

## EVALUATION OF THE APPLICATION OF GREEN CONSTRUCTION IN FACULTY OF ENGINEERING BUILDING, UIN CAMPUS 3 MALANG

**Victor Imanuel Tauho<sup>1</sup>, Deni Putra Arystianto<sup>2</sup>**

Construction Engineering Management Student, Department of Civil Engineering, State Polytechnic of Malang<sup>1</sup>, Lecturer of Civil Engineering Department, State Polytechnic of Malang<sup>2</sup>

Email: [victortauho@gmail.com](mailto:victortauho@gmail.com)<sup>1</sup>, [depe\\_arch@yahoo.com](mailto:depe_arch@yahoo.com)<sup>2</sup>

### ABSTRAK

*Pembangunan gedung di Indonesia, khususnya di Kota Batu, Jawa Timur, salah satunya yaitu gedung fakultas teknik kampus UIN Maulana Malik Ibrahim Malang - Kampus 3 merupakan salah satu proyek pembangunan yang berpotensi menjadi percontohan dalam penerapan prinsip bangunan gedung hijau (BGH). Pembangunan konstruksi seringkali tidak mempertimbangkan aspek keberlanjutan lingkungan. Penelitian ini bertujuan untuk mengevaluasi penerapan prinsip green construction pada proyek tersebut berdasarkan Permen PUPR No. 21 Tahun 2021, khususnya pada tahap pelaksanaan konstruksi. Metode yang digunakan meliputi pengumpulan data primer melalui observasi lapangan dan kuesioner kepada pihak terkait (owner, konsultan, dan kontraktor), serta data sekunder dari dokumen proyek. Analisis dilakukan berdasarkan empat aspek utama dalam penilaian BGH, yaitu: kesesuaian kinerja pelaksanaan konstruksi, proses konstruksi hijau, praktik perilaku hijau, dan rantai pasok hijau. Hasil penelitian diharapkan dapat memberikan gambaran tingkat implementasi green construction pada proyek serta rekomendasi praktis untuk peningkatan penerapannya. Dengan demikian, gedung fakultas teknik diharapkan dapat menjadi contoh pembangunan ramah lingkungan dalam sektor pendidikan tinggi.*

**Kata kunci :** Konstruksi Hijau, Permen PUPR No.21/2021, Bangunan Gedung Hijau, Evaluasi Konstruksi

### ABSTRACT

The construction of buildings in Indonesia, especially in Batu City, East Java, one of which is the engineering faculty building on the campus of UIN Maulana Malik Ibrahim Malang - Campus 3 is one of the development projects that has the potential to become a pilot in the application of green building principles (BGH). Construction development often does not consider aspects of environmental sustainability. This research aims to evaluate the application of green construction principles in the project based on Permen PUPR No. 21 of 2021, especially at the construction implementation stage. The methods used include primary data collection through field observations and questionnaires to related parties (owner, consultant, and contractor), as well as secondary data from project documents. The analysis was conducted based on four main aspects in the BGH assessment, namely: suitability of construction implementation performance, green construction process, green behavioural practices, and green supply chain. The results of the research are expected to provide an overview of the level of implementation of green construction on the project as well as practical recommendations for improving its application. Thus, the engineering faculty building is expected to be an example of sustainable development in the higher education sector.

**Keywords** Green Construction, Permen PUPR No.21/2021, Green Building, Construction Evaluation

## 1. INTRODUCTION

Development in Indonesia, especially in Batu City, often has a negative impact on the environment. Rapid economic growth triggers an increase in building construction, but often without considering environmental impacts. Therefore, a sustainable development approach is needed, by applying the concept of green construction. One of the efforts to mitigate these negative impacts is to apply the concept of green building or Building Green Building (BGH), which emphasises resource efficiency, waste reduction, and the comfort and health of the building environment.

The Faculty of Engineering Building of Maulana Malik Ibrahim State Islamic University Malang - Campus 3 is one of the government construction projects that has great potential to become an example of the application of BGH principles. With an area of 14,025 m<sup>2</sup>, this building is not only designed to support academic activities, but is also expected to be able to realise the concept of environmentally friendly buildings. The Indonesian government, through the Ministry of Public Works and Housing (PUPR), has issued *Permen PUPR No. 21 of 2021* concerning Green Building Performance Assessment, which serves as a reference in implementing green construction principles at the planning stage to construction implementation.

