

Evaluation and Implementation of Green Building in Office Building (Case Study: Munara 99 Sabilulungan Building)

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ABSTRAK

Konsep Green Building adalah konsep perencanaan bangunan untuk memenuhi kehidupan yang lebih baik bagi generasi berikutnya. Sebuah bangunan dapat diklasifikasikan sebagai bangunan hijau jika memenuhi persyaratan dan memiliki sertifikasi bangunan hijau. Tujuan penelitian ini yakni menganalisis serta mengevaluasi kriteria bangunan eksisting yakni gedung Munara 99 Sabilulungan melalui perhitungan poin-poin penilaian Greenship GBCI v1.2 karena belum adanya penilaian dan rating bangunan hijau dari GBCI sehingga dibutuhkan evaluasi penilaian bangunan hijau. Metode deskriptif dengan pendekatan evaluatif dipilih untuk menggambarkan dan membandingkan kondisi eksisting bangunan dengan perangkat penilaian greenship untuk bangunan baru v1.2. Penilaian greenship GBCI untuk bangunan baru v1.2 terdiri dari 6 kategori, yaitu kesesuaian penggunaan lahan, efisiensi dan konservasi energi, konservasi air, sumber dan siklus material, kesehatan dan kenyamanan ruang, dan manajemen lingkungan bangunan. Untuk menunjang penilaian greenship GBCI data yang digunakan yakni gambar shop drawing gedung, Bill of Quantity (Boq), hasil wawancara dan observasi lapangan. Berdasarkan hasil penilaian bangunan hijau, gedung Munara 99 Sabilulungan mendapatkan peringkat GBCI yaitu peringkat perunggu dengan skor 44 poin. Untuk meningkatkan peringkat bangunan hijau menjadi peringkat emas, maka gedung Munara 99 Sabilulungan direkomendasikan untuk memperbaiki beberapa kategori sehingga dapat memperoleh peringkat emas dengan nilai 67 poin dan untuk perbaikan peningkatan peringkat tersebut membutuhkan biaya sebesar Rp 1.790.085.000,-.

Kata kunci: Evaluasi, GBCI, Bangunan Gedung Hijau, Greenship untuk Bangunan Baru v1.2, Implementasi

ABSTRACT

Green Building concept is the concept of building planning to fulfill a better life for the next generation. A building can be classified as a green building if it meets the requirements and has green building certification. The purpose of this research is to analyze and evaluate the existing building criteria, namely the Munara 99 Sabilulungan building through the calculation of Greenship GBCI v1.2 assessment points because there is no green building assessment and rating from GBCI so that an evaluation of green building assessment is needed. A descriptive method with an evaluative approach was chosen to describe and compare the existing condition of the building with the greenship assessment tool for new buildings v1.2. The GBCI greenship assessment for new buildings v1.2 consists of 6 categories, namely land use suitability, energy efficiency and conservation, water conservation, material sources and cycles, space health and comfort, and building environmental management. To support the GBCI greenship assessment, the data used are building shop drawings, Bill of Quantity (Boq), interview results and field observations. Based on the results of the green building assessment, the Munara 99 Sabilulungan building received a GBCI bronze rating with a score of 44 points. To improve the green building rating to a gold rating, the Munara 99 Sabilulungan building is recommended to improve several categories so that it can get a gold rating with a value of 67 points and for improvements to increase the rating requires a cost of Rp 1,790,085,000, -.

Keywords: Evaluation, GBCI, Green Building, Greenship for New Building v1.2, Implementation

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1. INTRODUCTION

As a country with a rapidly growing population and economy, Indonesia plays an important role in reducing greenhouse gas emissions and addressing the impacts of climate change. One of the sectors that

needs special attention is the building sector, because this sector contributes considerable greenhouse gas emissions (Aisyah, Rizky, Lksamana, & Fajar, 2022). The global issue of climate change is one of the most important environmental issues today. Climate

change is caused by increased greenhouse gas emissions caused by various human activities such as transport, industry, and the construction sector. The impacts of climate change are very significant, including increasing global temperatures, increasing the frequency and intensity of extreme weather events, rising sea levels, environmental damage, and threats to the survival of humans and other life on Earth (Adeswastoto, et al., 2023)

