Conference Paper

Parameter of Green Concept Implementation in Residential Building: A Community Perspective

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Received: 24 May 2019
Accepted: 25 July 2019
Published: 4 August 2019

Publishing services provided by Knowledge E

Selection and Peer-review under the responsibility of the ISTECS 2019 Conference Committee.

Abstract

Residential buildings significantly become one of the factors that cause the problem of global warming. Implementation of green building concept can become a solution for residential building, which can reduce environmental impact due to global warming. In the development of the green building concept, the view of the community as a residential user should be one of the considerations to achieve the target. This paper will describe the results of research about community perspective with various backgrounds that shape the factors that influence the application of green concepts and formulate it into green concept parameters that can be applied in residential development. The purpose of this research is to develop a green building concept implementation for the residential building based on a community perspective. This research was conducted using the qualitative and quantitative mixed method. For the qualitative approach, data were analyzed using open coding, axial coding and selective coding is taken from previous research. Quantitative methods were performed using Principle Component Analysis (PCA) and factor analysis. Data were collected by an online questionnaire survey that was distributed using the snowball sampling method. The results showed that there are ten dimensions parameters of green concept implementation for residential buildings from the community perspective.

Keywords: green building, green concept, community perspective, residential

1. Introduction

Climate change is increasingly felt today, which is marked by an increase in extremely warm temperatures in the various country over the world. The rise in temperature has reached 0.85 (0.65-1.06) ° C during the period 1880-2012 calculated from the combined data of surface temperature of the land and sea, according to the Intergovernmental

Panel on Climate Change (IPCC) report [1]. The limitation of the global average temperature rise continues to be campaigned by the United Nations Framework Convention on Climate Change (UNFCCC) not to exceed 2° Celsius in the 21st century [2].

A sector that has a significant role in earth temperature rise one of which is the building. According to EECCHI data, the building sector absorbs about 40 percent of the world's energy resources. In Indonesia, the building sector consumes 50 percent of total energy expenditure and more than 70 percent of overall electricity consumption [3]. Also, the building sector also contributes to the production of 30 percent of Greenhouse Gas (GHG) emissions in Indonesia, based on the amount of energy consumption [4].

Residential buildings are a type of building that consumes vast amounts of energy; this is demonstrated through the level of electricity subscribers, of which 90 percent of customers come from residential and other types of customers in the business, social, office and industry sectors [5]. Other data also show that residential buildings produce abundant CO2, reaching about 10 to 30 tons of CO2 per year [6]. If associated with the population growth of the Indonesian Central Bureau of Statistics [7], the number and rate of population growth over the next 25 years continue to increase by 238.5 million in 2010 to 305.6 million in 2035. Therefore, increased energy consumption and the production of CO2 residence in the next 25 years will be even bigger.

Some of the data previously presented indicate that the housing sector has significantly factors causing global warming problems. These problems lead to the need for sustainable development efforts in residential houses that aim to reduce the impact of global warming due to climate change. One of the struggles that can be done is to create, evaluate and collect ideas of the sustainable development concept and framework from various perspectives.

This study aims to see the perception or view of the community as home users with different backgrounds and formulate it into aspects or parameter dimensions of the green concept that should be applied in housing. The green building concept and framework from the community's perspective will be compared with existing ideas to see the difference. It can be used as an evaluation material or input for the development of concepts, regulations, and assessment of greenhouse building more precisely targeted to achieve the target of global temperature decrease in the future.

2. Green Building Concept Development

Sustainable development was first proposed and defined by the Brundtland Commission (1987) as "Sustainable development is a development that meets the needs of the present without compromising the ability of future generations to meet their own needs" [8, 9]. One derivative of the concept of sustainable development is the green building concept. Green building is considered as one of the solutions for a housing development that can reduce the impact of global warming. The concept of green building in the early days of its application focus on public buildings, but with the identified great benefits derived from the implementation of the idea, currently, the concept of green building is extended to urban planning, region, housing, etc. [10]. As a result of the growing interest in green building concepts and practices, several countries in the world developed tools to design and measure performance buildings that apply this green concept so that it can be used by governments, professionals, and developers [11].

In Indonesia, Green Building Council Indonesia (GBCI) has made a green concept assessment tool for home building (landed) that is Greenship Home in the form of self-assessment. This assessment tool was made by GBCI from an expert's perspective by comparing the assessment tools applied in other countries and adapting them for the needs of locality in Indonesia.

Two views generally become the basis of the application of the assessment of the green building is sustainable development (triple bottom line) and regenerative design [11]. The concept of sustainable development is always related to three main issues, including social, economic, and environmental aspects. While the concept of regenerative design is more focused on saving natural resources such as energy, water, and materials. For example, the IFC EDGE Green Buildings Certification System focuses on savings that reduce energy, water, and materials consumption and perform cost and operational cost calculations [12].

