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# GREEN RENOVATION & RETROFITTING AS A PHENOMENON TOWARDS SUSTAINABLE CONSTRUCTION: a Review

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**Abstract**: The discourses on climate change have become an issue in the construction industry in Indonesia for decades. Then, it becomes a consideration in the building design process. This paper focuses on renovation and retrofitting, which has differing meanings. The term renovation refers to the process of returning something to a good state of repair. In the construction industry, improvement relates to improving or modernizing an old, damaged, or defective building. The opposed to the term retrofitting, which is providing something with a component or feature not fitted initially. Retrofitting means providing something with a part not fitted during manufacture or adding something it did not have when first constructed. In this research, a case study is adopted as the data collection approach because this method can help the researcher demonstrate the relationship between the buildings and the tools that cause the green building assessment. The professionals from Java Island, Indonesia, as respondents. Architects, structural engineers, mechanical & electrical engineers, and construction managers work. It is aimed to see the phenomenon that occurs within sixteen years (2008-2020) for Professionals who do renovation & retrofitting work. Furthermore, it will identify sustainability initiatives that will mention the phenomena within ten years backward on renovating & retrofitting the current building to achieve the green assessment. The new scheme of phenomena is a finding that involves much thinking and practical consideration of the local institutional and building sector issues to the future as the target of the Green Renovation & Retrofitting on pre-construction to the current building. Moreover, this phenomenon will be related to developing renovation & retrofitting work in Indonesia that is expected to affect the professional profile in anticipation of global warming in the future.
**Keywords:** green practice, renovation, retrofitting, phenomenon, pre-construction

**Abstrak:** Wacana tentang perubahan iklim telah menjadi isu dalam industri konstruksi di Indonesia selama beberapa dekade. Kemudian menjadi pertimbangan dalam proses perancangan bangunan. Tulisan ini berfokus pada renovasi dan perkuatan, yang memiliki arti berbeda. Istilah renovasi mengacu pada proses mengembalikan sesuatu ke kondisi perbaikan yang baik. Dalam industri konstruksi, perbaikan berkaitan dengan peningkatan atau modernisasi bangunan tua, rusak, atau cacat. Kebalikan dari istilah retrofitting, yaitu menyediakan sesuatu dengan komponen atau fitur yang awalnya tidak dipasang. Perkuatan berarti menyediakan sesuatu dengan bagian yang tidak dipasang selama pembuatan atau menambahkan sesuatu yang tidak dimiliki saat pertama kali dibangun. Dalam penelitian ini, studi kasus diadopsi sebagai pendekatan pengumpulan data karena metode ini dapat membantu peneliti menunjukkan hubungan antara bangunan dan alat yang menyebabkan penilaian bangunan hijau. Para profesional dari Pulau Jawa, Indonesia, sebagai responden. Arsitek, insinyur struktural, insinyur mekanik & listrik, dan manajer konstruksi bekerja. Hal ini bertujuan untuk melihat fenomena yang terjadi dalam kurun waktu enam belas tahun (2008-2020) bagi para Profesional yang melakukan pekerjaan renovasi & perkuatan. Selanjutnya, akan mengidentifikasi inisiatif keberlanjutan yang akan menyebutkan fenomena dalam sepuluh tahun ke belakang pada renovasi & perkuatan bangunan saat ini untuk mencapai penilaian hijau. Skema fenomena baru merupakan temuan yang melibatkan banyak pemikiran dan pertimbangan praktis dari isu kelembagaan lokal dan sektor bangunan ke depan sebagai target Green Renovation & Retrofitting pada pra konstruksi bangunan saat ini. Apalagi fenomena ini akan terkait dengan berkembangnya pekerjaan renovasi & perkuatan di Indonesia yang diperkirakan akan mempengaruhi profil profesional dalam mengantisipasi pemanasan global di masa depan.
**Kata kunci:** green practice, renovasi, perkuatan, fenomena, pra konstruksi

## INTRODUCTION

Related to Building Regulations (Presiden Republik Indonesia, 2002). Article 3 mentioned that regulating aims for sustainable building. Due to this regulation, green development discourses have begun since 2002. Moreover, Public Works & Public Housing

Ministry issued for Implementation of Sustainable Construction and Green Building assessment.
Also, green evaluation in Indonesia uses the Public Works & Public Housing Ministry of the Indonesia Republic for Green Building and Circular Letters for the buildings. That focused on efficiency and effectiveness for building performance of sustainability. Southeast Asia has issued green development based on the World Green Building Council, such as in Indonesia, Malaysia, Singapore, Philippines, and Vietnam in 2013.