According to the Regulation of the Minister of Public Works Number 24/PRT/M/2008 concerning Guidelines for Building Maintenance, a building is a physical construction work that is partly or entirely related to the site or land or water building where people carry out activities such as daily life, business activities, religious activities, social activities, cultural activities, and special activities (Rohmat, 2020). Buildings that are constructed without regard to the surrounding environment can have a negative impact on the environment such as pollution of water, air and soil and climate change (Warlina, 2017). Severe droughts, extreme weather, extremely hot temperatures, rising sea levels and coral bleaching are all impacts of climate change. Office buildings play a role in energy wastage due to their high energy consumption levels. The impact of environmental damage due to development can be prevented by using the concept of green building (Massie, Dundu, & Tjakra, 2018). Green building is the planning of buildings to make life better and meet the needs of the next generation. Buildings that use the concept of green building utilize the natural resources around them and each component of the building is interconnected, no part is made in vain.

Green building assessment in Indonesia is regulated by the Minister of PUPR in PUPR ministerial regulation Number 21 of 2021 concerning green building performance assessment. This regulation adopts the green building assessment from GBCI, namely the Greenship Assessment Tool for New Building V1.2 assessment.

Indonesia has a green building organization called Green Building Council Indonesia (GBCI). GBCI is a non-profit and non-government organization that was established in 2009 and has the authority to provide and certify green buildings in Indonesia. GBCI is an affiliate of the World Green Building Council. (Sulistiawan, Maryanto, Aprizal, & Rachman, 2022)

GBCI conducts green building certification assessments based on the Indonesian rating system assessment tool called greenship (Putra, 2022). The benefits of having greenship certificates are: (i) increase building investment value and selling points, (ii) protect the surrounding environment and participate in reducing the impact of global warming, (iii) can apply for loans to banks and other parties and (iv) get sustainable finance support by the Financial Services Authority (OJK).

Greenship is divided into six categories: (i) appropriate site development, (ii) energy efficiency and conservation, (iii) water conservation, (iv)

material resources and cycle, (v) indoor health and comfort, and (vi) building environment management. The ranking levels that can be obtained from the greenship assessment results are divided into three ranks: (i) platinum with a total of at least 86 points, (ii) gold with a total of at least 67 points, (iii) silver with a total of at least 47 points, and (iv) Bronze with a total of at least 35 points.

Munara 99 Sabilulungan Building is a government office with a one-stop service system located at Jl. Al-Fathu, Soreang, West Java. Munara 99 Sabilulungan Building was built by the PUTR Office of Bandung Regency with planning consultant PT. Infra Konsulindo and contractor PT. Amber Hasya. Besides functioning as a public service mall, Munara 99 Sabilulungan Building is also targeted to become an icon of Soreang City.

A building can be said to have implemented the concept of green building if it has successfully gone through an evaluation process and has a green building certification (Atmanto, et al., 2020). Munara 99 Sabilulungan Building has not yet conducted and obtained green building certification. Therefore, an evaluation of green building implementation using greenship for new building v1.2 is needed to determine the application of the green building concept in the Munara 99 sabilulungan building.

The objectives of this paper are: (i) analyze and evaluate the existing level of application of the green building concept in the Munara 99 Sabilulungan Building using greenship for new buildings v1.2, and (ii) create recommendations that can be done to improve the application of the green building concept in the Munara 99 Sabilulungan building.

2. METHODS

The method used in this research is a descriptive method with an evaluative approach to describe and compare the existing condition of the building with the greenship assessment tool for new buildings v1.2 (Greenship Rating Tools For New Building Version 1.2). The GBCI greenship assessment for new buildings v1.2 consists of 6 categories, namely land use suitability, energy efficiency and conservation, water conservation, material sources and cycles, space health and comfort, and building environmental management. To support the GBCI greenship assessment, the data used are building shop drawings, Bill of Quantity (Boq), interview results and field observations. The analysis was conducted as follows:

- a. Evaluation of the criteria in the categories in the Greenship Rating Tool for New Buildings Version 1.2. based on the actual building conditions.
- b. Analysis of the assessment by accumulating the results based on the criteria and categories in the Greenship Assessment Tool for New Buildings Version 1.2. If the analysis results obtained a minimum rating value $\geq 35\%$, the predicate level will be determined and if the analysis results obtained ≤ 27 points or a percentage $\leq 35\%$, the

benchmarks in each criterion do not meet the standard value or predicate level in Greenship.

