

Implementation of Green Building Aspects Based on the Green Building Council Indonesia: A Case Study in the Regional Library Building of East Java Province

Cindy Alya Cantika^{1,2}, Yudith Vega Paramitadevi¹

¹ Environmental Engineering and Management Program, The Vocational Studies of Bogor Agricultural University, Bogor, Indonesia

² Environmental Engineering, Adhi Tama Surabaya Institute of Technology, Surabaya, Indonesia

corresponding author: yudith.vega@apps.ipb.ac.id

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Abstract - *The global warming cannot be separated from the existence of buildings. Buildings operational and maintenance can cause an increase in global warming, so it is necessary to apply the concept of green building. Most buildings in Indonesia are old buildings, so the Green Building Council Indonesia issues green building standards for existing buildings. The problems analyzed are the value of implementing green buildings in the Regional Library of East Java Province and recommendations that can be given after the assessment. The study method consisted of field observations, expert interviews, and a questionnaire survey with the Guttman Scale referring to the Greenship Existing Building version 1.0 using 12 of 41 criteria. There are 7 benchmarks for each criterion that have not been met, such as pedestrian facilities, percentage of softscape, provision of non-pet habitat, routine recording on kWh meters, operating and maintenance guides for air conditioning systems and electronic devices, collection and sorting of waste by type, as well as lighting that is less than the standard of SNI 03-6197-2000. The Regional Library of East Java Province received a Greenship Existing Building version 1.0 certification value of 26 points or 53.1% of 49 points. Recommendations are given so that the assessment benchmarks that are still not available can be met.*

Keywords – existing building, green building, greenship, guttman, regional library, west java

Introduction

Global warming becomes a currently happening problem all over the world. Kurniati et al. (2014) states that global warming is an increase in the earth's surface temperature due to the increase in the greenhouse effect. The greenhouse effect arises because of the increase in greenhouse gases in the atmosphere. The global warming cannot be separated from the existence of buildings. Wei et al. (2015) states that buildings contribute to 33% of CO₂ emissions, have a need of 17% of clean water, 25% of wood products, 30-40% of energy use, and 40-50% of the use of raw materials for construction and operation. Exploring natural resources without paying attention to the capabilities and resources of the environment can lead to a decrease in the quality of the environment.

One of the efforts that can be done to reduce global warming and environmental damage is to apply the concept of green building. Referring to the Regulation of the Minister of Public Works and Public Housing of the Republic of Indonesia Number 02/PRT/M/2015 on Green Buildings, buildings should meet specific requirements and have measurable performance in saving energy, water, and other resources through the application of green building principles. The body that certifies green building criteria standards in Indonesia is the Green Building Council Indonesia (GBCI).

Ferrari et al. (2022) states that green building has an important role in saving energy use in buildings. GBCI states that the building sector has the potential to make energy savings of 50% or more by 2050, to support limiting the global temperature increase of 2°C. The green building concept can be applied to commercial buildings, offices, and public facilities, one of which is library.

The green building concept applied to the library building affects the comfort of users who carry out activities inside and outside the building. Library visitors who get good service both internally and externally will be able to make them interested and want to revisit the library building (Uyun et al., 2019). In addition, the application of the green building concept in the library building is expected to reduce the emission rate considering that the library is one of the most widely used public facilities.

This study aims to describe the rating or certification as a benchmark for how far the level of application of green building criteria in the Regional Library of East Java Province and provide recommendations for improvement for the Office of the Library and Archives of East Java Province. This green building certification research refers to the Greenship Existing Building standard version 1.0 which was officially issued by GBCI. The existence of green building criteria research, especially in the Regional Library of East Java Province, is expected to be used as a reference for green building applied in other buildings for related or other institutions.

Method

Location. The Regional Library of East Java Province is under the direct supervision of the Office of the Library and Archives of East Java Province. It is located on Jl. Menuur Pumpungan No. 32 Menuur Pumpungan, Sukolilo District, Surabaya City, East Java (Figure 1).



Figure 1. Location of the Regional Library of East Java Province, 2021, Photo from above.

