Green Building Assessment

and Recommendations for Optimization

Case Study of the Rectorate Building

the University of Lampung

Ika Kustiani1, a), Masdar Helmi 1) and Nur Syahidah Aini1)

Author Affiliations

1Civil Engineering Department the University of Lampung

Jl. S. Brojonegoro No. 1 Bandarlampung, Indonesia 35145

Author Emails

 a) Corresponding author: ika.kustiani@eng.unila.ac.id

**Abstract.** The Green Building Concept is a concept that that offers a method of managing buildings with less energy and resources utilization since they are designed, built and operated with the aim of minimizing the total environmental impact. As this concept is becoming more accepted worldwide and its implementation has begun to be mandatory, it is time for the University of Lampung to pay attention to and start implementing this concept. Therefore, this research was aimed at assessing the Rectorate Building rating based on the national standard on Green Building Certification (Greenship-GBCI). There were several steps in conducting this research. Firstly, an opinion survey was conducted to measure the level of satisfaction of the building’s users. Secondly, a series of measurements related to lighting, temperature, humidity, noise, and air quality in work spaces within the Rectorate Building were carried out. Furthermore, an interview survey to the building household staffs were conducted to find out formal documents related to the operation and maintenance of the building. Finally, all of these data were entered in the Green Building rating tool for existing buildings. The results of the assessment showed that the Rectorate Building received a score of 23 from the maximum total score of 117. This is still far from the minimum rating to get a bronze rating as a Green Building, which is 35. Therefore, corrective action must be taken to optimize the building operation management to meet the Greenship-GBCI Certification. Assessment also needs to be done on other buildings in the university since many were not designed, built and operated in an environmentally friendly way. In addition, the results of this assessment can later be used as a benchmark or reference in developing the University of Lampung Eco-campus program.

**Keywords:** Green Building, Greenship, Green Building Rating/Certification.

# BACKGROUND

Experts estimates that 95% of human activities contribute to global warming due to CO2 emissions they release into the atmosphere. Furthermore, buildings and construction activities contribute to global warming and a decrease in the earth's biocapacity since they consume about 35% of the world's energy, 12% of the world's water, produce 25% of the world's waste and emit 40% of the world's greenhouse gas. Meanwhile, world’s cities, as well as Indonesia, continue to experience urbanization on a large scale which means an increase in the number of buildings.

The Green Building concept is an energy saving effort that can be applied to a building, new and existing. By applying the concept, buildings will be more energy efficient because they are designed, built and operated with the aim of minimizing the total environmental impact (Indonesia Green Building Council, 2008). This concept can be applied to commercial, office and educational buildings. World campuses have long been applying the eco-campus. However, there is no visible sign of the University of Lampung to start applying this concept. In fact, it can be assumed that the majority of the existing buildings in the university have not been designed according to the concept of an environmentally friendly building. Therefore, Therefore, a study is needed to assess the application of green building for existing buildings at the university. In this case, it started with the Rectorate Building. The Rectorate Building was chosen since it is the most notable building at the university. The structure of the building is in a very good condition despite it was built 30 years ago. This will make it an interested object to conduct a study.

The reference used to assess the Green Building application of the Rectorate Building is the National Standard of Greenship-GBCI (Green Building Council Indonesia). There are several stages in assessing the building according to the standard. Subsequently, the results on the Green Building performance of the Rectorate Building can later be used as a reference to review other buildings at the university as well as a benchmark in developing the Eco-campus program.

# LITERATURE REVIEW

## Greenship Rating System

According to the GBCI (2012), Green Buildings are new buildings that are planned and constructed or existing buildings that are operated by taking into account environmental/ecosystem factors and fulfilled requirements such as wise in land use, save water, save energy, save materials, reduce waste, indoor air quality, etc. A building can be said to have implemented the Green Building concept if it has successfully gone through an evaluation process to obtain Green Building certification. The assessment benchmark used is the Greenship Rating Tools.

Greenship Rating Tools contain rating items and each rating item has a value (point). If a building successfully implements the rating points, then the building will get points from those items. When the sum of all the points collected reaches a specified number, the building can be certified for a certain level of certification. However, before a building can be assessed for Green Building, it must fulfill the initial requirements for the assessment (eligibility) as follow:

1. Minimum building area is 2,500 m2.
2. Willingness for building data to be accessed by GBCI related to the certification process.
3. The function of the building is in accordance with the land use requirement based on the Local Spatial Planning (RTRW).
4. Own documents related to environmental impact analysis (AMDAL) and/or environmental management efforts plan (UKL)/environmental monitoring efforts (UPL).
5. Conform to building to fire safety standards.
6. Conform to earthquake resistance standards.
7. Conform to standards for people with disabilities.