- c. The last stage is determining the level of greenship predicate. At this stage, the building is assessed thoroughly from both the design and construction aspects and is the final stage that determines the overall good performance of building planning. The value of each category can be seen in the Greenship Rating Tool for New Buildings Version 1.2. There are 4 (four) levels of Greenship rating, namely Platinum, Gold, Silver and Bronze. The rating given, reflects the efforts of the building planning owner and his team in implementing the Green Building concept based on GBCI.

2.1. Study Area

Munara 99 Sabilulungan Building is located in Al-Fathu Street, Soreang City, West Bandung District, West Java, specifically placed in the southern part of West Java Province at coordinates 7° 1'13.82" South Latitude and 107°31'46.51" East Latitude. Munara 99 Sabilulungan building stands on an area of 4200 m² with 6 floors with a total of 4983 m² building area. Map of Munara 99 Sabilulungan Building are shown in Figure 1.

2.2. Green Building Concept

The concept of green building has emerged. This is important considering the phenomenon of global warming and the problems of environmental damage that afflict mankind. Based on data from the World Green Building Council, buildings around the world produce 33% of CO₂ emissions, 17% of water supply, 25% of wood products, 30-40% of energy consumption, and 50% of construction and operational raw material consumption (Reztrie, Lubis, Kusuma, Koerniawan, & Budiarto, 2018; Wijayanigtyas & Lukiyanto, 2021). Therefore, the concept of green building is considered as a solution to reduce environmental damage and minimise carbon emissions that are the main cause of global warming from the construction sector. (Wijayanigtyas, Redjo, Handoko, Lukiyanto, & Jiram, 2021).

2.3. Greenship for New Building v1.2

Greenship for new building v1.2 is one of the assessment tools from Green Building Council Indonesia (GBCI) that can be used to evaluate the implementation of green building concepts on a building (GBCI, 2016). Greenship for new building v1.2 consist of eligibility, 6 categories, 8 pre-requisite criteria and 37 credit criteria.

2.3.1. Eligibility

Building eligibility requirements in the greenship for new building v1.2 before the assessment process is carried out (GBCI, 2016), are : (1) the minimum area of the building is 2500 m², (2) the building function is in accordance with the land use based on the local neighbourhood, (3) ownership of environmental impact assessment (AMDAL) and/or environmental management effort (UKL) / environmental monitoring effort (UPL) plan documents, (4) compliance of the building with fire safety standards, (5) compliance of the building with earthquake standards, and (6) compliance of the building with disability accessibility standards.

2.3.2. Aproprate Site Development

The suitable site development category consists of 1 prerequisite criteria and 7 credit criteria comprising of criteria, Basic Green Area, Site Selection, Accessibility, Community, Public Transport, Bicycle Facilities, Site Landscaping, Microclimate, Rainwater Management. The appropriate site development category criteria get a total assessment score of 17 scores with an impact percentage of 16.8%. (Kurniawan, Moctar, & Simanjuntak, 2020).

2.3.3. Energy Efficiency and Conservation

The energy efficiency and conservation category consists of 2 prerequisite criteria, 4 credit criteria and 1 bonus criterion consisting of Electrical Sub Metering, OTTV Calculation, Energy Efficiency Measures, Ventilation Natural Lighting, Climate Change Impact, Onsite Renewable Energy as bonus criteria. The corresponding energy efficiency and conservation category criteria received a total assessment score of 26 scores with an impact percentage of 25.7%. (Mongan, Aditya, Jermias, Tisano, & Arsjad, 2019; Qiao & Liu, 2019).



Figure 1. Map of Munara 99 Sabilulungan Building
Source: Results of data processing (2023)

2.3.4. Water Conservation

Water conservation category consists of 2 pre-requisite criteria and 6 credit criteria consisting of Water Metering, Water Calculation, Water Use Reduction, Water Fixtures, Water Recycling Alternative Water Resources, Rainwater Harvesting, Water Efficiency Landscaping and The criteria of water conservation received a total assessment score of 21 scores with impact percentage of 20,8 %, (Febrina, Buraida, & Febriyanti, 2020).

2.3.5. Material Resources and Cycle

Material resources and cycle category consists of 1 pre-requisite criteria and 6 credit criteria consisting of Fundamental Refrigerant, Building and Material Reuse, Environmentally Friendly Material, Non-ODS Usage, Certified Wood, Prefab Material, Regional Material. The criteria of material resources and cycle category criteria received a total assessment score of 13 scores with an impact percentage of 12.9%. (Fatmayati, Anita, & Luthfi, 2021; Burhan, Hanny, Dena, Henry, & Gembong, 2021; Cantika & Yudith, 2022).