Several previous studies have discussed the application of the BGH concept in various projects. Nur Asriani Maulidianti (2024) identified the concept of green construction in the planning of the Tanjungpura University Central Library building and found that the building did not meet BGH standards due to a lack of points obtained in the assessment of building environmental management, conservation and energy efficiency, and water conservation. Research by Wahyudi et al. (2023) on the Rectorate Building of Pahlawan University also showed that the application of BGH was still not optimal, with the main obstacle being the lack of indicators used as a reference. Meanwhile, Firmansyah et al. (2024) redesigned the ICU building at Ngudi Waluyo Hospital to improve the BGH score, which shows the importance of integrating environmental aspects from the initial design stage. However, there is still a lack of research that specifically assesses the performance of the construction implementation stage based on *Permen PUPR No. 21 of 2021* comprehensively. Suropto et al. (2022) evaluated the extent to which the project met the green construction criteria according to the GreenShip New Building rating system version 1.2 from GBCI. However, the pollution category from construction activities was not fully compliant, particularly because liquid waste was not treated before being discharged into the environment. These findings indicate that although most green construction principles have been applied, improvements in waste management are still needed to achieve truly environmentally friendly buildings. Daffa

Mahardika et al. (2025) discuss the importance of implementing green construction strategies as part of sustainable development efforts. This study emphasises that the construction sector significantly contributes to environmental damage, particularly through energy consumption, material use, and waste production. The research findings show that the implementation of green construction strategies not only reduces environmental impact but also provides long-term economic benefits through resource efficiency and increased building value. The study recommends the need for supportive regulations, government incentives, and enhanced awareness and competence among industry stakeholders regarding green building concepts.

Based on this urgency, this study aims to: (1) identify the parameters used in the implementation of the BGH principles as stipulated in *Permen PUPR No.21 of 2021*; (2) evaluate the level of suitability of the implementation of green construction concepts at the implementation stage in the UIN Malang Campus Faculty of Engineering Building - Campus 3 project; and (3) provide strategic recommendations to improve the implementation of green construction in the project. The results of this study are expected to serve as a reference in the implementation of sustainable construction projects, especially in the higher education sector, as well as contribute to the development of environmental policies in the national construction industry.

## 2. METHODS

In research, the initial stage is to identify problems and determine case studies so that they can formulate problems that are in accordance with the subject matter. Then the objectives to be achieved in the research can be determined and the problem will be more focused and not deviate during implementation.

### Data Collection Methods

The data used are primary data and secondary data obtained from existing sources. The following are the primary data and secondary data required including:

#### a) Primary Data

Primary data includes:

1. Documentation  
Documentation of work items, execution, material utilisation and work monitoring
2. Questionnaire  
The results of the questionnaire related to performance appraisal in *Permen PUPR No.21 of 2021* concerning BGH Performance Assessment of the construction process of the engineering faculty building at the UIN 3 campus

#### b) Secondary Data

Secondary Data includes:

1. *Permen PUPR No.21 of 2021*
2. PBG Document
3. DED drawings, Shop drawings, As built & 3D drawings
4. Implementation Document
5. Contract Documents
6. Work Schedule
7. S-curve
8. Electricity usage data
9. Waste/landfill Retribution Data
10. Water Usage Data
11. Wastewater Examination Data
12. Air Quality Measurement Document
13. Noise Inspection Document
14. RMPK
15. Mutual Check (MC) Report
16. Implementation Report
17. Training certificate
18. Warranty certificate
19. Disaster management document
20. Operation document

#### Data Management Methods

The data that has been obtained is processed as follows:

##### a) Primary Data

Primary data obtained through distributing questionnaires to 15 respondents were processed quantitatively. Each answer in the questionnaire was scored based on three assessment categories, namely:

- Score 1: if the indicator has been fully implemented (answer “Yes”)
- Score 2: if the indicator is only partially applied
- Score 3: if the indicator has not been applied at all

The scores of all respondents on each indicator were calculated to obtain the mean and standard deviation. The mean is used to indicate the level of application of an indicator, while the standard deviation is used to measure the extent to which perceptions among respondents on the indicator are uniform or vary.