Green building concepts and frameworks are still evolving to better target and not by making performance indicators more ambiguous and challenging, but through increasing influence, linkage and contextualization with users [11]. Influence and relevance of live user, for example, very closely related to realizing green building concept in residential building.

Open-ended research that has been done before about the community understanding about the impact of global warming-related construction and green building implementation shows the awareness of the respondents on the effect of development related to global warming and majority of respondents understand green building in terms of environmentally friendly design and greening the building [13]. The results of this study indicate that the community as users of residential houses have a slightly different perception or view of the concept of green buildings developed today.

Perception is primarily a cognitive process experienced by a person in understanding information about his environment through the senses, both sight, and hearing [14]. In line with that, Wirawan [15] explains that the process of perception or view is the result of relationships between humans with the environment that can affect behavior. The outcome of the relationship is processed in the realm of consciousness based on a particular background and is influenced by past experiences, interests, attitudes, and intelligence. Based on the explanation, the perception or point of view of the community with various backgrounds, past experiences, interests, attitudes, and knowledge is considered important in responding to the concept of green building for residential houses. Such perceptions can be used to discover a new concept. New concepts from the perspective of the community can be compared and seen the difference between current concept and theories.

Green Building Council Indonesia as one of the non-profit organizations engaged in encouraging the application of green building concept, in 2014 issued a criterion of the greenhouse. Green Home [16] has various aspects of assessment in achieving sustainability. In the Greens Home, there are six categories or issues of green assessment criteria on single-landed buildings: (1)Appropriate Site Development; (2)Energy Efficiency and Conservation; (3)Water Conservation; (4)Material Resource And Cycle; (5)Indoor Health and Comfort; and (6)Building Environment Management.

On the other hand, based on previous research, six green building categories or aspects of housing were identified according to the understanding or views of the community, namely: (1) Environmentally friendly materials; (2) Eco-friendly design; (3) Eco-friendly construction; (4) Energy efficiency; (5) User behavior; and (6) Greening on buildings. From each category according to GBCI and based on previous research, there are various criteria in each category. Combination of each criterion in both sources will be used as measurable variables and then used as questions in the data collection in this study.

3. Methodology

The method used in this research is mix-method research, that is qualitative and quantitative with explorative approach [17]. In this study, the green concept implementation factors in housing will be revealed from a combination of open-ended qualitative research that has been done before and the Greenship Home assessment tool developed by GBCI.

3.1. Method of collecting data

Based on previous study [13], an open-ended questionnaire has been developed about the understanding of the impact of global warming, green building, and its implementation. The distribution of questionnaires was conducted online starting on August 24th and closed on August 30th, 2017. From the results of the questionnaire, distribution was obtained data from 100 respondents who then analyzed qualitatively with open coding, axial coding, and selective coding. Based on all respondents' answers, a total of 144 keywords was obtained which later formed the category of green building understanding on the housing.

The results of previous research indicate that people's understanding of green building in housing is dominated by "eco-friendly design" category with 39 percent. The reasons include: "eco-friendly design," "sustainable," "good air circulation," "resource saving," "minimizing global warming," "indoor comfort," "environmentally friendly technology," and " response to climate," became the biggest picture of the green building according to respondents.

The second dominant category is the category of "greening on buildings" by 26 percent. The other categories follow sequentially, "green development" by 10 percent, "energy efficiency" and "occupant behavior" by 8 percent of each class, and "environmentally friendly material" by 7 percent, while 1 percent answer "do not know." One percent or 2 keywords from the "do not know" answer are considered absent or not used in the second phase of the study so the percentage changes by only using 142 of 144 keywords. The findings of these categories and their criteria were used for the questionnaire instrument in this study and combined with the Greenship Home assessment tool.

In this current research, data were collected by questionnaire online-surveys distributed by convenient sampling / non-random sampling, snowball sampling technique [18]. The questionnaire prepared closed (close-ended) with answers compiled using semantic-differential method (SD-method) in the form of scaled interval 10. Data collected is numerical data which then analyzed quantitatively. The online questionnaire distribution was opened on October 22nd and closed on November 21st, 2017.

From the results of the distribution of the questionnaire, data were obtained from 112 respondents with 64 respondents (57 percent) male and 48 respondents (43 percent) female (Figure 1). The average age of respondents is approximately 17-25 years old as many as 70 people (63 percent). The remainder varies from age 26-35 to 56-65 (Figure 1). The education level of respondents varies from Senior High School to S3.

However, most education levels are S1 or equal (82 persons or 73 percent) (Figure 2). The occupation of respondents varied by 38 private employees (34 percent) and 37 students (33 percent) (Figure 2).