Source: Google Earth.

Tools and Materials. The instruments used in this study include a measuring instrument of Digital Lux Meter with the Smart Sensor brand type AS803. This Digital Lux Meter has a measurement distance of 1-200.000 lux specifications. It is used to measure light intensity on the Visual Comfort rating. In addition, another tool used is a Roll meter for primary data measurement on Site Landscaping ratings.

Work Procedure. The work procedure in this study is based on the Greenship Existing Building version 1.0 rating which has been determined using a questionnaire with respondents of academics (lecturers and students), the community, and visitors or workers of the Regional Library

of East Java Province. Direct observation is then conducted to see the general condition of the building and everything that need to be considered based on the rating determined at the Regional Library of East Java Province. It is followed with direct interviews and questionnaires with several resource persons who work in the Library and Archives of East Java Province. The collected data are analyzed and processed based on the Greenship Existing Building version 1.0 (Figure 2).

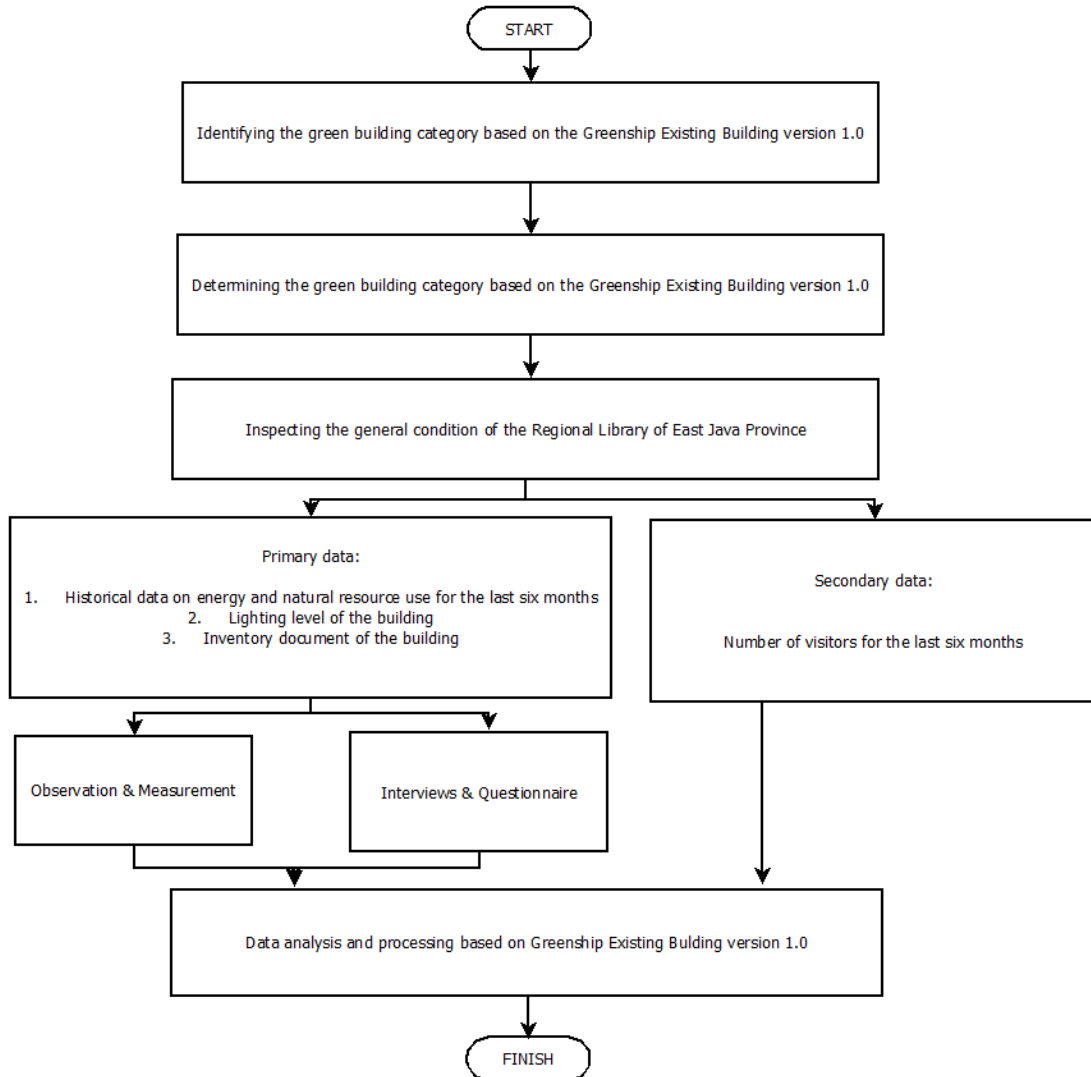


Figure 2. Research Work Procedure, 2021, Flowchart. Source: Authors.

Data Analysis Technique. Data analysis was carried out after all the data needed to assess the status of green buildings in the Regional Library of East Java Province or respondents were collected. The data obtained are analyzed based on the Greenship Existing Building version 1.0. Data processing activities include processing data from questionnaires to determine the rating to be used. The data processing stages consist of:

1. Editing: all questionnaire data collected will be checked and grouped first.
2. Preparation and calculation of questionnaire data: compiling and calculating data manually with the help of a computer and using the Guttman Scale.
3. Conclusion: concluding the rating that will be used in the study based on the results of the calculation of the questionnaire data.