The results of this analysis are then mapped in a quadrant diagram consisting of four sections to categorise indicators based on their level of application and perceived consistency, as follows:

- Quadrant I: Large mean value, small standard deviation value → Large mean means that respondents give high value to the factor. Small standard deviation means that respondents agree with the answer. (applied)
- Quadrant II: Large mean, large standard deviation → Large mean means that respondents give high

value to the factor. Large standard deviation means that respondents disagree with the answer. (Partially applied)

- Quadrant III: Small mean, large deviation → Small mean means that respondents give low value to the factor. Large standard deviation means that the answer does not match the answer. (less applied)
- Quadrant IV: Small mean, small deviation → Small mean means that respondents give low value to the factor. Small standard deviation means that respondents agree with the answer. (not applied)

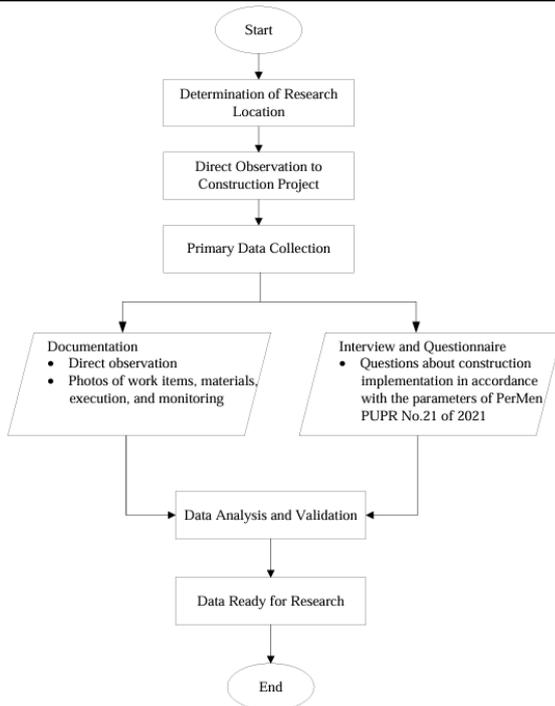
This mapping helps in identifying priority areas for improvement or strengthening the application of green building principles.

##### b) Secondary Data

Secondary data in the form of project documents were analysed qualitatively with verification techniques on the application of Green Building principles according to the criteria in *Permen PUPR No.21 of 2021*. The analysed documents include:

- Contract documents to adjust the suitability at the time of planning and at the time of implementation in the field
- Working drawings and technical specifications
- Implementation and quality control documents (quality of materials, work processes, and work results)
- Waste, water, energy and material management report
- *K3L (Keselamatan dan Kesehatan Kerja serta Lingkungan)* monitoring document
- Operational documents

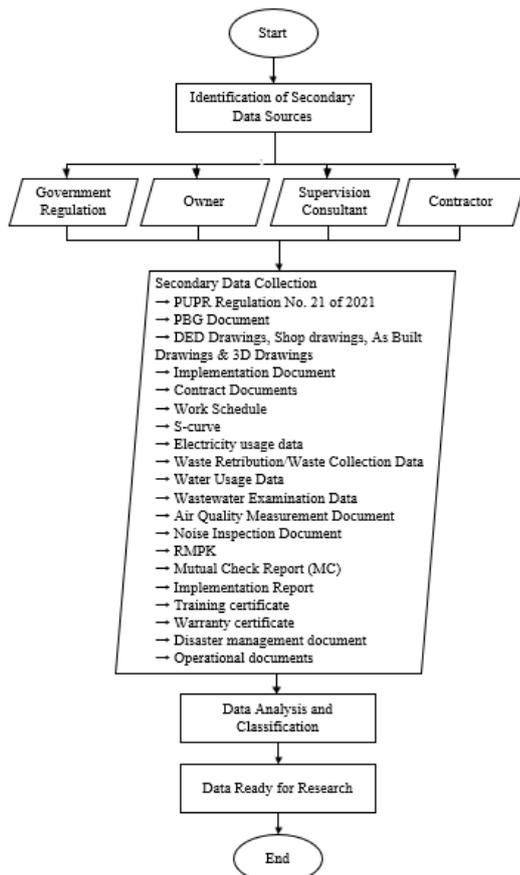
Each document was examined to ensure its existence and conformity with BGH assessment indicators, such as conformity of construction implementation performance, green construction process, green behavioural practices, and green supply chain. The results of this analysis are used as supporting evidence or confirmation of primary data, as well as the basis for developing recommendations for improving implementation in the field.