The table below shows the six main criteria of Greenship Rating Tools in which each category consists of several rating items that have point of value. The total maximum point of Greenship final assessment is 117.

|  |
| --- |
| **TABEL 1.** Greenship Main Criteria and point of final assessment |
| **Criteria** | **Point of Final Assessment** |
| Appropriate Site Development/ASD  | 16 |
| Energy Efficiency and Conservation/EEC | 36 |
| Water Conservation/WAC | 20 |
| Material Resources and Cycle/MRC  | 12 |
| Indoor Health and Comfort/IHC | 30 |
| Building and Environment Management/BEM | 13 |
| **Maximum Total Point** | **117** |

## Building User Questionnaire Survey

Greenship's rating assessment requires a building user survey to be conducted. A questionnaire/opinion survey was chosen because it is suitable for assessing element where there are different perspectives on system performance between different groups (Svendsen and Small, 1990). Abernethy, Jinapala and Makin (2001) describe aspects to consider in conducting opinion surveys such as techniques/methodologies, questionnaire types, and analysis of findings. Adapted from Abernethy, Jinapala, and Makin (2001), opinion surveys of building users are useful for gain insight and opinion regarding comfort and health aspects in the workspace. In this study, a quantitative method is utilized because they are easy and fast, reliable and easy. A set of questions was then set up to gain insights and opinions on the selected criteria. The questionnaire was asked randomly based on the people was available at the office since the assessment was conducted in Covid time. Respondents' answers can be classified with the help of a Likert scale, for example: very uncomfortable, less comfortable, quite comfortable, comfortable and very comfortable.

The questionnaires then analyzed using a frequency distribution. Frequency is a number that shows how many times a variable (denoted by a number) is repeated in a series of numbers. Frequency distribution is the arrangement of data into certain classes where each individual or item only belongs to one class. The objectives of the frequency distribution are:

1. Facilitate the presentation of data as it easy to understand and read as information material; and

2. Easier to analyze or calculate data, create tables and graphs.

Frequency distribution analysis is a type of descriptive analysis that includes a general description of the frequency of data variables such as mean, media, mode, deviation, standard, variance, minimum, maximum and so on. The statistical analysis of the frequency description is a descriptive statistic that describes the data in a quantitative form that does not include decision making through hypotheses. There are three types of frequency distribution analysis, namely: ordinary frequency distribution, relative frequency distribution and cumulative frequency distribution. The data used for descriptive statistics can be qualitative and quantitative. Subsequently, the ordinary frequency distribution can be divided into two types, namely: numerical frequency distribution in which class division is expressed in numbers; and event frequency distribution in which class division is stated based on existing data or data groups.

The responds then analyzed using the ordinary frequency distribution. A validation analysis is also carried out to check the missing value i.e. data that is not filled by the respondents.

In addition to user surveys, interviews were also conducted to household staffs managing the Rectorate Building. These surveys are an integral part of the Greenship Assessment Matrix since it can only be counted these surveys are done.

## Green Building Criteria Measurement

The followings are the explanation of the criteria measurement shows in Tabel 1.

1. Energy Efficiency Measure

Energy efficiency measurement can be done through Energy Consumption Intensity (ECI) and overall thermal transfer value (OTTV). Electrical ECI is a term used to express the amount of energy consumption per square meter of gross building area in a certain period of time. ECI is expressed in kWh/m2 per year (Hadiputra, 2007). In 2004, the Ministry of National Education of the Republic of Indonesia set guidelines for the standard value of ECI for buildings in Indonesia. It was acknowledged as quite efficient if the value did not exceed 12.08 kWh/m2/month for an air-conditioned room and 2.5 kWh/M2/month for a non-air-conditioned room.

1. Indoor Comfort

Indoor comfort (thermal comfort) can be measured from the temperature humidity index (THI) and relative humidity (RH), noise level and air quality.

1. Temperature humidity index (THI)

The results of research by Mulyana et.al. (2003, in Kurnia et.al.), stated that the comfort index in comfortable conditions was in the range of THI 20-26. Determination of THI or comfort index can be determined from the value of air temperature (°C) and humidity (RH).