The collected data were selected and calculated for further data processing. Each answer was scored using the Guttman Scale. According to Abidin et al. (2014), Guttman Scale is a measurement scale with data obtained in the form of interval data or dichotomous ratios (two alternatives). Answers can be made with the highest score of 1 (one) and the lowest 0 (zero). The values were weighted one for the answer “yes” or “agree,” while the values were weighted zero for the answer “no” or “disagree.” The ineffective rating is indicated by a percentage score of 0-50%, while the effective

rating is indicated by a score of 50-100%. The results of the analysis are expressed with the frequency distribution, both in absolute numbers and in percentage terms, accompanied by a qualitative explanation.

Seputra (2013) states that the percentage of respondents' answers can be calculated using the following formula:

$$P=f/N \times 100\%$$

where P is the percentage of answers obtained, f is the frequency of the data, and N is the number of samples processed. The number of samples obtained was 178 people (Table 1).

Table 1. Green Building Rating Based on Questionnaire Survey

Rating <i>Green Building</i>	Number of respondents answering "Yes" (N)	P (%)
<i>Community Accessibility</i>	99	56
<i>Motor Vehicle Reduction</i>	71	40
<i>Bicycle</i>	60	34
<i>Site Landscaping</i>	110	62
<i>Site Management</i>	125	70
<i>Building Neighbourhood</i>	49	28
<i>Optimized Efficiency Building Energy Performance</i>	140	79
<i>Energy Monitoring & Control</i>	107	60
<i>Operation & Maintenance</i>	109	61
<i>Water Sub-Metering</i>	54	30
<i>Fresh Water Efficiency</i>	93	52
<i>Water Quality</i>	56	31
<i>Non- ODS Usage</i>	57	32
<i>Waste Management Practice</i>	119	67
<i>Hazardous Waste Management</i>	56	31
<i>Management of Used Goods</i>	85	48
<i>Environmental Tobacco Smoke Control</i>	122	69
<i>CO & CO₂ Monitoring</i>	90	51
<i>Biological Pollutant</i>	84	47
<i>Visual Comfort</i>	107	60
<i>Building User Survey</i>	124	70
<i>Design Intent & Owner Project Requirement</i>	67	38
<i>Water Tap Efficiency</i>	66	37
<i>Material Purchasing Practice</i>	100	56

The Greenship Existing Building rating system version 1.0 takes into account several categories with a total of 10 prerequisite criteria and 41 credit criteria. The six categories are Appropriate Site Development (ASD), Energy Efficiency and Conservation (EEC), Water Conservation (WAC), Material Resources and Cycle (MRC), Indoor Health and Comfort (IHC), and Building Environment Management (BEM).

