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Title	The Architectural Design of Building Façade Models Related to Optimizing Daylight Distribution
Abstract	Utilization of Daylight as a source of natural light, is one of the saving energy factors. The building façade model that has good aesthetic value is perfection in designing the architectural design of the building the purpose of this study was to determine the distribution of daylight to the building with several building façade models. The methodology in this research is quantitative by analyzing the optimization of the use of sunlight as a source of natural light in the office building of Bank Mega Makassar. Radiance Illuminance program is an application that is used to determine the value of natural light distribution with various designs of facade models on building envelopes. The results showed that the massive glass facade model has the highest light distribution value compared to the vertical, horizontal, diagonal and vertical-diagonal facade models, but can cause glare and excessive brightness. The second highest light distribution is the vertical facade model, but there are still areas that exceeds the standard of illuminance level for workspaces. The vertical-diagonal facade model has a relatively even distribution of daylight in the morning, afternoon and evening, and in terms of architectural aesthetics the building it doesn't look monotonous and is inviting. The results of this study can be a guide for designing buildings with aesthetic value.
Keywords	Building façade, daylight, illuminance, workspace
Paper type	Research article
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The Architectural Design of Building Façade Models Related to Optimizing Daylight Distribution

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Abstract

Lighting control integrated with natural lighting is recognized as an important and useful strategy in energy efficient building design. One of the right factors to reduce energy consumption for artificial lighting during the day is the maximum utilization of sunlight. The aim of this research, distribution of daylight into the building analysis with five models of building facades and value of illuminance in the morning, afternoon and evening with orientation of the window openings to the northeast and southwest. Bank Mega is one of the tall buildings in Makassar Indonesia, which is located in a coastal area that is not blocked by other tall buildings, so this building is the object of research as a basis for designing façade models on building envelopes. The methodology this study is quantitative, analyzing the performance of sunlight as a source of daylighting in office buildings. This paper presents field measurements in office buildings, namely in rooms that are oriented northeast and southwest. The analysis in the two spaces are a reference to determine the effect of sunlight on the orientation of the building. Furthermore, simulate using the Radiance Illuminance Program software to determine the illuminance value of room in the morning, noon and afternoon with five building facade model designs, i.e: massive glass, vertical, horizontal, diagonal, and vertical-diagonal model. The results presented in this paper show that the distribution of daylight in an east-oriented room is higher in the morning than in the evening and noon. Whereas in the southwest orientation it is inversely proportional, the value of light distribution is higher in the afternoon than in the morning and noon. Accordingly, orientation of the building affects distribution of daylight. The massive glass facade model without using sun shading has the highest light distribution value compared to other façade models, but can cause glare and excessive brightness. Furthermore, the second highest distribution of daylight with the vertical facade model, but there are also areas that exceed the standard illuminance level for workspaces, but only in areas near window openings. The combined model of the vertical-diagonal facade which also has a high distribution of illuminance value and to redirect daylight deep into building interior simultaneously in the morning, afternoon and evening. Accordingly, façade model on envelope of building affects distribution of daylight. The aesthetic value of architectural design shows that the appearance of the building does not look monotonous or massive, when using the building facade models because there are attractive areas in the building envelope.
.value

Keywords: Building façade, illuminance value, daylight, energy.

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Abstrak dalam penelitian apapun dianggap sebagai bagian yang paling penting di dalamnya, namun dalam penelitian ini muncul dengan cara yang tidak mencerminkan isi makalah dengan baik, sehingga perlu ditulis ulang.

Commented [NJ2R1]: Terimakasih atas koreksi nya. Abstrak telah dirubah sehingga dapat dipahami tujuan, metode dan hasil penelitian ini.

Thanks for the correction.
The abstract has been revised and clarified the aims, methods and results of this study.

1. Introduction

Utilization of sunlight as a source of natural lighting is one way to minimize the consumption of electrical energy in buildings. Climate change also has an impact, because solar radiation causes excessive heat and light. This results in increased energy requirements as a cooling load as well. In terms of lighting, it can reduce energy consumption when utilizing daylight, but still consider the negative effects it causes, including glare, high brightness and illuminance value ratio. The percentage of utilization of daylighting can be different, if the architectural design of the building facade is also different. This is the basis for knowing the level of lighting in space by designing a building facade model and can be a reference in designing energy-efficient based buildings. The purpose of this study was to determine the effect of the shape of the building facade on the distribution of natural light that can enter the building. In this study analyzed five different forms of building facades, namely the massive glass, sun shading vertical, horizontal, diagonal and vertical diagonal models. This facade design is to find out the facade model that can distribute daylight into the building, so as to minimize energy use.

The natural lighting factor during the day is the ratio of the level of lighting at a point in the room to the level of illuminance at open field, this is a measure of the performance of the opening window on building [1]. The requirements for natural lighting codes and guidelines, do so from two different points of view. The Standard General Skies of the World Organization for Standardization (ISO) and Commission International de l'Eclairage (CIE) are a set of standard skies that can mathematically represent the distribution of brightness in a sky[2]. Standards and regulations are the first considerations and subsequently focus on the development and scope of climate-based daylight modeling [3]

The aesthetic qualities are influenced by both the lighting system and the kind of sky, and the strong interaction effect suggests that the aesthetic perception of the natural lighting system is dependent on the sky type. According to subsequent statistical data, the natural lighting system that performs best under both clear and cloudy sky situations is made up of high-reflective blinds [4]. The façade opening design has a significant impact on how well a building performs in terms of daylighting, solar heat gain, and natural ventilation. Under various housing conditions, the positions before opening are the most important influential factor on overall energy consumption. Meanwhile, natural ventilation and daylighting are significantly impacted by the east and west sheltering walls [5].

The results of past research show that in both climates, adaptability leads to higher energy savings, consistent with the current very low energy building definition [6]. The sunshine occurrence analysis also determined similar results using three weather statistical approach data files (DA, DAcon, UDI) and maximum difference was 5% independently of orientation [7]. Annual calculated dynamic daylight metric indicates variations of up to 13% under the different weather files analysis. This is a relevant topic since the accurate prediction of daylight levels for indoor environments guides daylighting design [8].

The energy consumption and comfort levels of any structure are significantly influenced by the facades. In addition to design solutions aimed at enhancing occupant comfort, controlling physical environmental variables like heat, light, and sound should be taken into account during the design process [9]. Previous research has shown that illuminance level in the workspace is influenced by the building facade and model various facade models produce significant differences in the illuminance level in the workspace. While the area massif glass façade in workspace has the highest level of illuminance, the vertical and horizontal strip facade models are more illuminated than the hyperbolic parabolic facade models. [10] Subsequent studies on the performance of buildings with different physical configurations and facades [11][12].

According to previous research, the building facade model affects the distribution of daylight into the room [13][14][15] Likewise, the orientation of the building also affects the distribution of daylight into the room [16]. This system and algorithm assess the efficiency of a smart facade, which is made up of a number of kinetic grids that respond to artificial light and take occupant preferences into account [17]. These reducing envelope technologies enable meeting the need to enhance indoor environmental quality and to simplify the building scale utilization of renewable energy sources. Because they can respond to external stimuli and change their behavior and functioning as a result, adaptive building envelopes can actually be seen as the next major advancement in façade technology [18].

