Post occupancy evaluation for green building certificated (case study UGM law centre building)

D N A Nugradi  
Architectural Study Program, Faculty of Engineering Universitas Negeri Semarang  
didiknop@mail.unnes.ac.id

Abstract. Green building has recently become the main approach in the construction of a building, including in Indonesia. A building that has been certified as a green building does not mean that it has all the components that meet the requirements of comfort, health and safety, especially if the main goal for certification is to pursue energy efficiency in buildings. The purpose of this study is to describe the level of user satisfaction of the UGM Law Learning Center building after the building is certified as a green building. This type of research is a post-occupancy evaluation (POE) in the form of survey research with a quantitative descriptive approach. The steps to be taken are: identification of building performance based on the EDGE instrument, identification of building data, interviews, observations, data search through questionnaires, quantitative descriptive analysis. The results of the study indicate that, in general, the spaces in the building have met the activity needs and user comfort, but there are several aspects that need to be improved, namely: visual comfort, cleanliness, and spatial efficiency.

1. Introduction  
The trend of green building has been widely discussed and applied to buildings in Indonesia. Green Building Council Indonesia (GBCI) has started since 2009 by educating, applying environmental best practices and facilitating the transformation of a sustainable global building industry. GBCI has a concern for the application of the green building concept, especially in the building sector in Indonesia. GBCI is an established member of the World Green Building Council (Word GBC) based in Toronto, Canada. There are 33 buildings that have received green building certification from GBCI based on the Greenship rating tool, from 2009 to 2018 in Indonesia.

The Law Learning Centre Building of Gajah Mada University (UGM) has received a green building Certificate from the Green Building Council Indonesia based on the EDGE rating tool. The building uses resource-efficient design features and technologies to reduce environmental impact and reduce operating costs. Energy savings for lighting are made with LED lighting, reflective paint, and solar photovoltaic, while savings for water resources are made through a clean water network system that saves water, as well as a grey water recycling system.

Even though a building has received green building certification, it does not mean that the problems related to the health aspect in the space are completely gone. Olanrewaju and Hussain [1] stated that even though the building received a “Platinum” green certification level, it still received a score of zero out of 15 indoor environmental quality values. The use of pesticides in buildings can cause poor indoor air quality, this is due to the fact that there is no obligation to inform about the use of chemicals that have been used. This proves that not all green buildings have good environmental values, because
perhaps green buildings are more focused on reducing development costs. To overcome this problem, it is necessary to use the Post-Occupancy Evaluation (POE) method.

POE is an effective way for architect and parties involved in building procurement to reduce environmental impacts. This method can also reduce construction costs by reducing building environmental problems.

2. Literature Review

2.1 Green Building. As a result of climate change, green building is expected to be a solution to overcome the increasingly limited resources for human life. Green building is a concept for saving and optimizing resources, controlling pollution, which also takes into account the health and comfort needs of building users.

The Green Building Council Indonesia (GBCI) as a pioneer of the green building movement in Indonesia formulates several measurable criteria to assess and facilitate the realization of green buildings by grouping the criteria into several categories, i.e. (1) Appropriate Site Development – ASD; (2) Energy Efficiency and Conservation – EEC; (3) Water Conservation – WAC; (4) Material Resources and Cycle – MRC; (5) Indoor Health and Comfort – IHC; (6) Building Environment Management – BEM [2-3].

Each category has several criteria, both as prerequisite criteria and criteria that get an assessment. ASD category has criteria as a prerequisite that must be met, namely the basic green area, while the criteria for assessment include: site selection, community accessibility, public transportation, bicycle user facilities, landscaping on land, microclimate and runoff water management. The EEC category has prerequisite criteria, namely: sub-meter installer and OTTV (overall thermal transfer value) calculation.

The criteria for the EEC category which are criteria for assessment include: energy saving measures, natural lighting, ventilation, impacts of climate change, and renewable energy in the site. The WAC category has prerequisite criteria, namely: water meter and water use calculation. The assessment criteria are: reduction in water use, water features, water recycling, alternative water sources, rainwater storage and efficient use of landscape water. The MRC category has prerequisite criteria, namely: fundamental refrigerants. The criteria that are assessed for this category are: use of used materials, environmentally friendly materials, use of refrigerants without ODP, certified wood, pre-fabricated materials, and regional materials. The IHC category has prerequisite criteria, namely, introduction of outside air, while the assessment criteria include: monitoring of CO2 levels, control of cigarette smoke in the environment, chemical pollutants, view of the outside of the building, thermal comfort, and noise levels. The BEM category has prerequisite criteria, namely basic waste management, and assessment criteria, namely: GP (Green Professional) as a member of the project team, pollution and construction activities, advanced waste management, good and correct commissioning systems, submission of green building data, agreements in carrying out fit out activities, and surveying building users.

2.2 Post Occupancy Evaluation (POE). POE is one of the methods to evaluate the performance of buildings after being occupied. This activity focuses on users and building needs. Based on the results of the POE, it is hoped that it will be an input for a better building in the future. According to Barlex, POE is one way to provide feedback, based on an evaluation of the use of the building for better development in the future [4]. In line with this, Preiser stated that POE is a tool that allows building managers to systematically evaluate technical aspects or building performance [5].