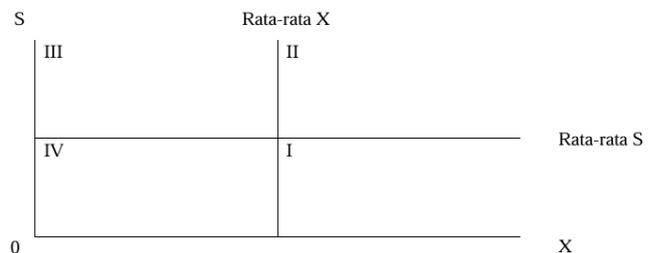
Flow chart primary data



Flow chart Building Performance Assessment



Flow chart secondary data



quadrant chart

Description:  
S = Standard Deviation  
X = Mean

## 2. RESULTS AND DISCUSSION

### a) Primary Data

Primary data was obtained through distributing questionnaires to 15 respondents who were directly involved in the construction project of the Faculty of Engineering Building, UIN 3 Malang Campus. The analysis was conducted by calculating the mean value and standard deviation of all answers, to evaluate the level of implementation of Green Building indicators at the construction implementation stage.

No	Position	Total	Percentage
----	----------	-------	------------

1	Cost Control	1	6,67%
2	SOM	1	6,67%
3	GSP	1	6,67%
4	Engineering	3	20,00%
5	PP Project Staff	1	6,67%
6	Drafter	1	6,67%
7	Field Coordinator	1	6,67%
8	Inspector	1	6,67%
9	Infrastructure Inspector	1	6,67%
10	MEP Inspector	2	13,33%
11	Architectural Inspector	1	6,67%
12	Technical Team Staff	1	6,67%
	<b>Total</b>	<b>15%</b>	<b>100%</b>

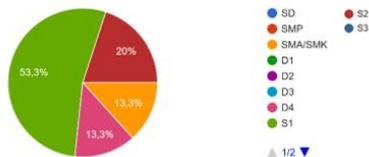
Source: Primary Data 2025

Respondent's position/responsibility

No	Latest Education	Total	Percentage
	SD	0	0%
	SMP	0	0%
	SMA/SMK	2	13,33%
	D3	0	0%
	D4	2	13,33%
	Starta 1 (S1)	8	53,33%
	Starta 2 (S2)	3	20,00%
	Starta 3 (S3)	0	0%
	<b>Total</b>	<b>15</b>	<b>100%</b>

Source: Primary Data 2025

Pendidikan Terakhir  
15 jawaban

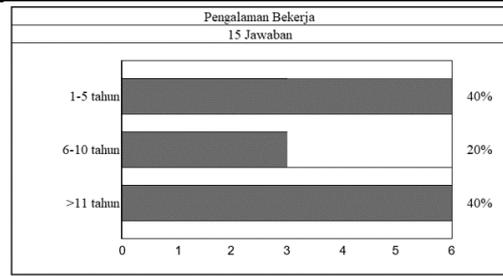


Source: Primary Data 2025

Respondent's last education

No	Experience	Total	Percentage
	1-5 tahun	6	40%
	6-10 ahun	3	30%
	>11 tahun	6	40%
	<b>Total</b>	<b>15</b>	

Source: Primary Data 2025



Source: Primary Data 2025

Respondents' work experience

Data processing results show:

- Aspects of Construction Performance Suitability obtained:

No	Yes	Partially	No	Total	Mean	Standard Deviation	Conclusion
Q1	10	5	0	15	1,67	0,49	Applied
Q2	11	4	0	15	1,67	0,49	Applied
Q3	12	3	0	15	1,67	0,49	Applied
Q4	10	5	0	15	1,80	0,41	Applied
Q5	13	1	1	15	1,33	0,62	Less Applied

Source: primary data, 2025

- Green Construction Process Aspects gained:

No	Yes	Partially	No	Total	Mean	Standard Deviation	Conclusion
Q6	12	3	0	15	1,87	0,35	Applied
Q7	12	3	0	15	1,80	0,41	Applied
Q8	13	2	0	15	1,87	0,35	Applied
Q9	14	1	0	15	1,93	0,26	Applied
Q10	11	4	0	15	1,20	0,68	Less Applied

Source: primary data, 2025

- Aspects of Green Behavioural Practices gained:

No	Yes	Partially	No	Total	Mean	Standard Deviation	Conclusion
Q11	5	8	2	15	1,80	0,41	Applied
Q12	11	4	0	15	1,73	0,46	Applied
Q13	13	2	0	15	1,87	0,35	Applied
Q14	10	5	0	15	1,87	0,35	Applied
Q15	13	2	0	15	1,67	0,49	Less Applied

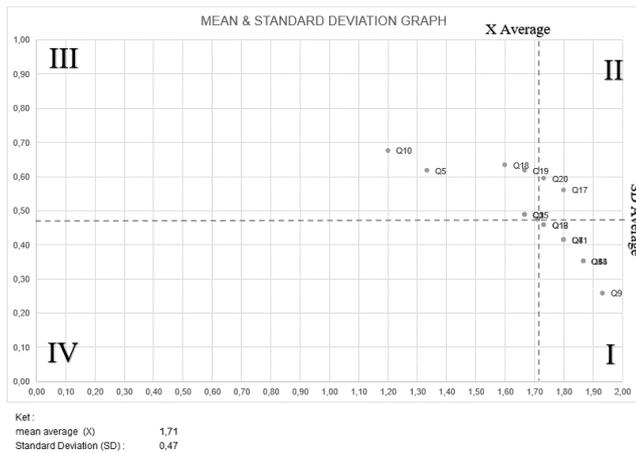
Source: primary data, 2025

- Green Supply Chain Aspects gained:

No	Yes	Partially	No	Total	Mean	Standard Deviation	Conclusion
Q16	5	8	2	15	1,73	0,46	Applied
Q17	10	1	0	15	1,80	0,56	Partially applied
Q18	10	4	1	15	1,60	0,63	Less Applied
Q19	11	3	1	15	1,67	0,62	Less Applied
Q20	12	2	1	15	1,73	0,59	Partially Applied

Source: primary data, 2025

In general, the values show that most of the Green Building indicators have been partially implemented, with the main focus on the technical aspects of implementation in the field, while aspects of sustainability in the supply chain and green behaviour still need to be improved. Quadrant mapping shows that indicators in Quadrants I and II should be maintained and expanded, while indicators in Quadrants III and IV are missing.



Quadrant diagram of mean & standard deviation of respondents' answers

b) Secondary data

The secondary data in this study was analysed using a checklist reference from *Permen PUPR No.21 of 2021* for the construction implementation stage. The checklist contains a number of parameters that must be met for a building to be categorised as a Green Building (BGH). The analysis was conducted by matching the project implementation documents against the items in the checklist, covering four main groups: suitability of construction implementation, green construction process, green work behaviour, and green supply chain.

No	Assessment Parameters	Standard points	Assessment Points
1	Appropriateness of construction implementation	74	56
2	Green construction process	60	40
3	Green work behaviour	20	18
4	Green supply chain	11	9
	Total	165	123

Here is the discussion:

1. Appropriateness of Construction Implementation

In this aspect, the project is assessed to fulfil most of the required documents, such as:

- Rencana Mutu Pelaksanaan Konstruksi (RMPK)
- Berita Acara
- Material quality testing documents

However, there are some drawbacks, such as:

- No technical planning criteria regarding water utilisation

2. Green Construction Process

The evaluation results show that the project has started to implement green working methods, characterised by:

- Use of building materials that meet environmentally friendly technical specifications
- Implementation of work using heavy equipment with an efficient work schedule
- Reuse of some used materials (e.g. formwork boards)

However, there are still shortcomings in the documentation, such as:

- Absence of water and energy usage logbooks in the field

In conclusion, this aspect has shown the intention of implementing green methods, but is still weak in terms of reporting and monitoring.