The importance of building envelope design is increasing, and in this situation, the usage of passive and climate-adaptive building shells (CABS) is being looked into as a potential for energy savings and improved thermal and visual comfort for users. The findings demonstrate that systems that

Commented [NJ3]:
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1.Tinjauan pustaka datang secara dangkal tanpa memperhitungkan urutan logis dalam menyajikan gagasan dan dari segi keumuman ke kekhususan, meskipun ada kajian dan penelitian yang berkaitan dengan subjek penelitian. Disarankan untuk menulis ulang dengan cara yang lebih baik, dan kemudian mengangkat masalah penelitian dan tujuannya. - Pembahasan hasil lemah dan singkat serta tidak memberikan justifikasi atas hasil yang diperoleh tinggi atau rendah. Sebaliknya, diskusi harus membahas signifikansi dan alasan di balik persentase ini.

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No.1 shading device dinamis ... perlu dianalisis
Saving energi perlu dianalisis
Kenyamana visual perlu dianalisis

undergo continuous mechanical changes as a result of temperature changes offer a higher level of adaptation, energy efficiency, and thermal and visual comfort in the spaceg [19]. The model-based control (MBC) method was created and is being used for lighting and shading activities. The intention is to reduce lighting energy use and prevent glare. At an early point of the design process, the offered approaches and tools can assist the designer in examining the effects of various louver designs and operational options. Comparing the potential effects of various dynamic louver movement situations on the interior lighting is another option. This can make it easier for designers to assess and contrast different dynamic systems, which can lead to more cost-effective designs [20].

Distribution of daylight will cause glare, if the illuminance value is very high. The building facade is one of the forms that prevent glare on the building. Analysis of the quantity of daylight glare, it is better to use the CSWD(C) or Meteonome files in normal climate conditions and the Chinese average year weather file when considering extreme weather conditions [21]. It's possible that the traditional physical and photometric criteria used in glare indices and formulas are insufficient to accurately define and forecast the frequency and intensity of uncomfortable glare from both natural and artificial lights [22]. Several previous researchers have discussed glare in buildings [23][24][25][26] [27]. Façade and shading systems have evolved into major building features that play an important role in passive design strategies [28]. Louvre is a common type of shading devices and has been increasingly used in office [29].

Explanations from several previous studies are closely related to this research, so it can be understood the need to analyze various models of building facades for the utilization of daylight.

Tambahkan studi literatur

2. Methods

The research method is a quantitative, namely describing the simulated data into a statistical program, namely SPSS to determine the increase or decrease in the illuminance value of the result on measurement in workspace. The application used in this research is the Autodesk Ecotect export to Radiance Illuminance application to determine the distribution of daylight entering the building.

Bank Mega Building in Makassar Indonesia is the object of this research and its located in the coastal area of Makassar city in Indonesia. The building has 12 floors with various functions including work space, meeting room, conference room and others. On the 6th floor there is a work space that is directly related to window openings in the building envelope. The Promotional Staff workspace (Room A) is oriented towards the northeast and the Processing Credit Card workspace (Room B) is oriented towards the southwest, so this space is the object for measuring of illuminance value in this building, as shown in the following Fig 1.

Fig. 1. Workspace in the Bank Mega Building in Makassar Indonesia

In this research conducted simulation Radiance Illuminance program with Makassar Position is latitude of -5.1° longitude 119.5° (+8.0 DPL). Simulations on all facade models in this study were carried out with Makassar weather and in June at 8 am (morning), 12 pm (noon) and 4 pm (afternoon). Tambahkan mengapa dilakukan 21 june.

Commented [NJ6]: Tambahkan studi yang lebih relevan yang menyelidiki distribusi siang hari (misalnya Ahmad Eltaweel, Mohamed Alaa Mandour, Qinghua Lv, Yuehong Su, Peningkatan Distribusi Siang Hari Menggunakan Automated Prismatic Louvre, Journal of Daylighting 7 (2020) 84-92. http://dx. doi.org/10.15627/jd.2020.7)

Commented [NJ7]: Reviewer4 no 4
Metodenya tidak dijabarkan dengan benar.
-Apakah model digital sebanding dengan bangunan yang ada?
-Bagaimana nilai pantulan ruang kerja eksisting dihitung?
-Bagaimana transmisi kaca diperoleh? Bagaimana itu bisa diverifikasi?
-Apa setting material untuk 5 model fasad yang digunakan?

Commented [NJ8R7]: Model digital dipersepsikan sebanding dengan memperhitungkan nilai validasi penukuran langsung di lapangan dan hasil simulasi. Di valisdasi sebelum di simulasi dengan model yg berbeda

Transisi kaca dengan reflektansi ... persen da valis=dasi hasil simulasi dan pengukuran telah dilakukan dengan nilai reflektansi tsb

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Mengapa obyek (Bank Mega) yang dipilih pertama kali? Bagaimana kondisi iklim dari lokasi yang dipilih?

Commented [NJ11R10]: Bank Mega menjadi obyek terpolih, oleh karena bangunan ini terletak pada area pesisir dan tidak terhalani oleh bangunan tinggi pula sehingga dstribusi cahaya dpat diperhitungkan. Kondisi iklim pada bangunan ini adalah posisi pesisir pantai sehingga dengan kondisi iklim tropis lembab

Commented [NJ12]: Reviewer 4 no9
Tanggal di bulan Juni juga tidak jelas, dan mengapa tanggal tertentu yang dipilih untuk jam evaluasi juga tidak ada.

Commented [NJ13R12]: Simulasi memilih bulan Juni, oleh karena pada ssat bulan juni ... matahari berada di garis katulistiwa mare ..GBU... desember GBS dan Juni septe sama. Dan penelitian ini hanya memilih satu diantara 4 posisi matahari

The simulation chose June, because June is one of the points where the sun's position is at the equator, which is in the position of North latitude

Commented [NJ14]: June

Fig. 2. Position and measurement point of room A and B in Bank Mega Makassar Indonesia

The building's floor plan and the location of the measurement points in Rooms A and B are shown in Fig. 2. Building orientation is Northeast (behind the building) and southwest (front the building). The building envelope in the form of window openings with massive glass material so that it can receive excessive distribution of daylight but there is a glare and brightness effect.

(a) (b)

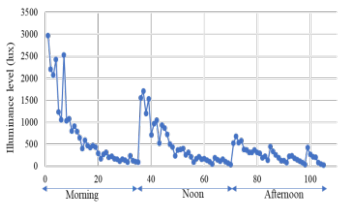
Fig. 3. Existing Condition of Workspace on (a) Room A and (b) Room B

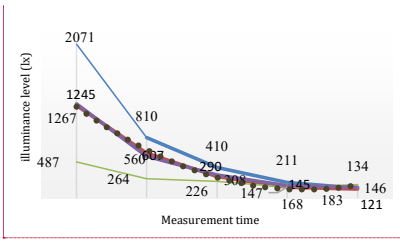
Fig. 3 shows the condition of workspaces A and B, Room A only has window openings on one side of the building envelope while Room B is on two sides of the building. The layout of the workstation is arranged according to the shape of the room and does not pay attention to the condition of the distribution of daylight which can cause a glare effect and interfere with the activities of users.

