optimize the light intensity at the Universitas Bandar Lampung library should use the furniture with bright colors and the walls a lighter color (yellow, lightgreen, pink, lightblue), which can reflect more light. Thus increasing the intensity of light in the room. Libraries should replace the main door leaves with transparent doors (glass). The reading room should use the furniture with a lighter color. With the limited size of the room that you should use a more minimalist furniture and colors are brighter and give a lot of openings to not obstruct Natural illumination. To provide more convenience in library should provide more artificial lighting so that the light intensity in the room can meet the standards. Keywords—lighting; natural; visual; comfort

1. Introduction

To design the lighting is well to note from a larger scale that takes into account the design of the building, and then leads to a smaller scale, such as elements of the building. Before designing a building a designer must learn the natural state in the site, such as the angle of movement of the sun, sky conditions, wind direction, climate, and the nature of the site. After understanding the state of the

site, the design of the building can be done with syncing between nature and the building. If the building has been designed and created in line with nature, the elements such as aeration and lighting will flow and run well. Therefore, it should be studied factors in the building need to be tailored to the nature [1].

1.1 Openings in Space

There are three basic forms of openings to allow light into the space, sidelighting, toplighting and atria.

1) Sidelighting

Aperture the side of the room, the most common was a window. Planning a window needs to be done with caution, due to improper planning can cause glare and heat tends room temperature, especially in tropical countries such as Indonesia.

There are a few strategies to keep in mind when designing a window in a room, namely:

- a. Placement of windows should be located on the floor and spread evenly (not just on one wall) in order to distribute the light evenly. Avoid lighting unilateral (only window on one wall) and use bilateral lighting (windows on two sides of the wall) to allow a better distribution of light throughout the room and can prevent glare. Placement of openings along the edge of the wall or in a corner of a room will be able to increase the level of light in the room, because light would enter the adjoining wall surface and the light bounces off the walls.
- b. The windows were too broad often inappropriately used in tropical countries, because of the heat and glare of too much radiation into the room.
- c. Protection against sunlight can be done in two ways:
 - Shadowing sunlight

Shadowing can be done using the meeting roofs, eaves, awning windows, papa, or field that can be mounted vertically. This type of protection can be adjusted based on the direction of the fall of the image produced. On the north and south sides can use horizontal perindungan because sunlight dating from the front, so that the image produced this protector can protect from glare [2].

- Filtering sunlight

Filtering sunlight dapat dilakukan by using blinds, kerepyak (jalousie), grilles, pergolas and so on. Things to consider in putting these tools, which must be outside the window, not inside. Fitting in will cause the radiation to the grille which will become a source of heat and pans would be reduced between the grille and glass. This can cause the convection process and can increase the temperature in the room [2]. Visual comfort is associated with the human senses of vision, that eye. The human eye is a sensitive sensing tool. The eye is able to see the light only in a very narrow part of the whole spectrum elektromagnetik, called the visible spectrum but in the narrow lanes. The human eye can absorb small variations in both color and relative intensity of the light. The human eye is composed of individual parts -masing be some special functions with regard to acceptance and responsiveness / light perception [3]. Visual comfort associated with standard lighting conditions and glare allowable standards. Factors affecting visual activities eg lighting effect in the lighting activities in teaching and learning activities in classrooms [4]. Superior visual comfort in the room is set on SNI 03-6197-2000 with a level of visual comfort and activities tailored to the needs of the building [5]. The minimum light level and color renderisasi recommended for indoor function Institutions are as follows;

1. Classroom : 250 lux
2. Library : 300 lux
3. Laboratory : 500 lux
4. Room Picture : 750 lux
5. Diner : 200 lux

Lighting contain aspects of quantity (light intensity) and quality (color glare). Glare can occur directly (highlighted light) or indirect (reflected light). Too much light in the room will cause the pupils to shrink too long, so that the eyes tired.

1.2 Factors visual comfort

Factor forming visual comfort [6], namely:

1. The quantity of light or the light of the strong level (lighting level)
2. or the turning light density distribution (luminance distribution)
3. Limitation of glare (limitation of glare)
4. Directions form shadow and the scattering of light (shadows and light directionality)
5. and climatic conditions in the room
6. a light color and reflection color (light color and color rendering)