1. Thermal Comfort

Relative humidity (RH) and air temperature can be measured directly with the help of a device, namely a thermo-hygrometer (Figure 1). In each room, measurements were carried out in the morning, afternoon and evening, approximately 5 minutes in each measurement. In addition, indoor comfort can be achieved artificially by installing an air conditioner (AC).

1. Noise (Acoustic Level)

SNI 03-6386-2000 regarding Specifications for Sound Levels and Reverberation Time in Buildings and Residential Buildings stated that the maximum recommended sound level should not exceed 65 dB.

1. Air Quality

Based on SNI 19‐0232‐2005 regarding Threshold Value of chemical substances in the workplace air stated that rooms with high density (general workspace) are required to be equipped with a carbon dioxide (CO2) gas sensor installation. This equipment has a mechanism to regulate the amount of outdoor air ventilation so that the CO2 concentration in the room is not more than 1,000 ppm. In addition to CO2 level, the threshold value for chemicals in the workplace air requires that the maximum concentration for Volatile Organic Compound (VOC) is 0.37 mg/m3 and Formaldehyde (HCHO) is 0.10 mg/m3.

|  |  |
| --- | --- |
| (a) | (b) |
|  (c) |

**Figure 1.** Indoor comfort measurement tool: (a) thermo-hygrometer, (b) sound level meter and (c) air quality monitor

1. Visual Comfort

Visual comfort is measured by the level of lighting in the room. It can be measured with a lux meter. Measurements are made at several points in each room, so that the resulting lighting pattern and average lighting in each room can be measured. The standard of lighting in office spaces based on SNI 03-6197-2000 regarding Energy Conservation in Lighting Systems is between 150 to 750.

The level of lighting in the room are divided into natural and artificial lighting. Natural lighting according to Snyder and Catanese (1997) as cited by Aziz (2013) is lighting that uses sunlight in the morning and afternoon or also known as the plate solar system. The natural daylight factor (DF) is measured at a minimum of 3 measuring points in a room, with a condition that the lights are completely off and all the curtains are open as well as counting ratio of the light level to the measured area of ​​the room. These measures were carried out to determine the utilization of natural light in the room.

On the other hand, the Law of the Republic of Indonesia No. 28/2002 regarding Buildings stated that the provision of artificial lighting through electrical installations or energy systems in buildings is intended that the people in the building can carry out activities according to the the functions of the building. The number of lights needed for a room needs to be calculated to fit the needs.

|  |  |
| --- | --- |
| (a) | (b) |

**Figure 2.** Lux meter and laser distance measure

1. Alternative Water Resources and Water Use Reduction

Measurement of this criterion is carried out by calculating the consumption of clean water from each water source used every month and compares them to the need for water use in a building based on SNI 03-7065-2005 regarding the Procedure of Plumbing System Planning (50 l/employee/day for offices). Subsequently, the decrease in the percentage of clean water consumption from primary sources can be calculated.

## Greenship and Building Feasibility Rating Tools

To assess the Rectorate Building, the matrix used is GREENSHIP ASSESSMENT TOOLS FOR EXISTING BUILDING Version 1.1.

# research method

The object of the Green Building Assessment is the Rectorate Building of the University of Lampung. The assessments are carried out in several stages and utilized a quantitative method through opinion survey questionnaire, household staff interview, observations and measurements. The data used in this study are primary data and secondary data. The primary data are data from direct measurements/observations and surveys, while secondary data is documents regarding the operation of the building.

Firstly, an opinion survey was conducted to measure the level of satisfaction of the building's users. A minimum of 30% of the total permanent users of the Rectorate Building were surveyed (87 respondents out of a total of 260 building users). The questionnaire was designed in the local language (Indonesian) and as short as possible (consisting of 20 questions). Both closed-ended questions and open-ended questions were used in the survey and were divided into two parts. Part A consists of general questions to identify the respondent's profile. Part B is intended to gather opinions of building users regarding the comfort of workspace (air temperature, room lighting levels, sound level, building cleanliness and the presence of pests (pest control)). A statistical analysis of the frequency description was utilized to determine the distribution of responses from each user of the Rectorate Building. The results of the questionnaire survey were statistically analyzed using the SPSS (Statistical Program for Social Science) program.