3. Result of research

3.1. Measurement result analysis of illuminance value in workspace of northeast orientation (Room A)

Measurements were made in the 6th floor workspace, namely points A1-A5 to G1-G5 (Room A) and points A1-A6 to N1-N6 (Room B). Measurement of the illuminance value in the room was carried out for 3 days in the morning, noon and afternoon. The graph of the average value of the measurement results in room A is as shown in Fig. 4 below.





Commented [NJ15]: Reviewer 1 no 9
Titik A1 hanya samapi A3 bukan A6 jelaskan

Commented [NJ16R15]: Titik A1-N1 to A3-N3 and F4-N4 toF6-N6

Commented [NJ17]: Reviewer 1 no 4
pada prosedur simulasi: Luas atau dimensi dua ruangan, Sifat bahan pancaran, Parameter simulasi, Tinggi dan jarak kisi simulasi, Jenis langit, Hasil Lingkungan:

Commented [NJ18R17]: luas dan dimensi ruangan room a dan B akan dijelaskan di metodologi

sfat bahan pancaran

tinggi dan jarak kisi simulasi

Commented [NJ19]: hilangkan persamaan garis.

Fig. 4. Mean value of measurement results in room A in the morning, noon and afternoon ; (b) Graph of decreasing illuminance value at measuring points A1-A5 to G1-G5

The measurement results show that the illuminance value decreases from morning to afternoon and evening, especially at the building envelope area, namely points A1-G1 in the morning an average of 2071 lux, afternoon of 1245 lux and evening of 487 lux. The results of the morning measurements are A1 of 2071 lux, A2 of 810 lux, A3 of 410 lux A4 of 211 lux and A5 of 134 lux. This shows that the illuminance value decreases based on the depth of space or the distance from the measuring point to the window opening in the building envelope.

Fig.4 shows that there is a decrease in the percentage of illuminance values for measuring points A1-A5 to G1-G5 in the morning, afternoon and evening. Points A1-A2 is 61%, point A2-A3 is 49%, point A3-A4 is 48% and point A4-A5 is 37%. Likewise, the measurement of the illuminance value during the day and evening decreases the farther from the window opening on the building envelope. The percentage of decrease in illuminance value from morning to noon is an average of 40% and then to evening is 61% (table 1).

Commented [NJ20]: reviewer 1 no 7apa tujuan persamaan garis

Commented [NJ21R20]: dgn adany a persaaan garis dapat diketahui nilai iluminasi pada titik tengah antara titik, misalnya nilai E antara titk A1 dan A2 dstnya

Commented [NJ22]: ini hanya menerangkan point A1-A2 dst ttp bagaimana B1-B2 dst

Commented [NJ23]: rerata pagi belum ada

To clarify the decrease in illuminance value from the morning to evening, it can be seen in the following graph. The average value at points A1-G1 of 21 measuring points shows that the illuminance value decreases from morning to evening (fig. 4).

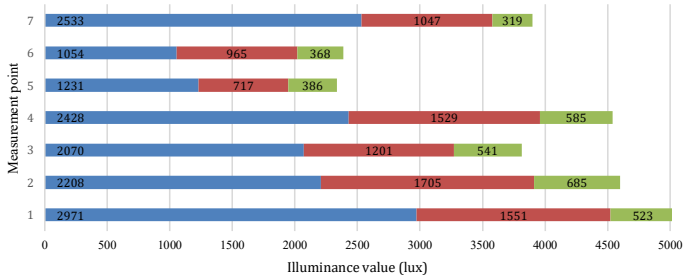


Fig. 5. The average value of the illuminance of points A1-G1 in the morning, noon and afternoon

3.2. Illuminance value analysis in workspace of southwest orientation (Room B)

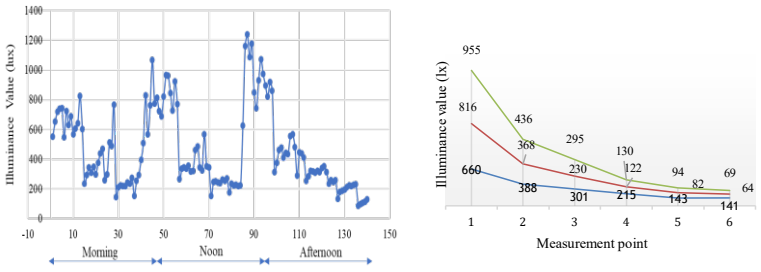


Fig. 6. (a) Mean value of measurement results in room B in the morning, noon and afternoon (b) Graph of decreasing illumination value at measuring points A1-A3 to N1-N6 and F1-F6 to N1-N6 (Room B)

Fig. 6 shows the illuminance value in the Northeast orientation workspace is inversely proportional to the south west orientation, especially at the measuring point in the window opening area. The graph shows that the illuminance value increases from morning to evening. The results of the analysis show that there are differences between rooms A and B due to different orientations. Based on the results of this analysis, it can be seen that the orientation of the building affects the distribution of daylight in to the room.

Next, we analyze the percentage of decrease in the value of illuminance against the distance of the measuring point to the window opening, this can be seen in fig. 7. The

average value of the percentage decrease in the value of illuminance for points A1-A2 is 41%, A2-A3 is 22%; F3-F4 by 29%; F4-F5 by 33%; and F5-F6 by 1%. The results of the analysis show that the farther the measuring point is from the window opening, the lower of daylight distribution.

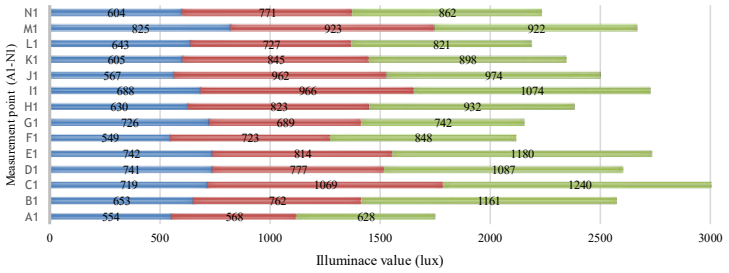


Fig. 7. The average value of the illumination of points A1-N1 in the morning, afternoon and evening

3.3. The Shadow of the building

Building shadows are related to the distribution of daylight, because they cover direct sunlight, so it is necessary to analyze building shadow. The shadow of the building is different in the morning, noon and afternoon, because the sun rises in the east and sets in the west. In the morning, the shadow of the building is on the front of the building and it can be assumed that the illuminance level in the behind area of the building is higher than the front area of the building. Meanwhile, in the afternoon, the front area of the building is higher than the behind area of the building. Based on the shadow that occurs in this building, it can be assumed that time and orientation affect the illuminance value in space.

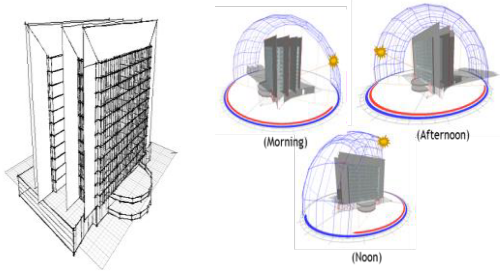


Fig. 8. The shadow of the building in the morning, noon and afternoon

The Radiance Illuminance Program is used to simulate the illuminance value based on this shading model in order to calculate the distribution of daylight inside the room, particularly at points A1-G1 (Room A) and A1-N1 (Room B) in the morning, noon, and afternoon. The simulation's findings demonstrate how the position of the building's shadow fluctuates according to where the sun is shining. Room A is located at the back of the building (Northeast) and the shadowing in the morning occurs on the front of the building so that the distribution of direct light is not obstructed by shadows and the illuminance value is relatively high compared to afternoon and evening, and conversely in room B.