2. Method

The method used is descriptive and qualitative research. Qualitative research is to understand phenomenon or a social phenomenon with more emphasis on a complete picture of the phenomenon under study rather than develop them into variables are interrelated [7]. Meanwhile, according [8] research is descriptive research that aims to explain or describe a situation, event, object, people, or anything related to the variables that better explained premises jackfruit biased numbers or words. Descriptive qualitative study sought to describe a social phenomenon. In other words, this study aims to describe the nature of some thing that is ongoing at the time of learning. This qualitative methods to provide complete information to benefit the development of science and more can be applied to various problems. Visual comfort on library research carried out by the measurement and distribution of questionnaires. The results of the measurements and questionnaires will be explained descriptively to determine the level of visual comfort of Universitas Bandar Lampung and Universitas Teknokrat Indonesia library. The research was conducted in March 2017 to June 2017. Measurements were made for ± 1 week more precisely on 11 July 2017-17 July 2017. Depending on weather condition that bright and not cloudy or rainy.

Table 1. Schedule measurement

Date	Time	Lecture Time	measuring method
Tuesday, July 11, 2017	Morning Afternoon Evening	8:00 to 09:00 am	Opened Window and Switch off Lamp
		13:00 to 14:00 pm	
		16:00 to 15:00 pm	
Wednesday, July 12, 2017	Morning Afternoon Evening	8:00 to 09:00 pm	Opened Window and Switch off Lamp
		13:00 to 14:00 am	
		16:00 to 15:00 pm	
Thursday, July 13, 2017	Morning Afternoon Evening	8:00 to 09:00 am	Opened Window and Switch off Lamp
		13:00 to 14:00 pm	
		16:00 to 15:00 pm	
Friday, July 14, 2017	Morning Afternoon Evening	8:00 to 09:00 am	Opened Window and Switch off Lamp
		13:00 to 14:00 pm	
		16:00 to 15:00 pm	
Monday, June 17, 2017	Morning Afternoon Evening	8:00 to 09:00 pm	Opened Window and Switch off Lamp
		13:00 to 14:00	

am
16:00 to 15:00
pm

Source: Author Documentation

Assessment natural lighting and visual comfort of campus library at Universitas Bandar Lampung jl. ZA Pagar Alam No. 26 Kedaton, Bandar Lampung and Universitas Teknokrat Indonesia on Jl. Pagar Alam No. 09 Kedaton Bandar Lampung.



Figure 1. Map Lampung. Source: Google map, 2017



Figure 2. maps Bandar Lampung. Source: Google map, 2017



Figure 3. The research (Red mark on the picture). University Bandar Lampung. Source: Google map, 2017



Figure 4. The research (Red mark on the picture). Kampus Universitas Teknokrat Indonesia. Source: Google map, 2017

2.1 Population and Sampel

Population of this research taken is the campus of the Universities of Lampung, namely:

1. Universitas Lampung
2. Universitas Bandar Lampung
3. Universitas Malayahati
4. Universitas Muhammadiyah Lampung
5. Universitas Muhammadiyah Metro
6. Universitas Saburai
7. Universitas Tulang Bawang
8. Universitas Megow Tulang Bawang
9. Universitas Teknokrat Indonesia

In this study, the author took a sample with purposive sampling method Universitas Bandar Lampung and Universitas Teknokrat Indonesia. Two campus is the largest and best campus in Bandar Lampung,

and the many achievements obtained. Universitas Bandar Lampung campus and the Universitas Teknokrat Indonesia has a campus library with an area of space, the same window openings and has the use of natural light in the library that can be used as comparison of the intensity of natural light. The existence of many library users can be used as a reference for measuring the level of visual comfort of the library.

2.2 Data Collection Technique

Data collection techniques used in this study is the observation and measurement. Data in the form of charts and situation of the library, the data of lighting intensity of library as well as data from the questionnaire. With the collection of the following data:

1. Floor plan of Universitas Bandar Lampung and Universitas Teknokrat Indonesia library.
2. Measurement Lighting Meters used Lux TASI-3720.
3. Measurements window and spacious room in the library is measured with a meter.

2.3 Research Instrument

Research Tool

1. Personal computer (PC) which equipped program:
 - a. AutoCAD 2010, is used to create two-dimensional images.
 - b. Microsoft Word 2013, used to write the report.
 - c. Microsoft Excel 2013 is used to compile research data in tabular form.
2. Digital cameras, used to take visualization during the field survey.
3. Luxmeter TASI-3720 was used to measure the intensity of light at the time of the survey, in which the results will be used as a result of light intensity.

The tool ways:

- 1) Press the power button to turn on the appliance.
- 2) Photo cell leads to the light source.
- 3) Press record button to record data and then let sit for a few minutes to obtain the data range.
- 4) Read result on display (level meter).