Effective rating according to respondents based on P value (Table 1) above 55% is selected: *Community Accessibility (ASD 1)*, *Site Landscaping (ASD 4)*, *Site Management (ASD 7)*, *Optimized Efficiency Building Energy Performance (EEC 1)*, *Energy Monitoring & Control (EEC 4)*, *Operation & Maintenance (EEC 5)*, *Fresh Water Efficiency (WAC 3)*, *Waste Management Practice (MRC 2)*, *Material Purchasing Practice (MRC 3)*, *Environmental Tobacco Smoke Control (IHC 2)*, *Visual Comfort (IHC 6)*, and *Building User Survey (IHC 8)*.

Results and Discussion

Roshaunda et al. (2019) states that before carrying out Greenship certification, a building must meet the certification requirements determined by the GBCI. The requirements in question are a minimum building area of 2500 m², the availability of building data to be accessed by GBCI during the certification process, having an Environmental Management implementation report approved by the Environmental Impact Management Board, and having an SLF (function-worthy certificate) issued by the local government. The observation results show that the Regional Library of East Java Province meets the four certification requirements determined by GBCI. The implementation of green building in the Regional Library of East Java Province is assessed based on the highest effective rating resulted from a questionnaire survey.

Community Accessibility. This rating considers 5 assessment benchmarks with a maximum value of two points. The results of the assessment of the Community Accessibility rating are:

1. There are at least 5 types of public facilities within the distance of reaching the main road as far as 1,500 m from the site.
2. There are no pedestrian facilities that are safe, comfortable, and free from intersections of motorized vehicle access to connect at least three public facilities above and/or with mass transportation stations.
3. There are no bus stops or public transportation stations within 300 m of the gate of the building site with calculations outside pedestrian bridges and ramps.
4. There is no shuttle bus for building visitors to reach public transportation stations.
5. There are no pedestrian facilities within the building area to get to the nearest bus stop or public transportation station.
6. The results of the assessment of the Community Accessibility rating show that the score points obtained were one point out of a maximum value of two points.

Site Landscaping. This rating takes into account three assessment benchmarks with a maximum value of three points. This assessment requires data on the area of buildings, open land, and the calculation of the total green space (softscape). Each softscape site is assigned a different code as shown in Figure 3.

1. The calculation of the building area of the Regional Library of East Java Province,

Building	= 3,428 m ²
Green Space (<i>Softscape</i>)	= 869.1 m ²
Open land	= <u>1,452.9 m²</u>
Total land	= 5,750 m ²
2. The use of local plants originating from the Surabaya City nursery and productive plants such as mango trees.

The percentage of softscape to the total land area of the Regional Library of East Java Province is 15.1%. It does not meet the benchmark on the Site Landscaping rating. There are local plants that come from local nurseries and productive plants and in accordance with the Minister of Public Works Regulation No. 5/PRT/M/2008 on Criteria for Yard Vegetation so as to get one point rating.

Site Management. Rating Site Management takes into account two assessment benchmarks with a maximum value of two points. This assessment focuses on the application of the Standard Operating Procedures for controlling plant pests and weeds and providing habitat for non-pet animals.

The assessment results of this rating after direct interviews with the park show that the Regional Library of East Java Province applies SOPs for controlling plant pests and weeds using non-toxic materials, i.e., a natural fungicide derived from garlic (*Allium sativum* L). In addition, the absence of non-pet habitat was at least 5% of the total building site area. Furthermore, the assessment results show that the Site Management rating gets one point.