2.3.6. Indoor Health and Comfort

Indoor health and comfort category consists of 1 pre-requisite criteria and 7 credit criteria and 1 bonus criteria with total 10 score with an impact percentage of 9.9%.

2.3.7. Building Environment Management

Building environment management category consists of 1 pre-requisite criteria and 6 credit criteria and 1 bonus criteria with total 13 score score with an impact percentage of 12.9%.

2.4. Greenship Rating Level.

Greenship for new building v1.2 rating levels are shown in Table 1 (GBCI, 2016).

Table 1. Greenship Rating Level

Rating	Minimum Score	Percentage
Platinum	74	73%
Gold	58	57%
Silver	47	46%
Bronze	35	35%

3. RESULT AND DISCUSSION

3.1. Eligibility

In evaluating green buildings the first step that must be taken before using the greenship for new building v1.2 assessment tool is the eligibility requirements. The eligibility requirements for building buildings set by greenship are based on laws and regulations set by the government so that the eligibility requirements must be met by the building (Lerebulan, Sangadji, & Buyang, 2023). The analysis of building eligibility requirements covers six aspects, namely (1) the minimum building area is 2500 m², (2) the building function is in accordance with land use based on the local environment, (3) ownership of

environmental impact analysis (AMDAL) plan documents and / or environmental management efforts (UKL) / environmental monitoring efforts (UPL), (4) building compliance with fire safety standards, (5) building compliance with earthquake standards, and (6) building compliance with disability accessibility standards (Arlisyah, Sukmawati, & Triasiana, 2020). The results of the eligibility requirements of the Munara 99 Sabilulungan Building based on greenship for new buildings v1.2 are shown in Table 2.

Table 2. Eligibility Results

Criteria	Checklist	
	Met	No
Minimum Building Area is 2500 m ²	✓	
Building Function in accordance with Land Use Based on Local Neighbourhood	✓	
Ownership of Environmental Impact Assessment (AMDAL) and/or Environmental Management Effort (UKL) / Environmental Monitoring Effort (UPL) plan documents	✓	
Compliance of the Building with Fire Safety Standards	✓	
Compliance of the Building with Earthquake Standards	✓	
Compliance of the Building with Disability Accessibility Standards	✓	

Source: Results of data processing (2023)

3.2. Appropriate Site Development (ASD)

The appropriate land use assessment category (ASD) consists of 1 prerequisite criteria and 7 main criteria. In the main criteria there are several indicators. Based on the results of the analysis, there are several indicators of the main criteria that are not met by Munara 99 Sabilulungan Building.. So that the score obtained in the appropriate land use category (ASD) is only 8 scores. The results of the analysis are listed in Table 3.

Table 3. Appropriate Site Development Results

Code	Criteria	Indicator	Checklist		Score
			Met	No	
ASD P	Basic Green Area	P1	✓		P
		P2	✓		P
ASD 1	Site Selection	*1	✓		1
		*2		✓	-
		*1	✓		1
ASD 2	Community Accesibility	*2	✓		1
		*3	✓		2
		*4	✓		2
ASD 3	Public Transportation	*1		✓	-
		*2		✓	-
ASD 4	Bicycle Facility	*1		✓	-
		*2		✓	-
ASD 5	Site Landscaping	*1A	✓		1
		*1B	✓		2
		*2	✓		1
ASD 6	Micro Climate	*1		✓	-
		*2	✓		1
		*3	✓		1
ASD 7	Stormwater Management	*1		✓	-
		*2		✓	-
		*3		✓	-
Total Score					8

Source: Results of data processing (2023)

3.3. Energy Efficiency and Conservation (EEC)

The Energy Efficiency and Conservation (EEC) category consists of 2 pre-requisite criteria and 5 main criteria. In the main criteria there are several indicators. Based on the results of the analysis, there are several indicators of the main criteria that cannot be met by the Munara 99 Sabilulungan Building. So that the score obtained in the efficiency and energy conservation category is only 7 scores out of the maximum value of 26 scores. The analysis results are listed in Table 4.