2.4 Analisis Data Technique

Analysis data technique in this study is to compare visual comfort level data library with visual comfort standard base on National Indonesia Standard [5]. The measurement results will be juxtaposed with the questionnaire results filled by library users:

Table 2. Measurement Time of Natural Lighting

MORNING	
Universitas Bandar Lampung	Universitas Teknokrat Indonesia
DAY	
Universitas Bandar Lampung	Universitas Teknokrat Indonesia
AFTERNOON	
Universitas Bandar Lampung	Universitas Teknokrat Indonesia

Source: Author Documentation

The way of collecting data by comparing the visual comfort of the morning, afternoon and evening with natural lighting.

2.5 Technical Sampling

The sample should be as big as possible. Opinions assumes that the more samples taken the more representative and the results can be digenelisir. But the size of the sample received will depend on the type of research [9].

1. If the research is descriptive, then minimum sample is 10% of the population.
2. If penelitiannya correlational minimum sample was 30 subjects.
3. If the causal comparative study, a sample of 30 subjects per group.
4. If the experimental research, the minimum sample was 15 subjects per group.

Not much different from the [9] also gave some guidelines for determining the sample size are:

1. The sample size of more than 30 and less than 500 is appropriate for most research.
2. If the sample is split into subsamples (male / female, junior / senior, etc.), the minimum sample size

of 30 for each category is appropriate.

3. Inresearch mutivariate (including regression analysis), the sample size should be 10 times greater than the number of variables in the study.
4. For a simple experimental study with rigorous control experiments, the research that success is possible with a small sample size of between 10 and 20.

Determining the sample size of a population with the following formula [10]:

$$n = N / N (d)^2 + 1$$

n = sample; N = population; d = the value of 95% or sig precision. = 0.05.

For example, the number of population is 125, and the desired level of error is 5%, then the number of samples used is:

$$N = 125/125 (0.05)^2 + 1 = 95.23, \text{ rounded so } 95.$$

Frankel and Wallen (1993 : 92), suggesting a minimum sample size for

1. researchdescriptiveas 100.
2. correlational study as many50.
3. causal-comparative study as much as 30 per group.
4. The experimental research as much as 30 or 15 per group.

For the factor analysis, the recommended sample size is not less than 50 observations, and suggested a sample size of 100 or more. As a general rule, some researchers recommend a ratio of 10: 1 or 20: 1 case for every variable [11]. This question is if the item questionnaire was designed as many as 20 items, then the minimum sample size is 20 x 10 = 200. For regression analysis, it is recommended is 15-20 observations per independent variable [11] further explained that the measure samples can reduce acceptance limit loading factor on the item. For example, for the 100 respondents, the loading factor of 0:55 or more can be considered significant. 0:30 As for the loading factor can be significant for a sample size of 350 or more. For discriminant analysis, many researchers suggest using a ratio of 20x the number of predictor variables [11].

3. Result

3.1 Library Bandar Lampung University

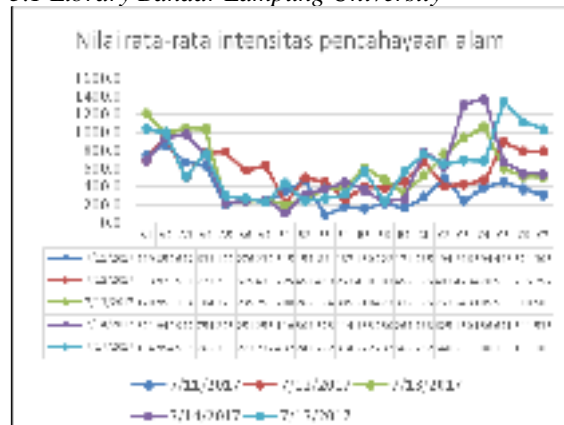


Figure 5. The light intensity of Bandar Lampung University Library. Source: Analysis of 2017

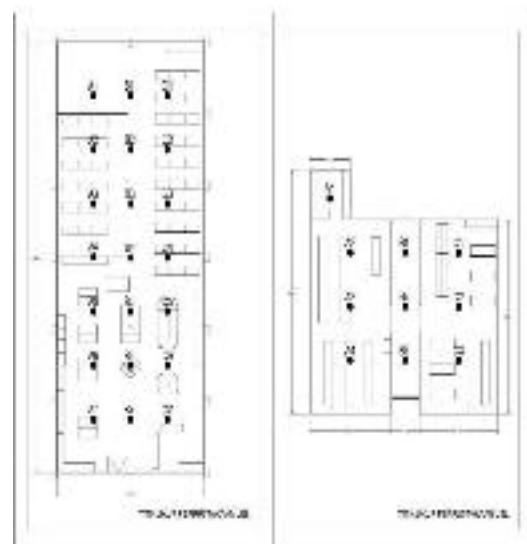


Figure 6. Titik measuring light intensity library Bandar Lampung University. Source: Personal Documentation