Secondly, an interview survey to the building household staffs were conducted to find out information related to the operation and maintenance of the building. This information has to be supported by formal documents.

Thirdly, a series of measurements of indoor comfort and visual comfort were caried out in about 100 rooms located on the I to IV floors of the Rectorate Building. Measures on energy and water consumption were also conducted. Finally, all of these data were entered in the national standard of Green Building rating tool for existing buildings

# RESULTS AND DISCUSSION

## Results on Building User Survey Analysis

The results of the user opinion survey analysis can be seen in the following table:

|  |
| --- |
| **TABLE 2.** Results on Building User Survey |
| **Critera** | **Air Temperature** | **Lighting** | **Noise Level** | **Pest Presence** | **Others** | **Overall Criteria** |
| Very uncomfortable | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| Uncomfortable | 0,0 | 2,3 | 3,4 | 1,2 | 0,0 | 2,3 |
| Quite Comfortable | 4,6 | 16,1 | 18,5 | 10,3 | 2,3 | 9,6 |
| Comfortable | 64,4 | 54,0 | 42,5 | 48,3 | 12,6 | 44,4 |
| Very Comfortable | 31,0 | 27,6 | 35,6 | 40,2 | 85,1 | 43,9 |
|  | 100,0 | 100,0 | 100,0 | 100,0 | 100,0 | 100,0 |

The results show that 88,3% of users feel comfortable working in the Rectorate Building. Since it is more than 80% of the total respondents felt comfortable, the rating item related to building user survey received 2 (two) points. In addition to the frequency analysis, a validity analysis also carried out. Since there is no missing value, the analysis is considered valid.

## Results on Parameter Measurement Analysis

The measurement of parameters such as air temperature and humidity, lighting levels, sound level and air quality was carried out using tools such as thermo-hygrometer, light/lux meter, digital sound level meter, air quality monitor, and laser distance measure. This survey was conducted for 10 days from 15 to 24 September 2021. The results of the measurement results can be seen in the following tables:

1. Air Quality Measurement

The results of air quality measurement is shown below:

|  |
| --- |
| **TABLE 3.** Results on air quality measurement |
| **Floor** | **Room** | **HCHO** | **VOC** |
| 1 | Main Lobby | 0.005 | 0.001 | 0.005 | 0.027 |
| Bureau of Academic and Student Affairs | 0.039 | 0.026 | 0.177 | 0.038 |
| 2 | Vice Chancellor of Student Affairs and Alumni | 0.001 | 0.015 | 0.003 | 0.003 |
| Vice Chancellor of Academic Affairs | 0.001 | 0.013 | 0.005 | 0.006 |
| Department of Finance | 0.019 | 0.017 | 0.088 | 0.008 |
| 3 | Bureau of Planning and Human Resources | 0.001 | 0.001 | 0.127 | 0.127 |
| Department of Personnel | 0.019 | 0.011 | 0.05 | 0.101 |
| 4 | SDG’s | 0.03 | 0.001 | 0.002 | 0.008 |
| Meeting Room | 0.001 | 0.002 | 0.008 | 0.076 |
| 5 | Research and Community Service: Head | 0.001 | 0.005 | 0.005 | 0.003 |
| Research and community service: Secretary | 0.001 | 0.013 | 0.002 | 0.005 |
| Research and community service: Data and Information | 0.011 | 0.019 | 0.008 | 0.003 |
| Air Quality Average Score  | 0.0105 | 0.036875 |

Measurement results on air quality in all rooms of the Rectorate Building shows the level of VOC and HCHO are below the maximum permissible concentrations. The first and second criteria of the rating item related to sources of indoor are pollution are VOC and HCHO level. Since the level of VOC and HCHO were under the threshold, then the building entitled 2 (two) points for this criteria. The third criteria is related to asbestos levels. This item does not get points because the building has never taken such measurement.

The fourth criteria related to regular maintenance schedule on cleaning filter, cooling coil and VAC (Ventilation and AC). The maintenance of these appliances are aimed at preventing the formation of moss and fungus as a media growth for microorganisms. Based on the interviews and supported by formal documents, cleaning of filters, cooling coils and VAC are carried out once a month. Therefore, for this rating item, the building gets 1 (one) point.

The fifth benchmark is measuring the number of bacteria with a maximum number of 700 bacteria colonies/m3 of air and free of pathogenic germs in the room. This benchmark does not get points because the building has never taken measurements.