Table 4. Energy Efficiency and Conservation Results

Code	Criteria	Indicator	Checklist		Score
			Met	No	
EEC P1	Electrical Sub Metering	P1	✓		P
EEC 1	Energy Efficiency Measures	P2	✓		P
		C1-1		✓	-
		C1-2		✓	-
		C2-1	✓		1
		C2-2		✓	-
		C2-3	✓		1
EEC 2	Natural Lighting	C3-1	✓		1
		C4-1	✓		2
		*1	✓		-
		*2	✓		-
EEC 3	Ventilation	*1	✓		1
EEC 4	Climate Change Impact	*1	✓		1
EEC 5	On-Site Renewable Energy - BONUS	*1		✓	-
Total Score					7

Source: Results of data processing (2023)

3.4. Water Conservation (WAC)

Table 5. Water Conservation Results

Code	Criteria	Indicator	Checklist		Score
			Met	No	
WAC P1	Water Metering	P1	✓		P
WAC P2	Water Calculation	P2	✓		P
WAC 1	Water Use Reduction	*1	✓		1
		*2	✓		7
WAC 2	Water Fixtures	*1	✓		3
WAC 3	Water Recycling Alternative	*1		✓	-
WAC 4	Water Resources	*1		✓	-
WAC 5	Rainwater Harvesting	*1		✓	-
WAC 6	Water Efficiency Landscaping	*1		✓	-
		*2		✓	-
Total Score					11

Source: Results of data processing (2023)

The water conservation category (WAC) consists of 2 prerequisite criteria and 6 main criteria with a maximum of 21 points that must be obtained. Based on the results of the analysis, there are several indicators of the main criteria for water conservation that cannot be met by the munara 99 sabilulungan

building. So that the score obtained in the water conservation category is only 11 scores from the maximum value. The analysis results are listed in Table 5.

3.5. Material Resources and Cycle (MRC)

The material resources and cycle category (MRC) consists of 1 prerequisite criteria and 6 main criteria with a maximum of 14 points that must be obtained. Based on the results of the analysis, there are several indicators of the main criteria of the material resources and cycle category (MRC) that cannot be met by Gedung munara 99 sabilulungan. So that the score obtained in the material resources and cycle category is only 5 scores from the maximum value. The analysis results are listed in Table 6.

Table 6. Material Resources and Cycle Results

Code	Criteria	Indicator	Checklist		Score
			Met	No	
MRC P	Fundamental Refrigerant	P1	✓		P
MRC 1	Building and Material Reuse	*1	✓		1
		*1		✓	-
MRC 2	Environmentally Friendly Material	*2		✓	-
		*3		✓	-
		*1	✓		1
MRC 3	Non-ODS Usage	*1	✓		1
MRC 4	Certified Wood	*1	✓		1
		*2		✓	-
MRC 5	Prefab Material	*1		✓	-
MRC 6	Regional Material	*1	✓		1
		*2	✓		1
Total Score					5

Source: Results of data processing (2023)

3.6. Indoor Health and Comfort (IHC)

Table 7. Indoor Health and Comfort Results

Code	Criteria	Indicator	Checklist		Score
			Met	No	
IHC P	Outdoor Air Introduction	P1	✓		P
IHC 1	CO ₂ Monitoring	*1		✓	-
IHC 2	Environmental Tobacco Smoke Control	*1		✓	-
		*1	✓		1
IHC 3	Chemical Pollutant	*2	✓		1
		*3	✓		1
		*1	✓		1
IHC 4	Outside View	*1	✓		1
IHC 5	Visual Comfort	*1	✓		1
IHC 6	Thermal Comfort	*1	✓		1
IHC 7	Acoustic Level	*1		✓	-
Total Score					6

Source: Results of data processing (2023)

The Health and Comfort category consists of 1 prerequisite criterion and 7 main criteria with a maximum of 10 points that must be obtained. Based on the results of the analysis, there are several indicators of the main criteria for health and comfort of space that cannot be met by the Munara 99 Sabilulungan Building. So that the score obtained in

the indoor health and comfort category is only 5 scores from the maximum value. The analysis results are listed in Table 7.

3.7. Building Environment Management (BEM)

The building environment management category consists of 1 prerequisite criterion and 7 main criteria with a maximum of 17 points that must be obtained. Based on the results of the analysis, there are several indicators of the main criteria for health and comfort of space that cannot be met by the Munara 99 Sabilulungan Building. So that the score obtained in the building environment management category is only 7 scores from the maximum value. The analysis results are listed in the Table 8.