In the diagram above shows the average value of the light intensity at points A and C higher than the average value B. highest lux is the measurement day 4 at the point C4 is 1368.3 lux with the laying of a point is next to the window and got direct sunlight. With sunny weather conditions. While the average value of the lowest lux is in the first day of the measurement at the point B3 is 88.0 lux with

the laying of a point in the middle of the room so just get the reflection of light from the left or right of the building with sunny weather conditions. point B only get the reflection of light in the room, but it pelekakan furniture in the library of the Universitas Bandar Lampung make shadows and reduce the intensity of light at some point. Distance comfortable in reading a book in the library in sitting is 70-80 cm distance from the floor.

Table 3. Value University library light intensity is Bandar Lampung below the standard value

	7/12/2017	7/13/2017	7/11/2017	7/17 / 2017
	7/14/2017			
A1	693.3	1208.01045.3	691.0	749.7
A2	975.7	998.0		859.3
A3	508.3	1043.3		672.0
A4	772.3	1040.7		633.0
A5	788.0	296.0	220.0	199.3
A6	579.3	239.0		276.3
A7	636.7	255.3	256.0	237.3
B1	225.7	432.7	200.0	345.7
B2	498.0	269.0		455.7
B3	459.0	374.3		88.0
B4	263.7	385.7		187.3
B5	400.0	610.3		160.0
B6	383.7	473.7	222.0	237.3
B7	455.7	325.0		171.7
C1	675.0	525.0		285.0
C2	402.0	762.3		494.3
C3	246.7		423.0	943.3
C4	470.3	1059.0		394.0
C5	900.0	596.3		446.0
C6	795.7	508.7		374.3
C7	792.3	500.3		305.7

Note: Values below the standards lux

Source: Analysis s 2017

Judging from the standard light intensity at the library, the average was approaching and exceeding the average value. The average lux value that has not yet reached the standard is A5, A6, A7, B1. Although the point A is located next to the east window of the building, but the average value does not meet the standards, at that point there is furniture with dark colors and Bayanga wall. While B1 is located at the midpoint and flanked by bookshelves measuring 1.8m high. As happened on July 14, 2017 at point B1 at 110.3 lux intensity value (lowest) in cloudy weather and on July 11, 2017 at point B1 at 432.7 lux intensity value (highest) in cloudy weather.

3.2 Universitas Teknokrat Indonesia Library



Figure 7. The light intensity library technocrat Universtas Indonesia. *Source: Analysis of 2017*

In the diagram above shows the average value of the light intensity at points A and B is lower than in C. The average value is the highest lux day 5 at the measurement point C1 is 554.3 lux, with the laying of a point is next to the window and gets direct sunlight from the east and sunny weather conditions. While the average value of the lowest lux is the point B3 and occurs throughout the measurement at the point of measurement on a first value that is 88.0 lux B3 titik with the laying of a point in the middle of the room is blocked by a wall and use groundbreaking kayu. Selain door furniture that affect the intensity of the light on room, the weather outside is also memiliki high influence on the level of intensity of natural light.

Table 4. Value Light intensity Universitas Teknokrat Indonesia library below the standard value

	7/12/2017	7/13/2017	7/14/2017	7/15/2017	7/16/2017	7/17/2017
A1	6.0	5.7	4.3	2.3	7.0	7.0
A2	11.0	8.7	7.0	4.0	10.0	10.0
A3	15.0	15.7	13.0	8.3	15.0	15.0
A4	8.3	6.7	5.0	2.7	7.3	7.3
B1	7.0	7.7	7.0	6.3	9.0	9.0
B2	50.7	46.3	35.7	26.3	59.7	59.7
B3	3.0	2.0	1.0	1.0	2.7	2.7
C1	357.7	298.0	203.7	665.3	554.3	554.3
C2	306.0	266.7	201.7	157.7	352.7	352.7
C3	116.3	53.3	47.7	32.0	108.7	108.7