1. Thermal Comfort Measurement

Results obtained from the measurement on the thermal comfort by using thermo-hygrometer are shown in the table below:

|  |
| --- |
| **TABLE 4.** Results on thermal comfort measurement |
| **Floor** | **Room** | **Morning Measurement** |
| **Temperature (°C)** | **Humidity** |  |
| 1 | Main Lobby | 26.9 | 66 |  |
| Bureau of Academic and Student Affairs | 29.3 | 56 |  |
| Sub-department of House hold | 25 | 57 |  |
| Sub-department of Government Own Properties | 27.3 | 64 |  |
| Administration and Protocol | 29.4 | 66 |  |
| 2 | Vice Chancellor of Student Affairs and Alumni | 27.2 | 66 |  |
| Vice Chancellor of Academic Affairs | 27.6 | 63 |  |
| Vice Chancellor of Planning, Cooperation and Information & Communication Technology | 28.5 | 68 |  |
| Department of Finance | 25.9 | 69 |  |
| Staff of Vice Chancellor of Academic Affairs | 26.3 | 65 |  |
| 3 | Bureau of Planning | 27.3 | 53 |  |
| Cooperation and International Services Development | 27.7 | 68 |  |
| Department of Personnel | 25.9 | 69 |  |
| 4 | Educational Development and Quality Assurance | 26.9 | 52 |  |
| SDG’s | 26.8 | 61 |  |
| Meeting Room | 27.8 | 63 |  |
| Foundation Year Course  | 27.5 | 61 |  |
| 5 | Research and Community Service: Head | 26.9 | 63 |  |
| Research and community service: Secretary | 29.3 | 67 |  |
| Research and community service: Data and Information | 31.8 | 27 |  |
| Research and community service: Meeting Room | 28.3 | 61 |  |
| Thermal Average Score  | 27.6 | 61.2 |

SNI 6390 - 2011 regarding Energy Conservation of Building Air Conditioning System stated that a room is considered comfortable if it has a temperature of 24°C to 27°C and a relative humidity of 60% ± 5%. Based on the thermal measurements, the average temperature and the relative humidity of the Rectorate Building were 27.6°C and 61.19% respectively. Since the measurement results are slightly above the SNI, then for this rating item no points are obtained.

1. Visual Comfort

Visual comfort in a room is measured through lighting conditions using a lux/light meter. Measurements are taken at a minimum of three location in each room. The table below shows the results of the measurement of the level of illumination (illumination) which was carried out during the survey at 10.00 – 12.00 WIB.

|  |
| --- |
| **TABLE 5.** Results on visual comfort measurement |
| **Floor** | **Room** | **Lighting Measurement (Lux) - Morning** |
| 1 | Main Lobby | 328 |
| Bureau of Academic and Student Affairs | 239 |
| Sub-department of House hold | 203 |
| Sub-department of Government Own Properties | 142 |
| Administration and Protocol | 328 |
| 2 | Vice Chancellor of Student Affairs and Alumni | 259 |
| Vice Chancellor of Academic Affairs | 314 |
| Vice Chancellor of Planning, Cooperation and Information & Communication Technology | 288 |
| Department of Finance | 107 |
| Staff of Vice Chancellor of Academic Affairs | 176 |
| 3 | Bureau of Planning | 305 |
| Cooperation and International Services Development | 144 |
| Department of Personnel | 192 |
| 4 | Educational Development and Quality Assurance | 172 |
| SDG’s | 241 |
| Meeting Room | 336 |
| Foundation Year Course  | 173 |
| 5 | Research and Community Service: Head | 315 |
| Research and community service: Secretary | 234 |
| Research and community service: Data and Information | 308 |
| Research and community service: Meeting Room | 259 |
| Lighting Average Score | 241 |

Based on SNI 03-6197-2000, the lighting level suitable for office is 150 to 750 lux depending on activities carry out in the room. The measurement taken on Rectorate Building shows an average luminance value of 241 lux. It can be concluded that in general the lighting has met the requirements despite there are still some rooms that less than 150 lux. For this rating item, the Rectorate Building gets 1 (one) point.