Table 8. Building Environment Management Results

Code	Criteria	Indicator	Checklist		Score
			Met	No	
BEM P	Basic Waste Management	P1	✓		P
BEM 1	GP as a Member of Project Team	*1		✓	-
BEM 2	Pollution of Construction Activity	*1	✓		1
BEM 3	Advanced Waste Management	*2	✓		1
BEM 4	Proper Commissioning	*1		✓	-
BEM 5	Green Building Submission Data	*2	✓		1
BEM 6	Fit Out Agreement	*1	✓		1
BEM 7	Occupant Survey	*1		✓	-
Total Score					7

Source: Results of data processing (2023)

3.8. Greenship for New Building v1.2 Evaluation Results

Evaluation results of green building implementation at Munara 99 Sabilulungan using greenship for new building v1.2 get 44 score with bronze rank. Evaluation results are shown in Table 9.

Table 9. Greenship for New Building v1.2 Evaluation Results

Category	Evaluation Score	Maximum Score
ASD	8	17
EEC	7	31
WAC	11	21
MRC	5	14
IHC	6	10
BEM	7	13
Total	44	106

Source: Results of data processing (2023)

3.9. Recommendations Plan

3.9.1. Bicycle Parking Plan

Bicycle parking calculations are carried out using a ratio of 1 bicycle parking for every 20 building employees (GBCI, 2016). Munara 99 Sabilulungan building employees consist of 50 employees. Bicycle parking spaces that must be met are 3. These results meet the requirements indicator of the ASD 4 criteria thus get an additional 1 point. The cost required to

implement this solution is IDR 1,500,000. Bicycle parking plan of Munara 99 Sabilulungan Building are shown in Figure 2.

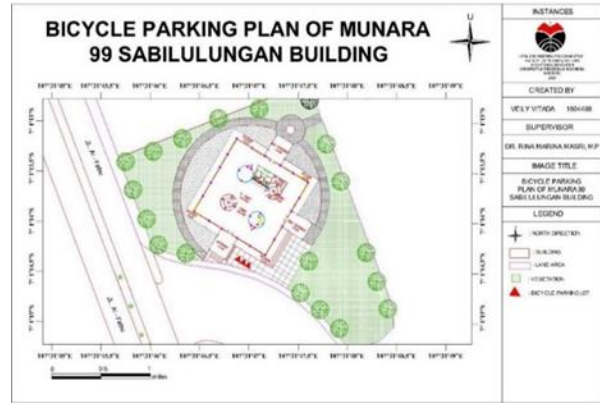


Figure 2. Bicycle Parking Plan at Munara 99 Sabilulungan Building

Source: Results of data processing (2023)

3.9.2. Roof Materials

The recommendation to use red ceramic roofing material is to get a greater albedo value. Red ceramic roofing has an albedo coefficient of 0.35. The roof area of the building is 1350 m², so the required red roof tiles are 33750 pieces. These results meet the requirements indicator of the ASD 6 criteria thus get an additional 1 point. The cost required to implement this solution is IDR 118,125,000. Recommended albedo value of building roof area using red ceramic roofing are shown in Table 10.

Table 10. Recommended Albedo Value of Building Roof Area

Material	Cover Area (m ²)	Albedo Coefficient	Albedo Value
Red Ceramic Roof	1350	0.35	0.31
Concrete	168	0.7	0.08
Total	1518	11	0.39

Source: Results of data processing (2023)

3.9.3. Roof Tank and Infiltration Wells

The recommendations to use of 2 roof tanks with a capacity of 30 m³ and 3 infiltration wells with a diameter of 1 m and a depth of 2.5 m are solution to reduce rainwater runoff from the roof and building grounds to the surrounding drainage network. The percentage of rainfall runoff water handling to the surrounding drainage is 53.91%. These results meet the requirements indicator of the ASD 7, WAC 4, WAC 5 and WAC 6 criteria thus get an additional 1 point for each criteria. The cost required to implement this solution is IDR 190,500,000.

3.9.4. OTTV

Performing Energy Efficiency and Conservation A building calculates its overall heat transfer value (OTTV). OTTV is a way of conserving energy in buildings that regulates the value of heat transfer in building walls (Iqbal, 2015). The calculation of the OTTV value is regulated in SNI 03-6389-2011

concerning energy conservation of building envelopes in buildings.

Factors that affect the OTTV value to comply with SNI are Building Orientation, Window Area, External Wall Area, and type of glass.