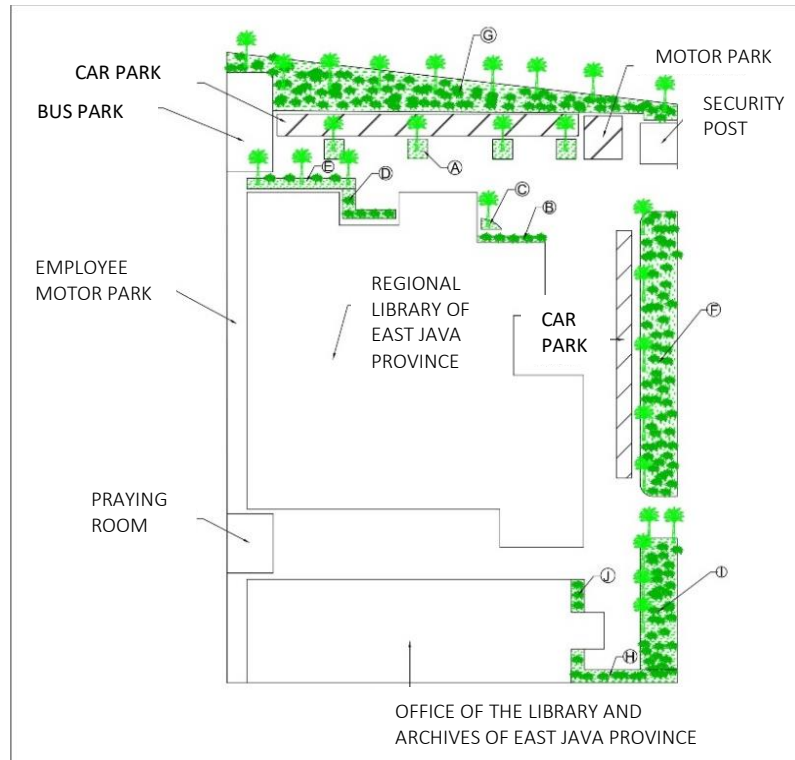


Figure 3 Softscape at the Regional Library of East Java Province, 2021, Floor Plan.
Source: Authors.

Optimized Efficiency Building Energy Performance. This rating takes into account three assessment benchmarks with a maximum value of 16 points. This assessment focuses on the implementation of the building electricity (Energy Consumption Intensity) in the last six months. The data on ECI for the Regional Library of East Java Province for the last six months (August 2020 – January 2021) can be seen in Table 2. The reference standard of ECI for electricity that has been determined by GBCI is 250 kWh/m².year for offices (Table 2).

Table 2. Energy Consumption Intensity (ECI) in the Regional Library Building of East Java Province

Month	Total Cost (Rp)	Electricity Rates per kWh (Rp)	Electrical Power (kWh)	Total Area (m ²)	ECI (kWh/m ²) per month	ECI (kWh/m ²) per year
2020						
August	25,166,917	1,444.70	17420.17	3,438	5.08	60.98
September	26,452,255	1,444.70	18309.86	3,438	5.34	64.10
October	30,801,273	1,444.70	21320.19	3,438	6.22	74.63
November	31,858,746	1,444.70	22052.15	3,438	6.43	77.20
December	36,085,042	1,444.70	24977.53	3,438	7.29	87.44
2021						
January	30,259,129	1,444.70	20944.92	3,438	6.11	73.32

Source: Regulation of the Minister of Energy and Mineral Resources No. 13 of 2012, processed.

The average value of ECI for the Regional Library of East Java Province was 72.94 kWh/m². Thus, the ECI for building electricity shows a value below the ECI reference standard for electricity in the last six months. There was a decrease in the ECI value of 16% in January 2021. The assessment results show that the Optimized Efficiency Building Energy Performance rating obtained 14 points.

Energy Monitoring & Control. Energy Monitoring & Control rating takes into account four assessment benchmarks with a maximum value of three points. This assessment focuses on the completeness of the kWh meter, the monthly recording of the monitoring results of the kWh meter, the appearance of information on energy use in public areas, or the application of EMS (Energy Management System) technology support. The assessment results of this rating are:

1. Availability of kWh meter which includes air conditioning system, lighting systems and socket-outlets, and spaces that are not excluded or conditioned.
2. The monthly routine recording of the monitoring results and data collection on the kWh meter has not been carried out for at least the last six months.
3. There is no Display Energy in public areas in the last 12 months.
4. There is no EMS (Energy Monitoring System) technology.

The assessment results show that the Energy Monitoring & Control rating got 1 point.