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Seperti yang ditunjukkan pada gbr.2 hanya ada A.1 hingga A.3 di ruang B tetapi pada hasilnya, nilai pencahayaan dari A.1 hingga A.6 dilaporkan (pada halaman nomor 5).

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gbr.4, tabel 1, dan gbr.5 (juga gbr.6 dan gbr.7) menunjukkan hal yang sama. Penurunan iluminasi pada titik-titik dapat ditunjukkan dalam satu grafik atau tabel. Selain itu, denah setiap ruangan dengan nilai iluminasi atau kontur dapat lebih bermanfaat.

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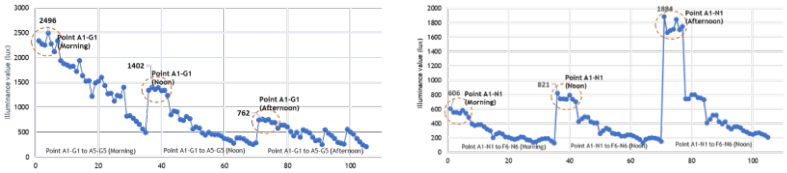
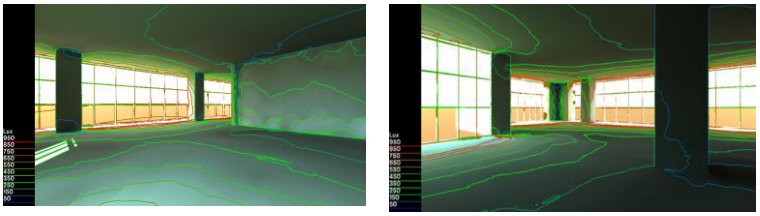


(a) (b)

Fig. 9 Simulation results of illumination values (a) Room A and (b) Room B

Figure 9 (a) shows the illuminance values in the building envelope area, namely points A1-G1 to A5-G5 (northeast orientation). The distribution of light at points A1-G1 with the highest value in the morning is 2496 lux, during the day 1402 lux and 762 lux in the evening. Overall at points A1-G1 to A5-G5 there is a decrease in the illuminance value in the morning, afternoon and evening. Figure 9 (b) shows the illuminance value at points A1-N1 (southwest orientation) and highest in the morning of 606 lux, 821 lux in the afternoon and 1884 lux in the afternoon. The results of the analysis show that buildings in northeast and southwest orientation are inversely proportional to the light distribution value. Northeast orientation decreases from morning to evening and otherwise of southwest orientation is increasing, so that it can be seen that the orientation of the building affects the distribution of daylight. Furthermore, to find out the value of the illuminance distribution of daylight, a simulation is carried out as shown in Figure 10 below.



(a) (b)

Fig. 10. Result of simulation of Radiance Illuminance of contour line (a) Room A and (b) Room B

Fig. 10 show describe the simulation results using Radiance Illuminance to determine the daylight factor in a room.

3.4. Façade Building Models

This study uses a shading device of facade model on the building envelope to assess the distribution of light that enters the room. The facade model will increase the aesthetic value of the building, but it is necessary to pay attention to the distribution of light into the space, whether it is increasing but causing glare and a high level of brilliance so that space users cannot do activities properly. This study analyzes the distribution of natural light into the space, with several facade models, namely: massif glass, Vertical, Horizontal, Diagonal and vertical-diagonal facade. The distribution of daylight illuminance value for these five facade models was analyzed in room A at measuring points A1-A6 to G1-G6.

3.4.1. Massive facade model

A graph of the simulation results in the shape of a massive glass facade is shown in Fig. 12. The brightness value for this facade model ranges from 689 lux to 2495 lux, with point 3 in the morning having the maximum iluminance and point 2 in the afternoon having the lowest.

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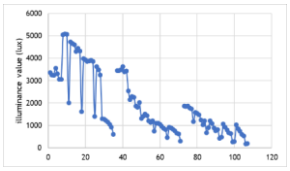
Pada gbr.9 perbedaan nilai iluminasi barisan dari pagi sampai sore bisa lebih didiskusikan

Commented [NJ29R28]: Sdh ditambahkan penjelasan gambar 9 nilai e pagi,siang dan sore

Commented [NJ30]: Reviewer4 no8
Model langit yang digunakan untuk simulasi tidak jelas.

Commented [NJ31R30]: Kondisi langit saat simulasi langit intermediate sky.
Semua kondisi langit intermediate weather makassar pada tgl 21 Juni dan telah dijelaskan di metodologi



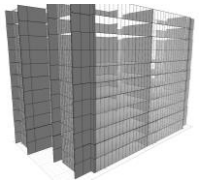


Fig. 11. Illuminance value graph of measurement point 1-6.

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gbr.13: gambar 13 (juga gbr.14, gbr.15 dan gbr.16) menunjukkan nilai pencahayaan rata-rata dari A1 ke G1, A2 ke G2, dan seterusnya. Jika tujuan simulasi bayangan adalah memeriksa distribusi siang hari, lebih baik tidak merata-ratakan nilai ini dan menunjukkan nilai ini dalam jenis grafik lain.

3.4.2. Vertical façade model

The vertical facade model is a facade model that reflects the formal value of the building and looks like the height of the building. The simulation was carried out at 8 am o'clock so that the back area of the building has a higher illuminance value than the front area of the building. The illuminance values in room A (Northeast orientation) are points A1-A6 with illuminance values of 1337-1402 lux in the morning, 754-8997 lux during the day and 689-762 lux in the afternoon (Fig. 13). The analysis's findings demonstrate that the distribution of daylight is influenced by the time of day and the direction of the building.

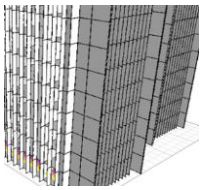
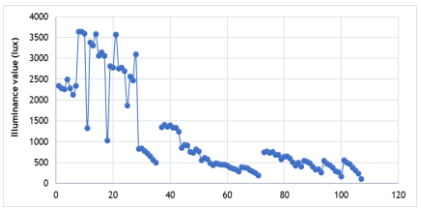
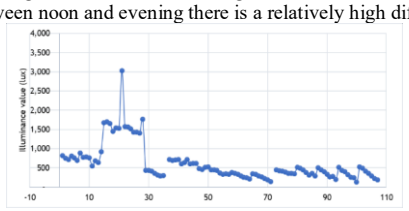
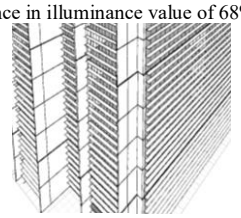
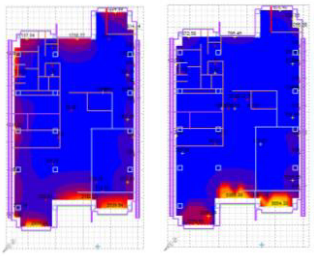



Fig. 12. Model Façade Building (a) Vertical façade (b) Result of simulation point A1-G6

3.4.3. Horizontal façade model

The horizontal facade of the model shows that the value of daylight distribution decreases until the afternoon, for example at measurement point A1 is 697 lux (morning), 644 lux (noon) and 355 lux (afternoon) (Fig. 14). The horizontal facade model has an effect on time, even though at all points there is only a slight difference in the illuminance value between morning and noon, with an average value between 759 lux and 683 lux or 11%. Meanwhile, between noon and evening there is a relatively high difference in illuminance value of 68%.