In the Munara 99 Sabilulungan Building, to increase the value of energy conservation, the use of low-e glass can reduce the heat load from the sun that enters and propagates on the walls of the building (Fatmala, 2019). So, it is recommended to use low-e solar control glass (Stoprav Vision 31T) because it has low shading coefficient of 0,22.

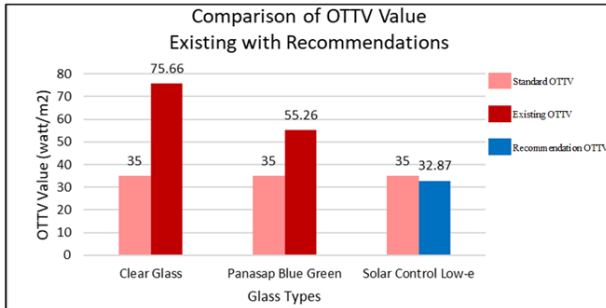


Figure 3. Comparison Chart of Existing OTTV Value with Recommendation

Source: Results of data processing (2023)

The OTTV value for solar control low-e glass type is 32.87 watts/m² < 35 watts/m², lower than that required in SNI 03-6389-2011. The type of glass used is solar control low-e (stopray vision 31T) with supplier PT. Asahimas. The area of glass to be replaced is 744 m². These results meet the requirements indicator of the EEC 1 criteria thus get an additional 3 point. The cost required to implement this solution is IDR 930,000,000.

3.9.5. Solar Panel

The recommendation to use solar panels is to reduce electricity consumption in the Munara 99 Sabilulungan Building. Munara 99 Sabilulungan Building can save energy consumption by 3% or 12.264 MWh annually by using Solterra 550 watt peak solar panels with total 36 units. These results meet the requirements indicator of the EEC 5 criteria thus get an additional 5 point. The cost required to implement this solution is IDR 400,000,000.

3.9.6. CO2 Sensor

The CO2 sensor ensures the amount of fresh air in the room and maintains the CO2 concentration below 600 ppm. The CO2 sensor is placed 30cm above the floor surface with a coverage radius of 78m². These results meet the requirements indicator of the IHC 1 criteria thus get an additional 1 point. The cost required to implement this solution is IDR 149,500,000.

3.9.7. No Smoking Sign

Recommendation to put 4 no smoking signs at each building entrance. These results meet the

requirements indicator of the IHC 2 criteria thus get an additional 2 point. The cost required to implement this solution is IDR 160,000.

3.9.8. Lux Meter and Sound Level Meter Tools

Recommendation to use lux meter tool to measure the intensity of light in a room and sound level meter tool to measure the noise level in a room. These results meet the requirements indicator of the IHC 7 criteria thus get an additional 1 point and indicator of the EEC 2 criteria thus get an additional 2 point. The cost required to implement this solution is IDR 300,000.

3.9.9. Recommendations Result

Categories that received additional score are: (1) ASD with additional 4 points, (2) EEC with additional 10 points, (3) WAC with additional 5 points and (4) IHC with additional 4 points. The final ranking of the recommendation results that can be obtained is gold with 64 points requires a cost of IDR 1,790,085,000.

4. CONCLUSIONS

The conclusion of this research is that the evaluation of the assessment of green building implementation in Munara 99 Sabilulungan Building using GBCI's greenship for new building v1.2 assessment tool consists of 6 categories with acquisition points, namely Appropriate Land Use (ASD) 8 points, Energy Efficiency and Conservation (EEC) 7 points, Water Conservation (WAC) 11 points, Material Sources and Cycles (MRC) 5 points, Indoor Health and Comfort (IHC) 6 points, and Building Environmental Management (BEM) 7 points. So that the results of the assessment of the implementation of green building in Munara 99 Sabilulungan Building get 44 points with a bronze rating. To improve the green building rating to a gold rating with final points totaling 67 points, this study provides improvement solutions that can be done including providing 3 bicycle parking lots for building employees, changing roofing material to red ceramic, providing roof tanks, using low-e solar control glass (stopray), using solterra solar panels, using rainwater as an alternative water source, installing CO2 sensors, installing no smoking signs in the building, renting a lux meter tool to calculate room lux and renting a dB meter to calculate noise levels. The cost required to implement the improvement solution is Rp 1,790,085,000 (One Billion Seven Hundred Ninety Million Eighty Five Thousand Rupiah).

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