Operation and Maintenance. The Operation and Maintenance Rating takes into account three assessment benchmarks with a maximum value of three points. This assessment focuses on the availability of operating and maintenance manuals for all air conditioning systems and other equipment systems along with monthly reports for the last six months. The assessment results of this rating are:

1. There is no operating and maintenance manual for all AC systems such as Air Handling Units, Chillers, and other devices.
2. There is no regular operating and maintenance manual for all other equipment systems.
3. There is a monthly report for at least the last 6 months for the operational and maintenance activities of the building system in an orderly manner in accordance with the format stated in the operation and maintenance manual.

The assessment results show that the Operation and Maintenance rating got 1 point.

Fresh Water Efficiency. The Fresh Water Efficiency Rating takes into account two assessment benchmarks with a maximum value of two points. This assessment focuses on the level of water consumption based on SNI: 7065 (2005) concerning Procedures for Implementing the Plumbing System. The data for this rating assessment is obtained by estimating the amount of water consumption. This method requires an estimate of the number of building occupants and the average daily water usage (Erizal et al., 2019). After calculating the estimation, it is known that the total water consumption of the Regional Library of East Java Province was 326,160 l/month (Figure 4).

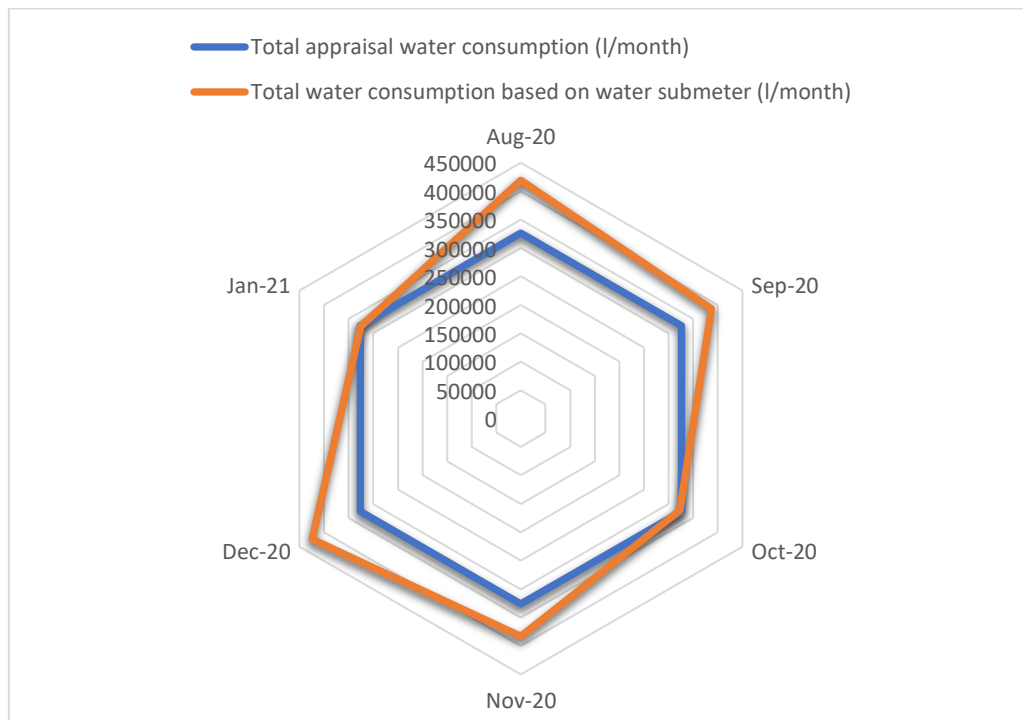


Figure 4. Clean water consumption compared to forecast, 2021, Radar chart. Source: Authors.

The total consumption based on water submeters in August, September, November, and December 2020 was greater than the estimated total water consumption. Thus, the conditions in these months exceeded the SNI standard. During September 2020, there was a decrease of 32,000 m³ of water or 7.6%. A decrease was also seen in October, which was 64,000 m³ or 16.5%. The increase in water consumption occurred in November and December 2020, but in January 2021 there was a further decrease of 99,000 m³ or 23.35%. In other words, the Fresh Water Efficiency rating has a maximum point of 2 points, because there was a decrease in water consumption by more than 10%.