Moreover, it has four assessment systems for green development. They are Permen PUPR no. 21/PRT/M/2021 (BGH), Greenship (from GBCI), SE no. 01/SE/M/2022 (BGH), UI Greenmetric, and EDGE. BGH, Greenship, and EDGE focus on the building sectors, and UI Greenmetric focuses on the sustainability of green sites of the university.
For green evaluation, Kats (G. Kats & E, 2003; G. H. Kats & E, 2003) found that the benefits of green buildings are most significant for public entities with a specific responsibility to be concerned about broader societal benefits such as health. Programming, design & planning, construction, operation, and demolition (part, retrofit, or energy evaluation) used for new and existing building evaluation of green assessment in Indonesia, with mandatory, recommended, and voluntary categories. Towards broader societal benefits of health, based on thermal comfort.

Furthermore, Cappelletti (Cappelletti, Dalla Mora, Peron, Romagnoni, & Ruggeri, 2015) found the five primary policy targets for reducing greenhouse gas emissions from buildings. They are increasing the energy efficiency of new & current buildings, the energy efficiency of devices, emission-reducing in buildings, changing attitudes & behavior, and renewable energies.

It means increasing the energy efficiency of new and existing buildings, focusing on building skin, appliances, attitudes & behavior, and renewable energies. Moreover, this is based on research on an existing building, particularly post-occupancy.

Later, Zhihua extended their analysis and revealed that conventional technologies used in the case study office building, such as improving the insulation of the building envelope and retrofitting the HVAC system. Similarly, operation strategies are essential in capitalizing on the benefits of building energy-efficient retrofitting. After the building's energy-efficient retrofitting, the staff can adjust the fresh air rate according to their demands and regulate the workplace temperature to a comfortable level via the ceiling fans. According to Airaksinen (Airaksinen & Matilainen, 2011), current office buildings are becoming more and more energy-efficient. Notably, while the importance of heating is decreasing, the share of electricity use is still increasing. Also, Zhenjun Ma (Ma, Cooper, Daly, & Ledo, 2012) found a systematic methodology for appropriate retrofits of existing buildings for energy efficiency and sustainability. Then, an overview of previous studies investigating and evaluating energy performance and economic feasibility was vided.

Then it is shown that it is possible to rank or rate buildings or retrofit scenarios according to multiple criteria. So, Fowler (K M Fowler & Rauch, 2006; Kimberly M. Fowler, Rauch, Henderson, & Kora, 2010) stated that sustainable building rating systems are used to examine the performance or expected performance of a 'whole building' and translate performance assessment into a tool that can be used to compare the building performance of other buildings or a performance standard.

## LITERATURE

### Renovation

James (Douglas, 2006) found that the consequences of current and future obsolete and redundancy must be considered in any adaptation proposal to respond to the obsolescence and redundancy. These are divided into three main groups: economic, technical, and functional. Economic obsolete occurs because maintenance has become unreasonably costly or disruptive and when acceptable (cheaper) alternatives to maintenance are available. The primary economic consequence is a built asset's capital/rental value depreciation.

Technical obsolete implies that the performance of the building is deficient or otherwise lacking, leading to dilapidation and if left unattended, dereliction. Functionally, a structure usually becomes underused because of obsolescence. Complete vacancy, however, is the most noticeable effect of building redundancy.

### Retrofitting

The current building retrofits predominantly focus on energy and cost efficiency at an individual or building component scale. While the aspirations of these retrofits are crucial to the sustainable development of our built environment, we can and need to do better. Many argue that we need a shift in worldview from mechanistic to regenerative, and to do so, we must engage with the living world by (re)aligning human and natural systems. A regenerative design model that explores the critical interactions between physical, human, and natural systems is developed to achieve these proactive outcomes. A set of regenerative design principles for building retrofits is proposed to emphasize the positive interactions an existing building can have with its surrounding environment. This paper will explore how an energy-efficient building retrofit can improve occupant health and well-being and restore and enhance local ecosystems. A detailed example will then demonstrate the principles to shift how designers and decision-makers view the building retrofit design process (Craft W. et al., 2017).

Moreover, Nandish (Kavani & Pathak, 2014) found that retrofitting an existing building into a green building taking into account the aspects of energy, water, and materials along with cost considerations such that the occupant well-being, environmental performance, and economic returns are improved. In the present project, we have proposed to give credits to rate the chosen building for its various green features according to the rating system of LEED and suggest measures to improve the green performance of the building.