Note: Values lux substandard

Source: Analysis of 2017

Judging from the standard light intensity at the library, the average value of the point layout measuring not approach the standard value except at point C, since the point C can still get langung light of the sun. Room A is in the west, but just getting light reflections from buildings and vegetation around the building, while B is the room like a corridor with a divider wall so light that enters only the reflected light from the room next to him. In addition to the laying of furniture that affect the intensity of light in the room, the weather outside is also memiliki high influence on the level of intensity of natural light. As happened on July 14, 2017 at point B3 with the intensity of 1.0 lux value (lowest) in cloudy

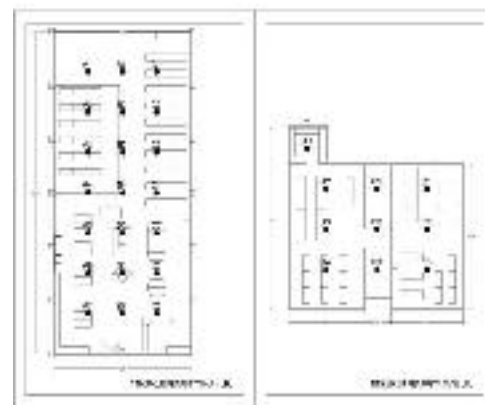


Figure 8. The measuring light intensity Universtas technocrat Indonesia. *Source: Personal Documentation*

weather and on July 11, 2017 at point B3 with the intensity of 3.0 lux value (highest) in cloudy weather.

3.3 Leisure Natural Light of Library

Addition to using the data collection tool, the author uses perceptual assessment using natural lighting comfort kuesioner library.

a. Visitors libraries

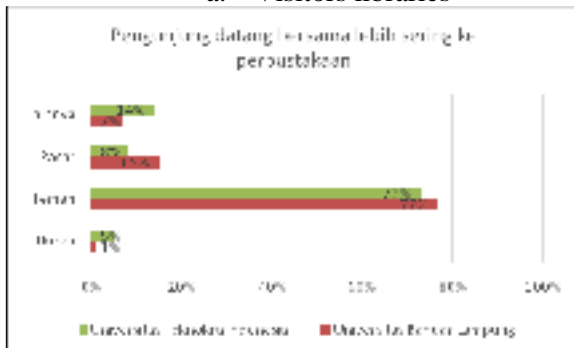


Figure 9. Diagram library patrons. *Source: Analysis of 2017*

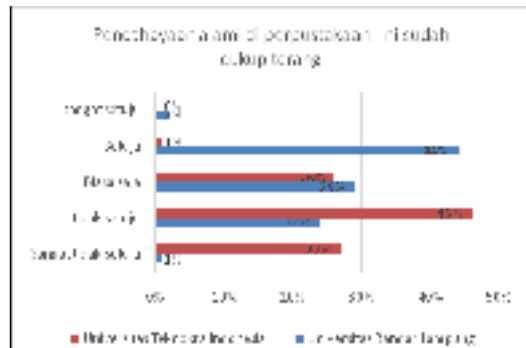


Figure 10. Diagram opinion of lighting intensity in the room is bright enough. *Source: Analysis of 2017*

In the above diagram library visitors 77% Bandar Lampung University and the University of technocrats Indonesia 73% more often come to the library with a friend. In addition to looking for books also spend time with friends. In the lighting assessment in Bandar Lampung University Library more 46% agreed and 29% indifferent. While the library of the Universitas Teknokrat Indonesia 46% disagree and 27% said they strongly disagree. Of the respondents judging proportional to the measured data using the tool, the light intensity at the University library Bandar Lampung is good enough, judging respondents Indonesian technocrats Library users also proportional to the measured data using the tool, the intensity of light in the library that is not good enough.

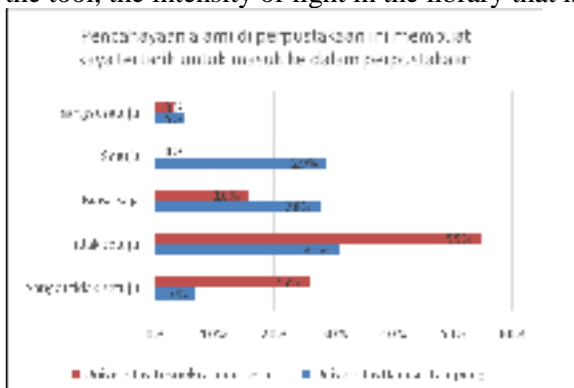


Figure 11. Diagram of interest in natural lighting Library. *Source: Analysis of 2017*