Materials Purchasing Practice. This rating takes into account two assessment benchmarks with a maximum value of three points. This assessment focuses on the use of environmentally friendly materials that are applied in the List of Environmentally Friendly Materials according to the Green Building Council Indonesia (2014) as follows:

1. 80% of regional production is based on total overall material spending.
2. 30% of SNI/ISO/ecolabel certified is based on the total material expenditure.
3. 5% of materials that can be recycled (recycled) is based on total overall material spending.
4. 10% of used materials (reuse) is based on the total material spent.
5. 2% of renewable materials (renewable) is based on the total overall material expenditure.
6. 30% of modular or prefabricated materials is based on total overall material spend.
7. 100% of certified timber is based on total wood material spending.
8. 2.5% of lamps do not contain mercury from the total unit lamp expenditure.
9. Insulation does not contain styrene.
10. Ceiling or partition does not contain asbestos.
11. Composite wood and agrifiber products have low formaldehyde emissions.
12. Low VOC emission paint and carpet products.

The Regional Library Building of East Java Province met points 1, 10, and 12. The assessment results show that the Material Purchasing Practice rating obtained 1 point.

Waste Management Practice. This rating takes into account five assessment benchmarks with a maximum value of four points. This assessment focuses on the procedural collection and sorting of waste by type. The data was obtained based on the results of interviews with outsourced employees in charge of maintaining the cleanliness and tidiness of the library building and office building. Among the things that were obtained were:

1. There are no standard operating procedures, training, and reports for collecting and sorting waste based on organic and inorganic types in the last 6 months for initial certification.
2. Independent organic waste processing or in collaboration with official organic waste processing bodies have not been conducted.
3. Independent inorganic waste processing or in collaboration with official inorganic waste processing agencies that have the 3R principle (reduce, reuse, recycle) have not been conducted.
4. There are no efforts to reduce packaging waste made of Styrofoam and non-food grade plastic.
5. There are no efforts to handle waste from renovation activities to a third party of at least 10% of the total renovation budget in the last 6 months for initial certification.

The collected data show that the Waste Management Practice rating did not get any rating points.

Environmental Tobacco Smoke Control. This rating focuses on the prohibition of smoking in the building area. Data were obtained through direct observation. The Regional Library of East Java Province has installed a campaign in the form of a no smoking sticker inside the building. The Regional Library of East Java Province has implemented a no smoking policy for visitors and employees in the building area, so that this rating gets a score of two points.

Visual Comfort. This rating focuses on the comfort of room lighting in the Regional Library of East Java Province. Measurements were made based on SNI: 6197 (2000) concerning Energy Conservation in Lighting Systems and SNI: 7062 (2019) concerning Measurement of Lighting Intensity in the Workplace. The results of the measurement of lighting intensity (Figure 5) show that the average general lighting intensity in the Regional Library of East Java Province was still below the SNI standard: 6197 (2000) of 300 lux.