1. Noise level

Based on SNI 03-6386-2000, the noise level for public offices is < 45 dB. Since the noise level exceeds the requirement, the Rectorate Building do not get point for this item rating. The table below shows the noise level in all room of Rectorate Building exceeds 45dB.

|  |
| --- |
| **TABLE 6.** Results on noise level measurement |
| **Floor** | **Ruangan** | **Noise Level Measurement (dB) - Morning** |
| **Location**  |
|  |  | **1** | **2** | **3** | **4** | **5** |
| 1 | Bureau of Academic and Student Affairs | 51.1 | 60,0 | 65.9 | 67.4 | 59.3 |
| 3 | Deoartment of Personnel | 54.8 | 52.1 | 54.4 | 52.4 | 52.7 |
| 5 | Research and Community Service: Head | 48.5 | 52.3 | 42.3 | 46.7 | 53.1 |
| Average Noise Level | 54.2 |
| Minimum Noise Level | 40 |
| Maximum Noise Level | 45 |

## Results on Greenship Assessment

All the assessment above then tabulated into Greenship Assessment Matrix. Points are obtained from the assessment process carried out on six criteria as describe in Tabel 1. The rating of a building is awarded based on the following:

1. Greenship Platinum; awarded when a building accumulates a total value of at least 74 points.
2. Greenship Gold: awarded when a building accumulates a total value of at least 58 points.
3. Greenship Silver awarded when a building accumulates a total value of at least 48 points.
4. Greenship Bronze: awarded when a building accumulates a total value of at least 35 points.

A summary of Greenship Assessment Matrix of the Rectorate Building is ​​shown in the following table:

|  |
| --- |
| **TABLE 7.** Summary of Greenshipp Assessment |
| **No.** | **Criteria** | **Maximum Point** | **Point Awarded** |
| **ASD 1** | Community Accessibility | 6 | 3 |
| **ASD 2** | Motor Vehicle Reduction | 3 | 1 |
| **ASD 3** | Site Landscaping | 4-5 | 0 |
| **ASD 4** | Heat Island Effect | 2 | 0 |
| **ASD 5** | Storm Water Management | 3 | 0 |
| **ASD 6** | Site Management | 2 | 1 |
| **ASD 7** | Building Neighbourhood | 5 | 2 |
|  | **SUB TOTAL** |  | **7** |
| **EEC 1** | Optimized Efficiency Building Energy Performance | 14 -27 | 0 |
| **EEC 2** | Testing, Recommisioning or Retrocommisioning | 3 | 1 |
| **EEC 3** | System Energy Performance | 6 14 | 1 |
| **EEC 4** | Energy Monitoring & Control | 9 | 2 |
| **EEC 5** | Operation and Maintenance | 3 | 0 |
| **EEC 6** | On Site Renewable Energy | 15 | 0 |
| **EEC 7** | Less Energy Emission | 6 | 0 |
|  | **SUB TOTAL** |  | **2** |
| **WAC 1** | Water Sub‐Metering | 1 | 0 |
| **WAC 2** | Water Monitoring Control | 2 | 0 |
| **WAC 3** | Fresh Water Efficiency | 4 - 10 | 0 |
| **WAC 4** | Water Quality | 1 | 0 |
| **WAC 5** | Recycled and Alternative Water | 6 | 2 |
| **WAC 6** | Potable Water | 1 | 0 |
| **WAC 7** | Deep Well Reduction | 3 | 2 |
| **WAC 8** | Water Tap Efficiency | 3 | 0 |
|  | **SUB TOTAL** |  | **2** |
| **MRC 1** | Non ODS Usage | 3 | 0 |
| **MRC 2** | Material Purchasing Practice |  |  |
| **MRC 3** | Waste Management Practice | 5 | 3 |
| **MRC 4** | Hazardous Waste Management | 3 | 0 |
|  | **SUB TOTAL** |  | **3** |
| **IHC 1** | Outdoor Air Introduction | 2 | 0 |
| **IHC 2** | Environmental Tobacco Smoke Control | 2 | 2 |
| **IHC 3** | CO2 and CO Monitoring | 5 | 0 |
| **IHC 4** | Physical, Chemical and Biological Pollutants | 9 | 3 |
| **IHC 5** | Thermal Comfort | 1 | 0 |
| **IHC 6** | Visual Comfort | 1 | 1 |
| **IHC 7** | Acoustic Level | 1 | 0 |
| **IHC 8** | Building User Survey | 4 | 3 |
|  | **SUB TOTAL** |  | **9** |
| **BEM 1** | Innovations | 3-5 | 0 |
| **BEM 2** | Design Intent & Owner's Project Requirement | 2 | 0 |
| **BEM 3** | Green Operational & Maintenance Team | 2 | 0 |
| **BEM 4** | Green Occupancy/Lease | 4 | 0 |
| **BEM 5** | Operation and Maintenance Training | 2 | 0 |
|  | **SUB TOTAL** |  | **0** |
|  | **Total Nilai Keseluruhan Maksimum** | **117** | **23** |

Unfortunately, based on the above assessment, the Rectorate Building of the University of Lampung does not meet the requirement even for the lowest category of Green Building. The minimum point to get a Bronze rating is 35, while the Rectorate Building points only awarded 23 points.