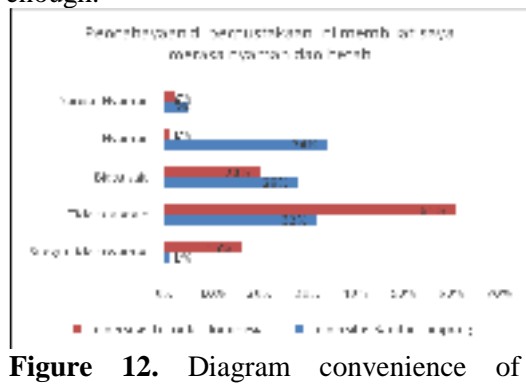


Figure 12. Diagram convenience of reading on natural lighting in the library. *Source: Analysis of 2017*

In the interest assessment natural lighting in the University library Bandar Lampung 31% more disagree, 29% agree and 28% indifferent. While the library of the Universitas Teknokrat Indonesia 55% disagree and 26% said they strongly disagree. Of the respondents above valuation Universitas Bandar Lampung library users feel quite interested when using natural lighting, and the University library technocrat Indonesia was not interested when using the library in the state do not use artificial lighting. In the assessment in reading comfort in the use of natural light into the library of the Universitas Bandar Lampungis 38% more normal states, 26% agreed and 25% disagreed. While the library of the Universitas Teknokrat Indonesia 35% strongly agree and 36% say they do not agree. Of the respondents above valuation Universitas Bandar Lampung library users feel comfortable when using natural lighting, and the Universitas Teknokrat Indonesia library feel uncomfortable when using

natural light. Measurements made is 70-80cm from the floor, resulting in a measurement result was reading in the library can be fairly uncomfortable, but unlike the Indonesian technocrats library, lux values are less than the standard can reduce the value of comfort in reading in the library.

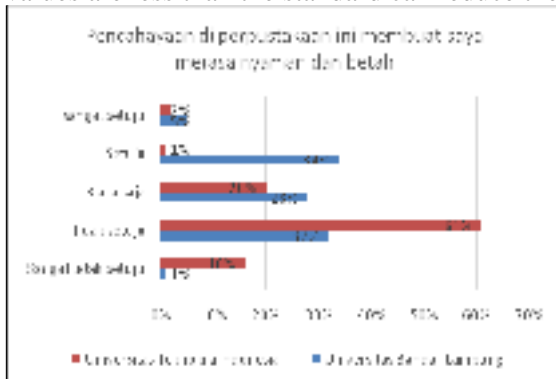


Figure 13. Diagram of the convenience of visitors during reading in the library. *Source: Analysis of 2017*

In the assessment of comfort and feel at home with the use of natural lighting in the University library Bandar Lampung 34% agree, 32% disagree and 28% indifferent. While the library of the Universitas Teknokrat Indonesia 61% disagreed and 16% said they strongly disagree. Of the respondents above valuation Bandar Lampung University library users feel comfortable and at ease when using natural lighting, and the University library Indonesian technocrats feel as comfortable and welcome to linger in the library when using natural light. In the assessment of energy saving programs by using natural light into the library of the Universitas Bandar Lampung 40% agree and 25% indifferent. While the University Library technocrat Indonesia 35% agree and 16% say they do not agree. Of the respondents above valuation Bandar Lampung University library users and library of Universitas Teknokrat Indonesia, agreed in energy saving programs and agree to use natural lighting.

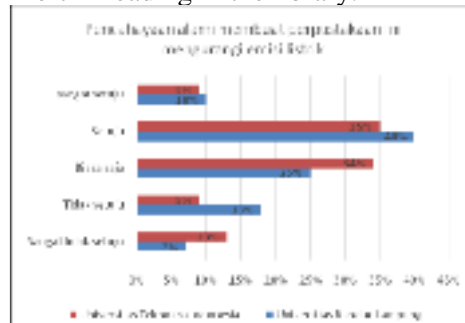


Figure 14. Diagram opinion on energy efficient. *Source: Analysis of 2017*

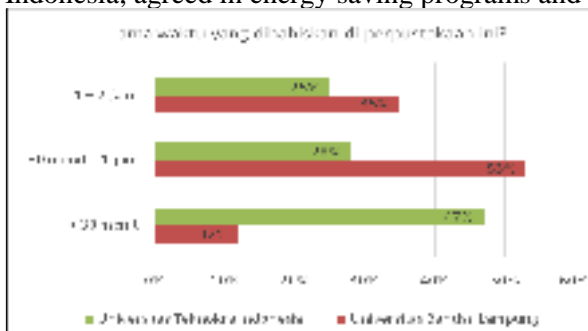


Figure 15. Diagram of time in the library Users. *Source: Analysis of 2017*



Figure 16. Diagram visitors think about natural lighting. *Source: Analysis of 2017*