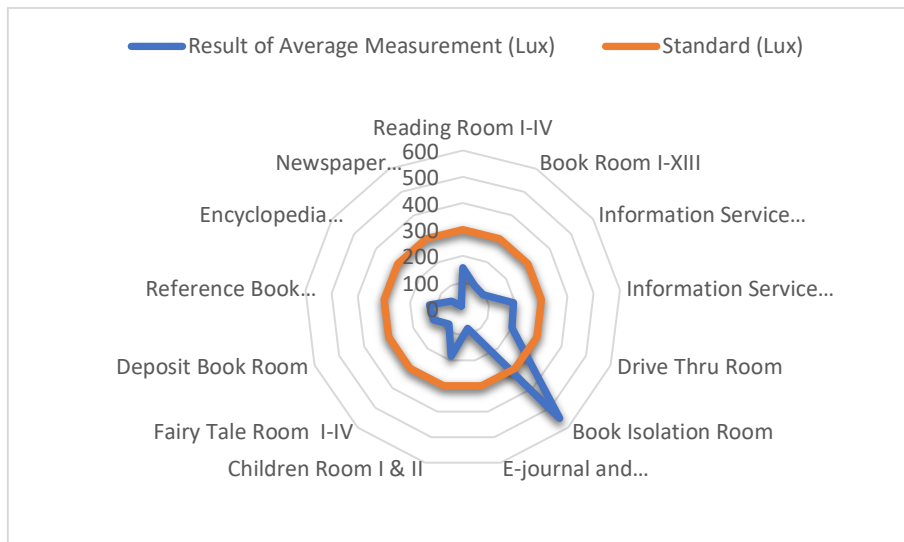


Figure 5: Room lighting level in the Regional Library of East Java Province, 2021, Radar chart. Source: Authors.

Building User Survey. This rating refers to the comfort of building users related to air temperature, room lighting level, sound comfort, building cleanliness, and the presence of nuisance pests. Respondents were taken at least 30% of the total permanent building users with the Likert Scale formula. According to Pranatawijaya et al. (2019), the Likert Scale is a psychometric scale that is commonly used in questionnaires and is the most widely used scale in survey data collection model research. Structured interviews were conducted on 37.2% of the total 43 users of the permanent building of the Regional Library of East Java Province. The interview results show 74.9% of building users feel comfortable so that an assessment score of 2 points is obtained.

Results of GBCI Assessment Implementation. After the assessment of all ratings has been completed, the point earned in the ASD aspect was four points or 42.8%, the EEC aspect was 16 points or 72%, the WAC aspect was two points or 25%, the MRC aspect was one point or 14%, and the IHC aspect was four points or 80. Thus, the total points earned for the Greenship Existing Building version 1.0 in the Regional Library Building of East Java Province were 26 points or 53.1%.

Recommendation. From the assessment results, the following recommendations were obtained for the Office of the Library and Archives of East Java Province as the building manager: (1) Community Accessibility areas can be in the form of pedestrian path facilities. Referring to the Minister of Public Works Regulation No. 30/PRT/M/2006 Chapter 2B, every construction of a building site, either inside or outside the building, must pay attention to facilities, including pedestrian paths; (2) Site Landscaping area can be added with a vegetation footprint (softscape) which can be applied through various forms of wall garden, roof garden, or terrace garden considering that there is an open area of 1,452.9 m²; (3) In the Energy Monitoring & Control area, routine recording and data collection on the kWh meter can be carried out so that the budget can be reduced; (4) Operational guidelines for all electronic units such as air conditioners and other equipment should be provided in the Operation and Maintenance area to make it easier for building users to operate; (5) Implementation of Standard Operating Procedures (SOP) in the Waste Management Practice Area for independent sorting of waste by type and reduction of the use of plastic waste by the building managers; and (6) The building manager can provide additional lights/change the color of the room and utensils (bookcases) with bright colors such as white and so on in the bookshelf area because lighting levels that are too low can make it difficult for visitors and staff to find books.

According to Ferrari et al. (2022), the choice of light wall and ceiling paint colors is more efficient in energy saving and can distribute light evenly compared to dark colors. Light colors can reflect more light, so the color of the room affects the strength of the lighting.

Conclusion

The results of measurements and assessments of a total of 12 Greenship Existing Building ratings version 1.0 show that the level of Green Building certification rating in the Regional Library of East Java Province was 53.1% or 26 points out of 49 points with details of the achievement of each aspect being four points (42.8%) on the ASD aspect, 16 points (72%) on the EEC aspect, two points

(25%) on the WAC aspect, one point (14%) on the MRC aspect, and four points (80%) on the IHC aspects.

Recommendations that can be given to the manager of the Regional Library of East Java Province include providing pedestrian paths, adding vegetation footprints, conducting routine recording of kWh meters, providing operating guidelines for all electronic units, selecting independent waste, reducing the use of plastic waste, adding additional lights, and changing the color of the room and equipment to be lighter.

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