In implementing the POE, researchers must first set clear parameters related to what will be observed. Zimring et al. stated that accessibility, aesthetics, cost-effectiveness, functionality, productivity, security and safety as well as sustainability as an assessment factor in implementing POE [7]. In line with this, according to the American Society for Testing and Materials, the assessment factors are grouped into two main groups. The first factor is user performance, which consists of user satisfaction and productivity, as well as security and safety. The second factor is building performance based on user ratings such as: air quality, thermal comfort, space comfort, ergonomics, privacy, noise, lighting and
aesthetics [7], while Mundo, Valerdi and J Sosa stated that POE includes interior quality, lighting, temperature, noise, space efficiency and energy consumption [8].

3. Methods
This research is quantitative research in which a survey is conducted to collect data on the opinions of building users through a questionnaire. Because the survey cannot be carried out directly on building objects and meet building users directly (offline), due to restrictions on activities in the DI Yogyakarta Province (Covid 19 Pandemic), the questionnaires are distributed online using the google form filling method by respondents. Respondents are students of the Faculty of Law UGM who have used or have activities in the Law Center Building. The number of respondents was 40 people (approximately 10% of students from the Faculty of Law who had been active in the building) and the selection of respondents was done randomly. The data analysis technique uses the following formula in Table 1.

4. Results
The questionnaire used to obtain building user perception data consists of 14 questions which are indicators of building performance based on perceptions for factors: materials and finishing, room ventilation (air ventilation), visual comfort, cleanliness, natural lighting, artificial lighting, thermal comfort, acoustics space, interior layout, water use, rainwater management, energy use, security systems, and strategic locations. Based on the results of data processing, it can be said that, users have a good perception of 65% (very positive 17.5% and positive 47%), and have a bad perception of 35% (5% less positive and 30% negative). The results are given in Table 2.

When viewed from each factor, of the 14 factors there were 6 factors that had good perceptions (2 very positive factors and 4 positive factors), and 8 factors had poor perceptions (6 less positive factors and 2 negative factors). Factors that need special attention, because they have negative perceptions, namely: water use and building layout. The results are given in Table 3.

5. Conclusion
Buildings that have received Green Building certification do not always get a fairly good perception assessment result from building users. There are several factors that need to be improved or improved. In the case of the Law Learning Center UGM building, in general, users already have a good perception of the building's performance (65%), especially related to the demands as a building that is included in the green building category, but there are several factors that need to be improved, namely the spatial
layout of the building and water usage. Based on this research, it is recommended that further research be conducted by taking a larger number of samples, and by using direct interviews with respondents not online.

**Table 3. User Perception Based on Supporting Factors**

| No | Items                                                                 | Perception        |
|----|-----------------------------------------------------------------------|-------------------|
| 1  | Use of materials and finishing in buildings                          | less positive     |
| 2  | Indoor air quality and ventilation systems                            | positive          |
| 3  | User visual comfort (users have easy access to see outside the room) | less positive     |
| 4  | Cleanliness (easy to do cleaning business).                           | positive          |
| 5  | Sufficient natural light                                              | very positive     |
| 6  | Artificial lighting                                                  | very positive     |
| 7  | Thermal comfort in both air-conditioned and non-AC rooms              | less positive     |
| 8  | Acoustic condition of the room (minimum noise from outside)          | positive          |
| 9  | Layout in the building                                                | negative          |
| 10 | Efficient use of water                                               | negative          |
| 11 | Rainwater management                                                 | less positive     |
| 12 | Efficient use of energy, both for air conditioning, lighting and equipment | less positive |
| 13 | Good security system management                                       | less positive     |
| 14 | Strategic building location, close to supporting facilities and infrastructure | positive |

**References**

[1] Olanrewaju A A and Chong Y S 2021 *J Hous and the Built Environ* 36 825–57
[2] GBCI 2019 Green Building Council Indonesia [https://gbcindonesia.org/](https://gbcindonesia.org/)
[3] Ardhiansyah I and Azizah R 2020 *Sinektika Jurnal Arsitektur* 15 79-86
[4] Barlex M, Blyth P and Gilby A 2006 *Guide to Post Occupancy Evaluation* (London: Melvyn Barlex)
[5] Preiser W F E 2006 *Facilities* 13 19-28
[6] Anonymous 20009 *ASTM Standards on Whole Building Functionality and Serviceability* (Pennsylvania: Astm Intl)
[7] Zimring C, Rashid M and Kampschroer K 2014 *Facility Performance Evaluation (FPE)* [https://www.wbdg.org/resources/facility-performance-evaluation-fpe](https://www.wbdg.org/resources/facility-performance-evaluation-fpe)
[8] Mundo-Hernández J, Valerdi-Nochebuena MC and Sosa-Oliver J 2015 *Frontiers of Architectural Research* 4 330– 40