Of the six categories assessed in Greenship, the sixth category that the University received did not score at all, namely the category of building environmental management. In this category there are 5 (five) criteria assessed, namely: innovation; project owner policy and design; environmentally friendly operation and maintenance team; Green contracts and operations, maintenance and training. From this it is known that there needs to be a policy issued to commit to Green Building, forming an environmentally friendly maintenance and operational team as well as training household staff to understand building operations and maintenance according to Green Building standards.

# CONCLUSION

From the results of this study it can be concluded that:

1. It is known that buildings and construction are major contributor to the global warming and climate change.
2. The study shows that Rectorate Building does not meet even the lowest level of Green Building rating criteria. This also means that the operation of the Rectorate Building is not effective and efficient.

Therefore, the implementation of Green Building at the University of Lampung needs to start immediately as it can save the environment as well as save operational cost.

# AcknowledgmentsAcknowledgments are conveyed to the Office of Research and Community Service, the University of Lampung for the funding of this research.

# References

1. Abernethy C L, Jinapala K, Makin I W 2001 Assessing the opinions of users of water projects (Irrigation and Drainage) v 50(3): p 173-193.
2. Svendsen M and Small L E 1990 Farmer's perspective on irrigation performance (Irrigation and Drainage Systems) v 4: p 385-402.
3. Aristia Andana, “Penilaian Kriteria Green Building Pada Gedung Teknik Sipil ITS,” Tugas Akhir Jurusan Teknik Sipil, Institut Teknologi Sepuluh Nopember, Surabaya (2012).
4. Aziz, Ashari. 2013. Kajian Terhadap Kenyamanan Ruang Teori Di Fakultas Teknik Universitas Negeri Yogyakarta Ditinjau Dari Pencahayaan Alami dan Pencahayaan Campuran, Jurnal Teknik Sipil, Universitas Negeri Yogyakarta, Yogyakarta.
5. Dewi, P. R. 2012. Audit dan Konservasi Energi pada Rumah Sakit Angkatan Laut dr. Ramelan Surabaya. Institut Teknologi Sepuluh November. Surabaya.
6. Green Building Council Indonesia. 2012. Greenship Rating Tools untuk Bangunan Baru Versi 1.2. Green Building Council Indonesia, Jakarta.
7. Hadiputra, H. R. 2007. Audit Energi pada Bangunan Gedung Rumah Sakit dr. Kariyadi Semarang, Skripsi, Universitas Diponegoro, Semarang.
8. http://penataanruang.pu.go.id/bulletin/index.asp?mod=fullart&idart=123. Tanggal akses 10 Oktober 2015.
9. Indonesia Green Building Council. 2008. Greenship Existing Buildings [Online]. Available: http://www.gbcindonesia.org.
10. Konservasi Energi Pada Sistem Pencahayaan (SNI 03-6197-2000), Badan Standarisasi Nasional, Jakarta.
11. Konservasi Energi Selubung Bangunan Pada Bangunan Gedung (SNI03-6389-2000). Badan Standarisasi Nasional, Jakarta.
12. Kurnia, R., Effendy, S., Tursilowati, L. 2010. *Identification of Building Thermal Comfort - Case Study: Classrooms in IPB Banangsiang and Darmaga Campuses*. Journal of Agromet 24 (1), pp. 14-22, 2010, ISSN: 0126-3633, Bogor.
13. Peraturan Daerah Kota Bandar Lampung Nomor 10 Tahun 2011 tentang Rencana Tata Ruang Wilayah Tahun 2011 - 2030. Bandar Lampung.
14. Tim Redaksi Penataan Ruang PU. 2009. “Indikator Pembangunan Berkelanjutan diIndonesia”. Bulletin Online Edisi Januari-Februari 2009, Jakarta.