3. Green Work Behaviour Practices

K3L documents show that:

- The use of Personal Protective Equipment (APD) and work safety training is carried out regularly
- There are safety signs and smoking restrictions in certain areas
- However, the checklist mentions unmet needs:
- Reward & punishment programme for green work behaviour
- System for reporting violations of green practices

The facts on the ground show that this aspect has only been partially implemented, and is still not systematically documented.

4. Green Supply Chain

This aspect has some shortcomings, namely:

- Not yet conducted and have an energy audit report of the equipment.

Although there are some waste segregation practices and efforts to minimise residual materials, from an administrative aspect and supporting evidence, green supply chain indicators have not been fully met.

3. CONCLUSION

Based on the results of the research, discussion, and findings that have been described in the thesis entitled 'Evaluation of The Application of Green Building in Faculty of Engineering Building, UIN Campus 3 Malang', the following conclusions are arranged briefly, clearly, and in accordance with the sequence of research objectives.:

1. The parameters used in the application of green building principles refer to *Permen PUPR No. 21 of*

2021, specifically at the construction implementation stage, including: suitability of construction implementation performance, green construction processes, green behavioural practices, and green supply chains.

2. The evaluation results show that the level of application of green construction concepts in the UIN Faculty of Engineering Campus 3 Malang building project has largely been applied with mean values that are generally above ( $>1.02$ ) and relatively small standard deviations ( $<0.44$ ), but has not fully fulfilled all parameters optimally - especially in the green construction process aspect which shows the lowest application.
3. To improve the implementation of green construction, improvement efforts are needed such as improving water use management in the field, optimising environmentally friendly construction methods, strengthening green work culture, and reward & punishment programs for green work behaviour, so that the implementation of green building principles can be improved thoroughly and sustainably in accordance with the provisions of *Permen PUPR No. 21 of 2021*.

*Diri (APD) di proyek pembangunan aparteman Marigold at Nava Park*"

- [9] Rezky Anggunmulia, Denny S. Widyanto, Herry P. Chandra dan Soehendro Ratnawidjaja, (2022). "Kriteria bangunan hijau dan tantangannya pada proyek konstruksi di surabaya"
- [10] Satripto, Muhammad Haikal Abdi, Edison Hatoguan Manurung (2022), "Evaluasi Penerapan Green Construction Proyek Pembangunan Gedung Rektorat Kampus UIII"
- [11] Daffa Mahardika, Rizci Purna Dewanti, Arief Subagyo (2025), "Strategi Green Construction dalam Konstruksi Berkelanjutan Untuk Bangunan Gedung Ramah Lingkungan Dan Ekonomis di Indonesia"

## LITERATURE

- [1] Alvin Ridla Firmansyah, Jojok Widodo Soetjipto, Retno Utami Agung Wiyono, (2024) "Redesain Perancangan Gedung untuk Memenuhi Standar Bangunan"
- [2] Ricky Wahyudi, Hanantatur Adeswastoto dan Safni Marwa, (2023) "Analisis Penerapan Green Building Pada Bangunan Gedung Rektorat Universitas Pahlawan"
- [3] Tri Rahmi Nurman (2021), "Analisa Penerapan Gedung Bangunan Hijau Pada Tahap Pelaksanaan Konstruksi"
- [4] Kementerian Pekerjaan Umum dan Perumahan Rakyat, (2021). "SE Menteri Pekerjaan Umum dan Perumahan Rakyat Nomor 86 Tahun 2016 tentang Petunjuk Teknis Penyelenggaraan Bangunan Gedung Hijau"
- [5] Nurhasan Syah, M Glatman, R.R. Putra, Syaigul Haq, Anggrleka Maharani, Nelvi Salendra, (2021), "Green Building Konsep & Implementasinya"
- [6] Hafnidar A. Rani (2016), "Manajemen Proyek Konstruksi"
- [7] Kementerian Pekerjaan Umum dan Perumahan Rakyat, (2021). "Peraturan Menteri Pekerjaan Umum dan Perumahan Rakyat Nomor 21 Tahun 2021 tentang Penilaian Kinerja Bangunan Gedung Hijau"
- [8] Ita La Tho, Fenita Purnama Sari Indah, Lela Kania Rahsa Puji, (2019). "Analisis pengawasan petugas safety dengan kepatuhan penggunaan Alat Pelindung