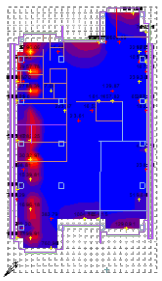


Fig. 13. Model Façade Building (a) Result of simulation point A1-G6 (b) horizontal façade

3.4.4. Diagonal Façade Model

The sun sets in the west so that the front of the building that is oriented towards the southwest produces more light distribution, height compared to the rear of the building or northeast orientation. Based on the results of this analysis, it can be seen that the orientation of the building and time affect the distribution of daylight.
Fig.15 shows that the diagonal and horizontal facade models have relatively the same decrease, but the diagonal facade model has a higher value. The illuminance value on the horizontal facade is between 408-759 lux while diagonal facade is between 536-1040 lux.

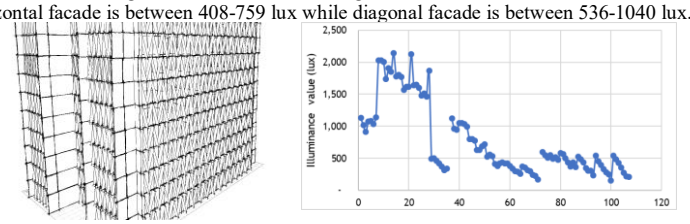


Fig. 14. Model Façade Building (a) Diagonal façade (b) Result of simulation point A1-G6

3.4.5. Vertikal-diagonal façade model

Fig.16 shows a design with a vertical-diagonal model and a graph of the illuminance value point A1-A6 with illuminance value of 867-894 lux in the morning, 549-844 lux during the day and 689-762 lux in the afternoon. This model shows that the distribution of light entering the space is lower, because the building envelope is covered by this facade model.

Commented [NJ33]: Salah nilai minus. Namun grafik dirubah.

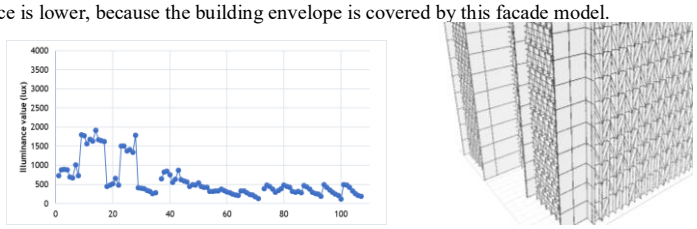


Fig. 15. Model Façade Building (a) Result of simulation point A1-G6 (b) Vertical-Diagonal facade

Commented [NJ34]: Reviwer 1 no 14
gambar 13 (juga gbr.14, gbr.15 dan gbr.16) menunjukkan nilai pencahayaan rata-rata dari A1 ke G1, A2 ke G2, dan seterusnya. Jika tujuan simulasi bayangan adalah memeriksa distribusi siang hari, lebih baik tidak merata-ratakan nilai ini dan menunjukkan nilai ini dalam jenis grafik lain

4. Analysis of five building façade model

In this study, the design of the facade model of the Mega bank building with the form of a massive glass, vertical, horizontal, diagonal and vertical-diagonal facade. These five models have architectural aesthetic values, each of which gives a different impression, for example

the massive glass facade model reflects the formal principle of an office building. Other facade models can give the impression of a tall/wide/attractive building in the vertical/horizontal/diagonal facade model. The vertical-diagonal facade model can be perceived as an impressive building model that is inviting and does not seem monotonous.

In this study, in addition to the perception of the building facade model, an analysis of the distribution of daylight values was also carried out on the five facade models using the Radiance Illuminance Program. The simulation results show different illuminance values for each facade model, as shown in the following Fig.16.

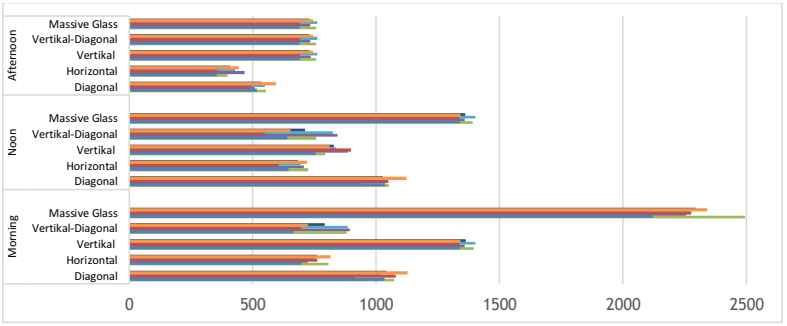


Fig. 16. Illuminance values on five building façade models

There is a decrease in the value of illumination for each facade model, in the morning, afternoon and evening. The massive facade model has the highest illumination value every time, namely a minimum of 729 lux and a maximum of 2294 lux. In the Afternoon, the average illuminance level on the massive glass, vertical and vertical-diagonal facade models is the same, while the horizontal and diagonal facade models are lower (Table 2).

Table 1. The average of Illuminance value on five building façade model

Building Facade Models	Average level of illuminance (lux)		
	Morning	Noon	Afternoon
Massif Glass Facade	3456	3889	5300
Vertical Facade	3129	3770	4908
Horizontal Facade	2994	3055	3685
Diagonal Facade	2846	3447	4617
Vertikal-Diagonal Facade	2376	2316	3248

Table 2 shows that the distribution of light using the vertical-diagonal facade model has no effect in the morning, noon and afternoon, because the difference in the average illuminance value at points A1-G1 is low, namely between 711-791 lux or 11%. While other models vary in different illuminance values, for example the vertical facade model is between 729 -1362 lux or 64%.

5. Discussion

The novelty of this research is to analyze the influence of the best building facade model for five building facade models and the results show that the vertical facade model can distribute light higher than the horizontal, diagonal and combined vertical-diagonal facade models. This study analyzes the distribution of light in the workspace on the 6th floor with different orientations, namely northeast and southwest orientations. Based on this analysis, research results can be developed in designing high-rise buildings that can distribute light optimally. Energy conservation is not only utilizing sustainable energy, but also paying attention to visual performance in the work space so that visual comfort can be realized.
Several previous researchers have analyzed this, but in this study, analyzed the value of illumination based on the different design models of building facades from previous studies.

The building facade model affects the distribution of natural light into the space. [5][6][7][8 . Likewise, the orientation of the building also affects the distribution of sunlight into the room [4]. This study further emphasizes the influence of the orientation and model of the building facade on the distribution of natural light.