## METHODOLOGY

### Data Approaches

In this research, a case study is adopted as the data collection approach because this method can help the researcher demonstrate the relationship between the buildings and the tools that are causing the green building assessment.

Most importantly, the study on the strategy of green achievement will bring to the organization and used by stakeholders in managing the green building achievement for public or government buildings can be more conducted and valid post-operation.
According to Patton, criterion sampling involves selecting cases that meet some predetermined criterion of importance (Patton, 2002). Respondent has taken from three provinces of Java Island in Indonesia. They are architects, mechanical & electrical engineers, structural engineers, & construction managers who are consulting, technical, advocating, and supporting to increase capacity and competence of building the organization for the building sector and stakeholders. There are three respondents areas: Eats Java, Yogyakarta, and West Java.

According to Rashid (Rashid et al., 2011; Reza Bin Esa et al., 2011), put some initiatives on energy efficiency and greening of government buildings to improve the population's quality of life. Moreover, there will be more concerted efforts in formulating action plans to further accelerate the energy efficiency and green building agenda for government buildings.

## RESULT & DISSCUSSION

The discourse on climate change has become an issue in the construction industry in Indonesia for decades. Then, it becomes a consideration in the building design process. This paper focuses on renovation and retrofitting, which has differing meanings. The term renovation refers to the process of returning something to a good state of repair. In the construction industry, improvement relates to improving or modernizing an old, damaged, or defective building. The opposed to the term of retrofitting, which is providing something with a component or feature not fitted initially. Retrofitting means giving something with a part or not fitted during manufacture or adding something it did not have when first constructed.

The respondents are architects, structural engineers, mechanical and electrical professionals from Java Island, Indonesia. Recognizing the awareness of green achievement is the purpose of the research. This state of the art provides how researchers understand green awareness. To achieve this purpose, studies on achievement strategies carried out by researchers within seven years in different countries are presented in Table 1.

The emphasis is a paradigm found in previous studies for the current sixteen years as state-of-the-art results. Then, this study found the gap in empirical phenomena in the green development of Indonesia.
According to numerous previous studies on the achievement strategy of green development, most of the strategies to achieve that focus from design to operation stage consider developing green and reducing energy consumption as findings by researchers. A few considerations show it as a tool component. Which emphasizes knowledge, awareness, attitude, and stakeholder role in the building sector, done by researchers as phenomena within the current eighteen years?
Empirical Phenomena

Then it is shown by Roulet (2002) that it is possible to rank or rate buildings or retrofit scenarios according to more than one criterion. Moreover, Fowler (K M Fowler & Rauch, 2006) the sustainable building rating systems used to examine the performance or expected performance of a whole building and translate performance assessment into a tool that can be used to compare the building performance of other buildings or a performance standard.

They are related to the green evaluation studies to obtain a strategy for achieving thermal comfort through assessing of green achievement approach. Hence, selected professionals will use respondents based on climate and geographic characteristics in Indonesia, to evaluate their practices on preconstruction terms.