In the respondents' assessment linger in the library when using natural light into the library of the Universitas Bandar Lampung 35% in favor and 53% 1-2 hours 30 minutes-1 hour can linger in the library, While the University Library technocrat Indonesia 47% in favor of <30 minutes can linger in the library. Of the respondents above valuation Bandar Lampung University library users can still linger with the use of natural lighting while using natural lighting in the library of the University of Indonesia technocrat visitors feel you can not linger in the library. In the assessment of respondents to the library when using natural light into the library of the Universitas Bandar Lampung 60% are content with the intensity of light in the library. While the library of the Universitas Teknokrat Indonesia 61% feel less light by using natural lighting. So is seen by the data obtained in a particular room light intensity Universitas Teknokrat Indonesia library did not go close to the standards set.

3.4 Optimize Daylighting InLibrary

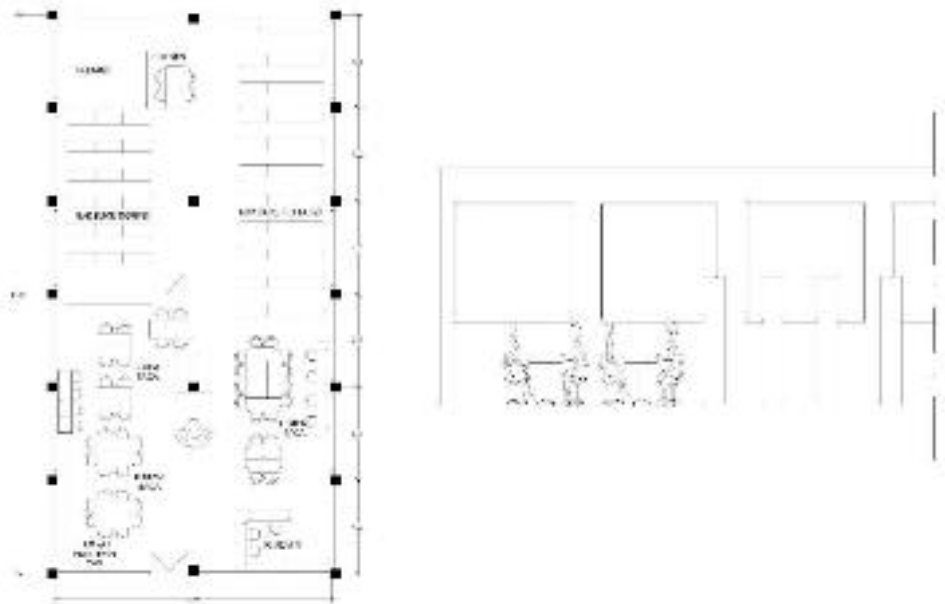
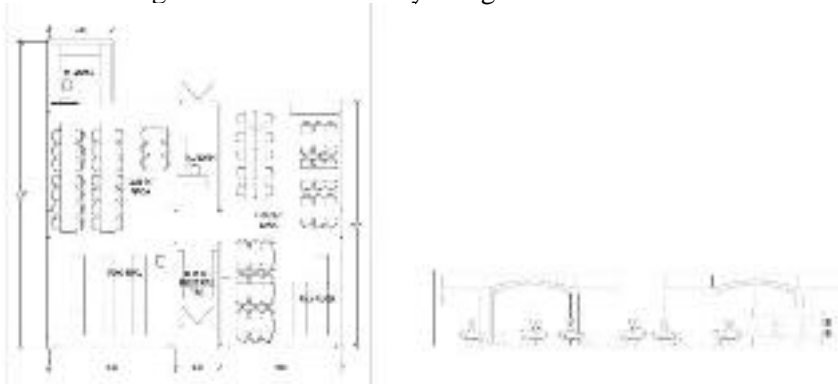


Figure 17. Furniture Layout of Bandar Lampung University Library. *Source: Author Documentation*

The area of the window opening in a library Bandar Lampung University has reached fairly well because the standard is 72m² and pass through 20% of the area of the room. When viewed from the plan Figure 5.1 The natural lighting coming from the left and right of the room.

he use of window stickers on the windows gives the effect of light entering through the window, propagated well. Although the incoming light is already well into the room, in Table 5.1 there is still a value that has not met the standards according to the author at the point of measurement caused by several factors. The first is the laying of furniture, judging by the lowest value of 88.0 lux (B3) blocked by the bookshelf with a height of 1.8m. despite the prolonged placement of which permeates the light from outside directly. This point only gets the reflection light around it. Second is the use of color on every existing furniture. Using colors that do not reflect light much like dark gray (on wooden bookcases) can absorb light so that the intensity of light around is reduced.