6. Conclusion

spaces. The distribution of sunlight on the building affects the sky conditions, the orientation and the model of the building facade. Radiance Illuminance Program is an application used to determine the value of natural light distribution with various facade model designs on building envelopes. The results showed that in addition to the existing Mega Makassar bank model, namely the massive glass facade model, it has the highest light distribution value compared to other models. from the utilization of energy is very beneficial, but it is necessary to pay attention to the negative effects such as glare, excessive ratio of illuminance and brightness.

The results also show that the distribution of natural light in the vertical facade model has a higher illuminance value than the horizontal, diagonal and vertical-diagonal models. This vertical facade model still exceeds the illumination standard for work spaces recommended by SNI, which is 350 lux and the morning it causes a glare effect in the work space, which is 1362 lux. Of these five façade models, the researcher formulated that the vertical-diagonal façade model was the best chose model in terms of architectural aesthetics and an even illumination level in the morning, afternoon and evening, although it was still above the standard of workspace illumination. However, there is still an alternative furniture layout design that does not approach the window opening area in the building envelope, due to a decrease in the illumination value in areas far from the window opening, which is around 400-500 lux and does not yet cause glare in the work space. Based on the results of this study, it is hoped that it can become a guideline in planning the design of building facades that have architectural value and meet recommended standards illuminance for work

Commented [NJ35]: reviewer 2 no 3
1.Dalam Kesimpulan, baris 379, hal.11, Distribusi sinar matahari pada bangunan mempengaruhi kondisi langit, orientasi dan model fasad bangunan....Frasa ini adalah kesalahan ilmiah utama! Karena prosesnya benar-benar terbalik...Kondisi langit, orientasi, dan model fasad bangunan mempengaruhi distribusi sinar matahari dan jumlahnya yang masuk ke dalam bangunan.

Commented [NJ36R35]: Akan di rubah..krn sala kata mempengaruhu tetapi harus berpengaruh dan kata didahului kondisi langit, orientasi dan model office

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REVIEWER 1		
1	A weak English language needs to be reformulated because it contains a lot of spelling, structural, grammatical, and expressive errors and omissions.	Manuscript revision has been completed
2	The abstract in any research is considered the most important piece in it, but in this research, it appeared in a way that does not reflect well the content of the paper, so it needs to be rewritten.	Thank you for the correction The abstract has been revised and clarified the aims, methods and results of this study.
3	The literature review came superficially without taking into account the logical sequence in presenting ideas and in terms of generality to specificity, despite the existence of studies and research related to the subject of the research. It is suggested to rewrite it in a better way, and then raise the research problem and its aim.	Thank you for correction this article. The literature review has been revised, logically explaining in terms of generality and then the specificity of this research. Describe the research problem and research objectives in detail
4	The discussion of the results was weak and brief and did not give justifications for the results obtained, whether they were high or low. Rather, the discussions should address the significance and reason behind these percentages.	Chapter discussion has been added and clarified
5	In the Conclusions, line 379, p.11, The distribution of sunlight on the building affects the sky conditions, the orientation and the model of the building facade....This phrase is a major scientific error! As the process is completely reversed...Sky condition, orientation, and building facade model affect the distribution of sunlight and its amount entering the building	Sorry, the conclusion of the article is wrong and has been corrected according to the reviewer's instructions. “Sky condition, orientation, and building facade model affect the distribution of sunlight and its amount entering the building”.
6	The study did not explain the standard and optimal cases of daylighting ratios in order to make a logical comparison between them and the obtained results.	Daylight factor is not discussed in this study, therefore
7	There are errors in some of the extracted values in the results with what is shown in the attached figures (for example, Figures 7 and 16).	Thanks for your corection. • This image will be revised and given an explanation so that it is clear. • Fig. 7 Illuminance value analysis in workspace of southwest orientation (Room B) • Fig.16 Analysis of five building façade model
8	Ecotect NOT Echtech! -	Thank’s your correction It’s change “Ecotect”
9	References 22 and 29 are the same! -	sorry, I don't correct references The reference is the same and has been merged
10	Reference 26, no publisher and place of publishing!	Thankyou. Reference number 26 was changed to number 17 M. M. El Sheikh, “Intelligent building skins: Parametric-based algorithm for kinetic facades design and daylighting performance integration,” ProQuest Dissertations and Theses, 2011.

REVIEWER 2		
1	In the whole content: 1. The meaning and structure of sentences should be revised and corrected. Introduction:	Thanks for your correction Meaning and sentence structure have been revised and improved
2	Does monotonous light distribution always lead to lower energy consumption? for instance energy consumption of a room with monotonous light distribution with 100 lux illuminance value on workspace and a room with varied light distribution with 200-500 lux illuminance.	Thanks for the response. if a room with monotonous light distribution with 100 lux illuminance value, it takes maximum electrical energy so it does not save energy. if it is very high, then the energy load is low, but it should be noted, the negative effects it causes
3	In the literature review the effects of dynamic shading systems on energy saving and visual comfort are discussed but they are not analyzed in the results. If this study aims to compare energy saving and visual comfort of these 5 facade designs, the results of lighting energy should be calculated, otherwise, it is preferred to discuss lighting distribution on workspace and its acceptable threshold in standards and guides.	Thanks for your corection Sorry, the discussion on energy saving has been omitted, so energy performance is not analyzed. In this article, a discussion of visual perception has been added to determine the visual comfort of room users. The recommended standard illumination for workspaces in Indonesia is 350 lux, and this article shows the distribution of natural light using several façade models and has been explained
4	Add more relevant studies which investigated daylight distribution (e.g. Ahmad Eltaweel, Mohamed Alaa Mandour, Qinghua Lv, Yuehong Su, Daylight Distribution Improvement Using Automated Prismatic Louvre, Journal of Daylighting 7 (2020) 84-92. http://dx.doi.org/10.15627/jd.2020.7) Methodology:	Thanks for your corection. Reference has been added with the title “Daylight Distribution Improvement Using Automated Prismatic Louvre”
5	Add more details to the simulation procedure: The area or dimensions of two rooms, Radiance materials' properties, Simulation parameters, The height and distance of the simulation grid, Sky type, Neighborhoods Results:	Dimensi Ruang A dan B telah ditambakan di Metodologi The simulation parameters are direct measurements at the Bank Mega Makassar office with measuring points according to standards. Sky conditions: Intermediate Sky Space Dimensions A and B have been added in Methodology
6	Add legend for charts.	Legend for chart has been added
7	fig 4. (b): this chart is for morning, noon, or afternoon? add more details for charts. What is the aim of Trendline and its Equation shown in fig4.b?	Thank for your corection. • Fig.4 The illuminance value of points A1-G1 in the morning, noon and afternoon • The trendline chart has been removed.
8	fig.4, table 1, and fig.5 (also fig.6 and fig.7) show the same thing. Decreasing illuminance in points can be shown in one graph or table. Also, a plan of each room with illuminance values or contour can be more useful.	Table 1 dan 2 has been deleted Have removed the table corresponding to the graph and added the illuminance values revision table Has removed the table corresponding to the graph
9	As shown in fig.2 there are just A.1 to A.3 in	The measuring point notation has been changed.