**Table 1.** The Components of Green Renovation & Retrofitting

| NO. | TARGETS ASSESSMENT | COMPONENTS | AUTHORS | | | | | | | | | | | | | | | | | | EMPHASIS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | James Douglas (2002) | Abbaszadeh, et. al. (2006) | Energy Star (2010) | Kim M. Fowler et al. (2010) | Michalis Gr. V. et. al. (2011) | Suresh B. Sadineni, et. al. (2011) | Max Paul Deuble, et. al. (2012) | Suresh B. Sadineni, et. al. (2011) | Alin-Enver Hoblea, et. al. (2014) | T Nosizo Sebake (2014) | Backtazh Fazlrabi (2015) | Backtazh Fazlrabi (2015) | Maija Krizmane, et. al. (2016) | Rajeev Ruparathna et al. (2016) | Zhihua Zhoua et al. (2016) | Tianzhen Hong, et. al. (2016) | ABCB (2016) | Ministry of BIE (2018) | |
| 1 | Functional Improvement of Building Energy & System | in the equilibrium of temperature indoor & outdoor | ✓ | | ✓ | | ✓ | ✓ | | ✓ | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | - human comfort<br>- building performance |
| 2 | | climates & geographical conditions | | | | | ✓ | | | ✓ | | | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | | |
| 3 | | materials of wall & floor | | | | | ✓ | | | ✓ | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | |
| 4 | | human comfort | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | | ✓ | ✓ | ✓ | | ✓ | ✓ | |
| 5 | | energy performance | | | | | ✓ | | | ✓ | | | ✓ | | ✓ | ✓ | ✓ | ✓ | | | |
| 6 | | technology tools | | | | | ✓ | | | ✓ | | | ✓ | | ✓ | ✓ | ✓ | | ✓ | | |
| 7 | Interior Function Improvement | personal control over operable windows | | ✓ | | | ✓ | | ✓ | | | | | | | | | | | | human attitude in building operation |
| 8 | | multi or single space | | | ✓ | | | | | | | | | | | | | | ✓ | | |
| 9 | | cleanliness & maintenance | | | | ✓ | | | | | | | | | | | | | | | |
| 10 | | lighting, acoustic & ventilation | ✓ | | | ✓ | | ✓ | ✓ | | | | | | | | | | ✓ | | |
| 11 | | attitude & education | | | | | | | ✓ | | | ✓ | | | | | | | | ✓ | |
| 12 | Building Envelope Improvement | routine & response maintenance | | | | | | ✓ | | | | | | | | | ✓ | | ✓ | ✓ | indoor temperature control |
| 13 | | building management | ✓ | | | | | ✓ | | | | | | | | | ✓ | | | | |
| 14 | Whole Building Improvement | reduce negative environmental impact | | | | | ✓ | | | | | | | | | | □ | | ✓ | | the self-control of the building by stakeholders' role |
| 15 | | satisfaction | | | | | | | | | | | | | | | ✓ | | ✓ | | |
| 16 | | software app usage | | | | | | | | | | | | | | | | ✓ | | | |
| 17 | | role of stakeholders | | | | | | | | | | | | | | | | | ✓ | ✓ | |
| 18 | Change Of Building Usage | function & physical attributes | ✓ | | | | | | | | | | | | | | | | ✓ | | upgrading |
| 19 | | upgradable | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |

Source: Survey, 2019 (Juliardi, Misnan, Khalid, & Haron, 2019b)

| Professionals | Location | Registered Member | Certified | Green Certified | | Age (years old) | | | Green Working Years Average (2008-2018) | | Green Rating Tools | | Position on Projects | | | Project Location (AMSL) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | GBCI | Others | 30-40 | 40-50 | >50 | >2 projects | Never | KemenPU PR RI | Greenship 1.2 | Principal | Assistant | Project Engineer | Bandung (700m) | Yogyakarta (110m) | Surabaya (2m) | Others |
| - Architect<br>- Structural Engineer<br>- MEP Engineer<br>- Construction Management | West Java | 86% | 75% | 47% | 8% | 36% | 42% | 19% | 44% | 50% | 33% | 64% | 42% | 25% | 25% | 56% | 11% | 6% | 22% |
| | Yogyakarta | 100% | 60% | 40% | 0 | 20% | 0% | 80% | 0 | 80% | 40% | 20% | 40% | 0 | 20% | 20% | 60% | 0 | 20% |
| | East Java | 100% | 56% | 11% | 0 | 67% | 22% | 11% | 0 | 100% | 0 | 33% | 22% | 22% | 0 | 11% | 0 | 33% | 11% |

Source: Survey, 2019 (Juliardi, Misnan, Khalid, & Haron, 2019a)

Note: Professionals Phenomena on Green Renovation & Retrofitting Practices.

Related, the government has an essential role in issuing the green rules for buildings implementation towards green achievement. Indonesia has a green policy (M. P. RI, 2021) and a Circular Letter (D. C. K. RI, 2022) to guide the building stakeholder such as architects, engineers, and building management. Green Building is defined as a building with criteria and real performance significantly on water and energy saving and other sources through green rules to function and classify its building management. It has staged such as programming, planning & designing, construction, operation, and demolition. Moreover, it is divided into three categories: mandatory, recommended, and voluntary for greening achievement.

According to the research focusing on renovation and retrofitting, in Building Regulation above stated that improvement is the activity of the demolition stage. Demolition means demolishing a part or full of the buildings, components, materials, and or facility that has a similar meaning to a renovation. Nevertheless, all retrofitting is based on repairing a green achievement.