Gambar 18. Furniture Layout of Universitas Teknokrat Indonesia Library. *Source: Author Documentation*

The window opening area in the library of Universitas Teknokrat Indonesia is good because it has reached the standard of 97.2 m² and passes 20% of the value of the room area. When viewed from the floor plan Figure 5.3 natural lighting comes from the front, left, and right of the room. windows are used like conventional windows with wooden frame frames with iron bars. the incoming light has been well into the room, in Table 5.2 there are still many values that have not met the standards according

to the author at the point of measurement caused by several factors. First is the wall boundary that causes the value at the point B1-B3 natural lighting obtained at this point is not much because of obstructed wall, second is the laying of furniture. The bookcase is placed near the window, reducing the light entering the reading area. In addition, the use of color in furniture and size can be a factor of reduced reflection and light intensity in the library. In room A only get a light intensity that is not much from the outside caused by the dimming of light caused by vegetation and pavement around. The state of a person reads in the library the distance between floors and books averages 70-80 cm above the table. The reflections that exist in the room determine the value of comfort in reading a library.

4. Conclusion

The result is that the size of the aperture affects the natural lighting in buildings, as happened in Universitas Bandar Lampung library, the library is located on the 2nd floor in the direction of many building facing east and west so that the sun in the morning and afternoon very high. Unlike the library, Universitas Teknokrat Indonesia although this library also has a large opening, but the design of window boxes with lines and coated wood material iron bars on the windows to reduce light entering the building. The intensity of natural light in the library of the Universitas Bandar Lampung better than Technocrats University of Indonesia. Because of the results of the data visible number of dots that already meet or approach the Indonesian national standards Daylighting. In addition to the openings possessed direction toward the building, the library of the Universitas Bandar Lampung intensity of light coming into the building lot.

The comfort level of library users against natural lighting in the library of the Universitas Bandar Lampung higher than at the library Universitas Teknokrat Indonesia. The intensity of light in the library of the Universitas Bandar Lampung is better and the results of the measurement was up to standard. As for the Universitas Teknokrat Indonesia library library user comfort at lower use of natural lighting for the room A does not get direct sunlight while room B is more convenient for getting direct sun light makes the room brighter. To optimize the light intensity at the Universitas Bandar Lampung perpustakaan should use the furniture with bright colors and the walls a lighter color (yellow, hijau muda, merah muda, biru muda), which can reflect more light. Thus increasing the intensity of light in the room. Libraries should replace the main door leaves with transparent doors (glass). The reading room should use the furniture with a lighter color. With the limited size of the room that you should use a more minimalist furniture and colors are brighter and give a lot of openings to not obstruct illumination alami. Untuk provide more convenience in perpustakaan should provide more artificial lighting so that the light intensity in the room can meet the standards.

References

- [1] Guzowski, Mary. 2000. *Daylighting For Sustainable Design*. McGraw-Hill, New York.
- [2] Mangunwijaya, Y. B. 1994. *Sastra dan Religiositas*. Yogyakarta: Kanisius.
- [3] Anthony J, Snyder James C. 1997. Jakarta : Erlangga.
- [4] Lechner, Norbert. 2007. *Heating, Cooling, Lightning: Metode Desain untuk Arsitektur*. P.T. Raja Grafindo Persada, Jakarta.
- [5] SNI 03-6197-2000. *Konversi Energi pada Sistem Pencahayaan*.
- [6] Darmasetiawan. 1991. *Teknik Pencahayaan dan Tata Letak Lampu*. Jakarta: PT. Grasindo.
- [7] Rahardjo, Mudjia. 2010. *Triangulasi dalam Penelitian Kualitatif*. Melalui: <http://www.mudjiarahardjo.com/artikel/270.html?task=view> [diakses 12 November 2016 Pukul 16:17].
- [8] Setyosari. Punaji 2010. *Metode Penelitian Pendidikan dan Pengembangan*. Jakarta: Kencana.
- [9] Gay, L.R. dan Diehl, P.L. 1992. *Research Methods for Business and Management*. MacMillan Publishing Company, New York.
- [10] Slovin, M. J., 1960, Sampling, Simon and Schuster Inc., New York.
- [11] Hair, J.F., W.C. Black, B.J. Babin, R.E. Anderson, R.L. Tatham, (2006). *Multivariate Data Analysis*, 6 Ed., New Jersey : Prentice Hall.