	room B but in the results, the illuminance value of A.1 to A.6 are reported (on page number 5).	The average value of the percentage decrease in the value of illuminance for points A1-A2 is 41%, A2-A3 is 22%; F3-F4 by 29%; F4-F5 by 33%; and F5-F6 by 1%.
10	The shadow of the building: This section can be summarized.	The shadow of the building has been revised
11	In fig.9 the differences in the illuminance value of rows from morning to afternoon can be more discussed.	according to the reviewer's instructions, the graph has been changed and explained
12	fig 10. there are four images of each room simulation with almost the same information. It is preferred to show just one image for each. Also as shown in the figures, the desks are not modeled. Furniture has effects on interior lighting and also lighting distribution. The illuminance values should be simulated in the workspace's height.	Thanks for your correction The furniture layout design has been designed in the room and will be simulated “Furniture has effects on interior lighting and also lighting distribution”
13	fig.12: This graph shows the illuminance values of 6 points named 1 to 6. These points are A1 to A6 or G1 to G6 or average of them?	Thank you for the reviewer's correction of the point name error and it has been fixed Fig. 12 has been replaced and the measurement point has also been fixed,
14	fig.13: figure 13(also fig.14, fig.15 and fig.16) shows the average illuminance value of A1 to G1, A2 to G2, and so on. If the aim of simulating shadings is examining daylight distribution, it is better to not average these values and show these values in another type of graph.	fig 13, 14 and 15 have been changed and instead of graphing the average value but all the illuminance values of the measuring points
15	What are the properties of shadings? (their depth, reflection coefficient, distance, ...) Analysis of five building facade model: It is a sub-section of results.	The influence of shadows has been described, that is, if the orientation of the building is to the east-north, then the shadow will be behind the building so that the distribution of light is not obstructed in the morning on the front of the building, and vice versa if the orientation of the building is to the southwest. The depth of field also has an effect, and the percentage of decrease in luminance value has been added to the depth of field
16	It is said that shading design has effect on the perception of the building. What kind of perception? Visually? Aesthetics?	Has analyzed the effect of massage glass on existing conditions on the visual comfort of the use of space… In terms of aesthetics it was not carried out, but in general it was based on several previous studies
17	fig.17: information in this chart is not expressive. There is no legend, and comparing different shadings is not clear. Discussion and Conclusion:	Figure 17 has been replaced
18	There are acceptable thresholds for light distribution in some standards and guides (e.g. EN 12464-1). The results of this study can be compared with standards.	This research is based on the Indonesian national standard, namely 350 lux (SNI 03-6575-2001) And will be followed up in the next study
REVIEWER 3		

1	Overall written English is not acceptable and it needs major revision. There are numerous spelling and writing errors. For example, where to write capital letters (lines 14, 31, 35, …) and spelling errors (lines 40, 156, 392, table 2, …). Furthermore, many sentences are nonsense! (lines 36, 51, 44, 64, 103, 379, 348, …). It is necessary to justify paragraphs. Bahasa Inggris tertulis secara keseluruhan tidak dapat diterima dan perlu revisi besar. Ada banyak kesalahan ejaan dan penulisan. Misalnya tempat penulisan huruf kapital (baris 14, 31, 35, …) dan kesalahan ejaan (baris 40, 156, 392, tabel 2, …). Selain itu, banyak kalimat yang tidak masuk akal! (baris 36, 51, 44, 64, 103, 379, 348, …). Perlu untuk membenarkan paragraf.	Thank's correction manuscript, some words have been deleted and changed line 14: **Keywords**: Building façade, daylight **already changed** Line 31: Daylight as a source 31 Line 35: The utilization of solar energy as a source Line 40: The procedure for designing a lighting system as a guide for designers to create (this sentences is deleted) Line 156: The building envelope in the form of window openings with massive glass material so that it can receive excessive distribution of natural light, but there is a glare effect and brightness. **already changed** The distribution of natural light into the space is very excessive, especially in the building envelope area, because the building facade is massive glass and does not use sun shading. High brightness and glare are possible effects. Line 392: Of these five façade models, the researcher formulated that the vertical-diagonal façade model was the best chose model in terms of architectural aesthetics and an even illuminance level in the morning, afternoon and evening, although it was still above the standard of workspace illuminance 392 (belum jelas dipakai kalimat ini atau tidak) di conclution "The researcher presented the results of the analysis that among the five facade models, the vertical-diagonal facade model is the best choice in terms of architectural aesthetics and an even illuminance value in the morning, afternoon and evening, but still above the workstation illuminance standard" Table 2. The average of Illuminance value on five building façade Line 35: The Utilization of solar energy as a source of natural lighting, is one way to minimize the consumption of electrical energy in buildings. Distribution of natural lighting into the 36 building through the building envelope on the roof (top lighting) or walls (side lighting). Line 52: The natural lighting factor during the day is the ratio of the level of lighting at a point in the room to the level of illuminance at open field, this is a measure of the performance of the opening window on building [1].

		Line 44: The purpose of this study was to find out how the influence of the shape of the building facade on the distribution of natural light that can enter the building "The purpose of this research was to determine the effect of the building facade's shape on how light is distributed inside a room" Line 64: Previous research has shown that illuminance level in the workspace is influenced by the building facade and model various facade models produce significant differences in the illuminance level in the workspace. "**Previous research has shown that different facades and building facade styles affect the distribution of daylight**" Line 104: The energy consumption and comfort levels of any structure are significantly influenced by the facades. (**this sentences is deleted)** Line 348: Fig. 17. Illuminance values on five building façade models Line 379: The distribution of sunlight on the building affects the sky conditions, the orientation and models of the building façade
2	Radiance is a tool/software, not an application.	Thanks for your correction (word has been changed) Radiance is a tool/software, not an application (**word has been changed**)
3	It is better to write the purpose of the study in the last part of the introduction and literature, not in the middle of them (line 44). Moreover, research gaps should mention in the last part of the literature.	at the end of the Introduction chapter, the purpose of this research has been explained
4	In line 61, you referred to 'previous research' which is not obvious!	According to previous research, the orientation of the building affects the distribution of 61 daylight into the space [4].
5	What do you mean by 'housing condition' in line 70?	Thank's your corection. This reference is removed because it is only related to energy "Under various housing conditions, the positions before opening are the most important influential factor on overall energy consumption"
6	Abbreviations should be introduced. for example, in a separate part before the introduction. (lines 93, 103)	Analysis of the quantity of daylight glare, it is better to use the CSWD(C) or Meteonorm 93 files in normal climate conditions and the Chinese average year weather file when 94 considering extreme weather conditions [17]