## CONCLUSION

Professional characteristics have an impact on what they do in the area. The table shows that professional practice (50 professionals) in each region still has minimal potential. The average competence is already registered in the area (75% west java, 100% Yogyakarta, and 100% east java). In comparison, that is certified not more than 75% in west java, 60% in Yogyakarta, and 56% in east java. Furthermore, it has shown in green certificates that are not owned by professionals (11% - 47%).

In this study, pre-construction work will be the goal of how professionals work according to their competencies and how professionals recognize the pre-construction work scope and readiness to start work. The table shows only a few professionals with work certificates for green buildings. Still, those who practice architecture found that none in Yogyakarta and Surabaya had certified green buildings.

## REFERENCES


Airaksinen, M., & Matilainen, P. (2011). A Carbon Footprint of an Office Building. *Energies*, *4*(8), 1197–1210. https://doi.org/10.3390/en4081197

Cappelletti, F., Dalla Mora, T., Peron, F., Romagnoni, P., & Ruggeri, P. (2015). Building renovation: Which guidelines could be proposed for policymakers and professional owners? *Energy Procedia*, *78*, 2366–2371. https://doi.org/10.1016/j.egypro.2015.11.189

Douglas, J. (2006). *Building Adaptation* (second ed.). Edinburgh - UK: Spon Press.

Fowler, K M, & Rauch, E. M. (2006). *Sustainable Building Rating Systems Summary*. https://doi.org/PNNL-15858

Fowler, Kimberly M., Rauch, E. M., Henderson, J. W., & Kora, A. R. (2010). *Re-Assessing Green Building Performance: A Post Occupancy Evaluation of 22 GSA Buildings*. USA: U.S. General Services Administration. https://doi.org/10.2172/1029438

Juliardi, R. D., Misnan, M. S., Khalid, A. G., & Haron, L. (2019a). Recognizing Building Components to Achieve Green Performance for Renovation and Retrofitting Works. In *International Conference on Green Energy and Environment (ICOGEE)* (pp. 3–4). Pangkal Pinang.

Juliardi, R. D., Misnan, M. S., Khalid, A. G., & Haron, L. (2019b). The Problems in Renovation & Retrofitting Works to Achieve Green Building Performance: a Review. In P.-F. UTM (Ed.), *International Graduate Conference of Built Environment & Surveying* (1st ed., Vol. 1, pp. 295–303). Johor Bahru, Malaysia.

Kats, G., & E, C. (2003). *The Cost and Financial Benefits of Green Buildings* (Vol. 232).

Kats, G. H., & E, C. (2003). *Green Building Costs and Financial Benefits*. Massachusetts - USA: Environmental Business Council of New England, Inc. Retrieved from http://www.bankerandtradesman.com/pub/4_91/commercial/185123-1.html

Kavani, N., & Pathak, F. (2014). Retrofitting of an Existing Building Into a Green Building. *International Journal of Research in Engineering and Technology*, *03*(06), 339–341. https://doi.org/10.15623/ijret.2014.0306062

Ma, Z., Cooper, P., Daly, D., & Ledo, L. (2012). Existing building retrofits: Methodology and state-of-the-art. *Energy and Buildings*, *55*, 889–902. https://doi.org/10.1016/j.enbuild.2012.08.018

Patton, M. Q. (2002). *Qualitative Research and Evaluation Methods: 3rd edition (book review)*. Thousand Oaks, USA: Sage Publication, Inc.

Presiden Republik Indonesia. UU RI no. 28 - 2002: ttg Bangunan Gedung, Pub. L. No. 28/2002 (2002). Indonesia.

Rashid, Y. R., Sulaiman, M. S., Aziz, A., Selamat, H., Mat Yani, A. H., & Kandar, M. Z. (2011). Greening government's office buildings: PWD Malaysia experiences. *Procedia Engineering*, *21*, 1056–1060. https://doi.org/10.1016/j.proeng.2011.11.2111

Reza Bin Esa, M., Marhani, M. A., Yaman, R., Arzlee, A., Hanisah, H. N., Rashid, N., & Adnan, H. (2011). Obstacles in Implementing Green Building Projects in Malaysia. *Australian Journal of Basic and Applied Sciences*, *5*(12), 1806–1812. https://doi.org/10.1016/j.vhri.2015.12.002

RI, D. C. K. Surat Edaran no. 01/SE/M/2022: ttg Petunjuk Teknis Penilaian Kinerja Bangunan Gedung Hijau (BGH), Indonesia.

RI, M. P. PerMen PUPR No 21/PRT/M/2021: ttg Penilaian Kinerja Bangunan Gedung Hijau, Indonesia.