		The sunshine occurrence analysis also determined similar results using three weather statistical approach data files daylight autonomy (DA), useful daylight illuminance (UDI) and maximum difference was 5% independently of orientation **Abbreviations have been explained**
7	Figures are not organized and they do not follow a similar pattern (fig.2 and 3.). Furthermore, information is repeated in these figures. Resolution is not acceptable in Figure 1-2-3 and small pictures are not legible.	Figures 2 and 3 describe the plan and position of the room. One of the images has been removed, at the direction of the reviewer
8	8) Why do you choose 'June' and mention hours? The reason should have mentioned.	The simulation chose June, because June is one of the points where the sun's position is at the equator, which is in the position of North latitude Jam tkah disebut…. Pagi, siang, sore .. cek ulang
9	Facades and office parameters should be introduced in the methodology or in a separate part before your results.	
10	The method part can be expressed in a stepwise manner. Thus, the application form of the study can be brought to a more understandable level. The other way is the research flowchart, which can be depicted in a schematic diagram to make the research overview clear enough.	Buat diagram skematik
11	How are the simulation results validated? Absolutely, a field measurement can be a rational solution.	Hasil simulasi telah di validasi terhadap pengukuran langsung di lapangan … pada halaman …. Uji validasi grafik…persamaan garis…
12	You need to add a baseline model. So you can compare the performance of all facades.	Model dasar juga telah di simulasi yaitu mode massive glass seperti kondisi existing bangunan tersbt
13	The color of graphs and diagrams should be clarified. It is not clear which color is for which parameter. To edit all of them or add a general legend.	*auto_awesome* Mungkin maksud Anda adalah: The color of graphs and diagrams should be akan ***diperbaiki*** 59 / 5.00
14	why research steps are mentioned here? Line 272-276	This study analyzes the distribution of natural light into the **272** space, with several facade models, namely (1) Massif glass façade (2) Vertical facade; (3) 273 Horizontal facade; (4) Diagonal facade and (5) Vertical-diagonal façade. The distribution of 274 daylight illuminance value for these five facade models was analyzed in room A at 275 measuring points A1-A6 to G1-G6. (**the façade model is transferred to the methodology chapter**
15	How building shadow section contributes to the final conclusion or the façade selection?	The building's shadow is only related to the distribution of light in the morning and evening, because there is a shadow in the east in the morning so that a little distribution of light takes a long time and in the afternoon it sets in the west and shadow occurs so that little light enters the building. The conclusion is inversely

		proportional in the morning and afternoon in terms of light distribution which is affected by the shadow from the building itself. Figures 2 and 3 describe the plan and position of the room. One of the images has been removed, at the direction of the reviewer
16	Discussion section is not complete. you have to do a comparative analysis between the five facades and the baseline model. so that you can find out which one is the best. Bagian diskusi tidak lengkap. Anda harus melakukan analisis komparatif antara lima fasad dan model dasar. sehingga Anda dapat mengetahui mana yang terbaik.	Thank's your correction, discussion chapter will be completed
3	Why is the object (Bank Mega) chosen in the first place? What is the climatic condition of the chosen location?	Bank Mega building is the most selected object, because this building is located in a coastal area and is not blocked by tall buildings either so that light distribution can be calculated. The climatic conditions in this building are the position of the coast so that the climate conditions are humid tropical
9	The date in June is also unclear, and why that particular date has been chosen for evaluation hour is also missing. Tanggal di bulan Juni juga tidak jelas, dan mengapa tanggal tersebut dipilih untuk jam evaluasi juga tidak ada.	The simulation chose June, because June is one of the points where the sun's position is at the equator, which is in the position of north latitude

REVIEWER 4		
1	Obviously, English requires significant amount of improvement in many areas, such as spelling, tenses, word choice, clarity and conciseness. Those problems are discovered throughout the manuscript. Jelas, bahasa Inggris membutuhkan banyak perbaikan di banyak bidang, seperti ejaan, tenses, pilihan kata, kejelasan dan keringkasan. Masalah-masalah itu ditemukan di seluruh naskah.	1.
2	The introduction is rather confusing, its structure, flow and cohesiveness are not carefully and well-prepared. Pengantarnya agak membingungkan, struktur, alur, dan kekompakannya tidak dipersiapkan secara matang dan matang.	
3	Why is the object (Bank Mega) chosen in the first place? What is the climatic condition of the chosen location? Mengapa obyek (Bank Mega) yang dipilih pertama kali? Bagaimana kondisi iklim dari lokasi yang dipilih?	2. Bank Mega is the most selected object, because this building is located in a coastal area and is not blocked by tall buildings either so that light distribution can be calculated. The climatic conditions in this building are the position of the coast so that the climate conditions are humid tropical
4	The method is not properly elaborated. Does the digital model comparable to the existing building? How is the reflectance value of the existing working space calculated? How is the glass transmittance obtained? How those can be verified? What is the material setting for those 5 façades model used? Metodenya tidak dijelaskan dengan benar. Apakah model digital sebanding dengan bangunan yang ada? Bagaimana nilai pantulan ruang kerja eksisting dihitung? Bagaimana transmisi kaca diperoleh? Bagaimana itu bisa diverifikasi? Apa setting material untuk 5 model fasad yang digunakan?	
5	In terms of input variables, author should have elaborated more clearly, thus, the reason behind the best façade model can be explained through roughly. Dalam hal variabel input, penulis seharusnya menguraikan lebih jelas, sehingga alasan di balik model fasad terbaik dapat dijelaskan	Perlu uraiakn ;eboih jelas pemilihan model terbaik pada kelima fasad ini.

	secara kasar.	
6	The manuscript does not show clearly the output variable/s. Why authors have chosen the "point-in-time" measurement while at the introduction, authors have acknowledged the existence of climate-based daylight modeling? This also relate to the chosen discontinued simulation tool (Ecotect which still used old radiance version) which still has many limitations and unable to simulate for annual daylight simulation. On the other hand, radiance has gone significant improvement overtime, for instance, through its rcontrib function has the ability to calculate for annual daylight metrics. Naskah tidak menunjukkan dengan jelas variabel keluaran. Mengapa penulis memilih pengukuran "point-in-time" sementara pada pendahuluan, penulis telah mengakui keberadaan pemodelan siang hari berbasis iklim? Hal ini juga terkait dengan pemilihan alat simulasi yang dihentikan (Ecotect yang masih menggunakan versi radiance lama) yang masih memiliki banyak keterbatasan dan tidak dapat disimulasikan untuk simulasi siang hari tahunan. Di sisi lain, pancaran telah mengalami peningkatan yang signifikan dari waktu ke waktu, misalnya, melalui fungsi rcontrib yang memiliki kemampuan untuk menghitung metrik siang hari tahunan.	
7	Radiance setting both for illuminance and image simulations are not found within the manuscript. What rpict setting has the authors been utilized? Pengaturan pancaran baik untuk penyinaran maupun simulasi gambar tidak ditemukan dalam naskah. Pengaturan gambar apa yang digunakan penulis?	
8	Sky model utilized for simulation is unclear. Model langit yang digunakan untuk simulasi tidak jelas.	
9	The date in June is also unclear, and why that particular date has been chosen for evaluation hour is also missing. Tanggal di bulan Juni juga tidak jelas, dan mengapa tanggal tersebut dipilih untuk jam evaluasi juga tidak ada.	The simulation chose June, because June is one of the points where the sun's position is at the equator, which is in the position of North latitude
10	Due to the unclear method utilized, the result from this work is questionable. Thus, the conclusion might not be trusted. Karena metode yang digunakan tidak jelas,	

	hasil dari pekerjaan ini dipertanyakan. Dengan demikian, kesimpulannya mungkin tidak dapat dipercaya. I do not recommend the manuscript for publication.	

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Author(s): **Nurul Jamala[1*], Baharuddin Hamzah[2], Rosady Mulyadi[3], Isty Cahyani[4]**

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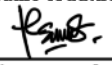	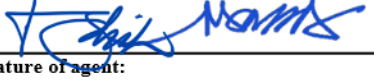
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