Figure 1: Sex of respondent and age range of respondent (author's analysis).

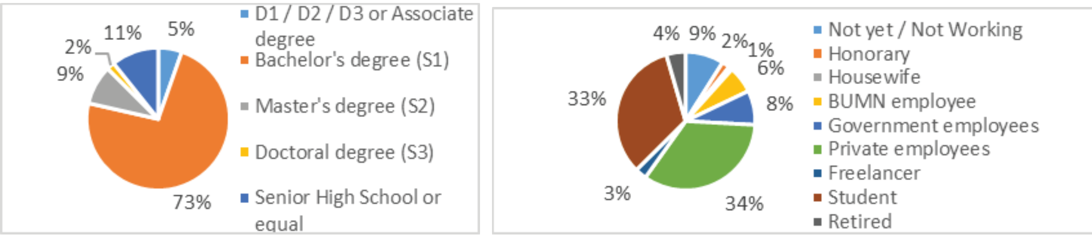

Figure 2: The education level of the respondent and respondent's job (author's analysis).

The diversity of respondents' backgrounds reflects the diversity of memory-induced views of past experiences, interests, attitudes, and the different bits of intelligence of each. That diversity was used to form the theory about the parameters of green concept implementation in a residential building that represents the views or perspectives of the community.

3.2. Data analysis method

Respondents were asked to fill out a questionnaire containing questions about the expected level of application of the concept of green building in housing. The question of the implementation of green building in the housing in this questionnaire is a composite of the assessment tools that GBCI has created, namely Greenship Home and keywords from the respondents' category of green building understanding in previous open-ended research. The classification used is a category with keywords or variables that are not in the Greenship Home assessment, so their functions are complementary. Measurable variables are crossed in the mark by color shading in Table 1 below.

The answers given through this method represent the level of importance of every aspect of green building concept implementation in a residential building that expected by the respondents. It was described in the form of scale. Each question is measured on a scale running from 1 to 10. Each of these polar answers is an opposing adjective, a range of 1 to 10 with one representing very unimportant and ten a very important.

Table 1: Example part of the questionnaire instrument (author's analysis).

Category	Criteria	Source
Energy Efficiency and Conservation	Air Conditioning	Greenship Home & Ramadhan (2017)
	Heat Reduction	Greenship Home
	Energy Efficient Home Appliances	Greenship Home
	Renewable Energy Sources	Greenship Home & Ramadhan (2017)
Occupant Behaviour	Electricity Saving Behavior	Ramadhan (2017)
	Eco-Friendly Behavior	Ramadhan (2017)

Positive word positions are placed on the right, and negative words are placed in the left position. This is intended to facilitate the respondents in filling out the questionnaire. Examples of questions in the online questionnaire are shown in Table 2.

Table 2: Example of semantic-differential (SD-method) questions in the online questionnaire (author's analysis).

Has Water Meter In Primary Water Source											
Very Unimportant	1	2	3	4	5	6	7	8	9	10	Very Important
Not Degrading the Ecosystem In Construction Process											
Very Unimportant	1	2	3	4	5	6	7	8	9	10	Very Important

The data analysis was done quantitatively by using Principal Component Analysis (PCA) and factor analysis. PCA is used to find the principal component (replacement variable) that can represent measurable variables by collecting as much variability (the portion of the described phenomenon) of all measurable variables in some major principal components [19]. Furthermore, analysis factor is performed to help determine the number of latent variables that underlie or represent a set of measurable variables, then help to explain variations between variables by using some new variables, and determine the content or meaning of the latent variables found [20].

4. Result Of Data Analysis and Discussion

From the results of the analysis using PCA, the number of major components (eigenvectors) were determined using the Kaiser termination rule [21]. This termination is performed on an eigenvalue of more than 1. Table 3 shows the eigenvalue summary of the principal component of the 50 variable measured results. It can be seen that the first 10 component principles have an eigenvalue of more than 1, this means having the variance/variability portion exceeds the measured variable because it is used to represent or replace the measured variables. The first 10 component principles also have a cumulative percent of 74.95 percent or close to 75 percent. Thus, the ten components of the principle can represent 74.95 percent portion of the ability to explain the phenomena of the 50 measurable variables available. It can be concluded that to explain the 74.95 percent phenomenon simply by using ten principal components (10 latent variables), no need to use 50 measurable variables (Table 3).

Table 3: The eigenvalue of principal component analysis (author's analysis).

No	Eigenvalue	Percent	Cum Percent
9	1.12	2.25	72.84
10	**1.05**	2.11	**74.95**
11	0.94	1.88	76.83

In the next step, factor analysis is performed to find latent variables that can be easily named. Factor analysis was done by rotating the principle component orthogonally so that it will be obtained between the elements to be uncorrelated and as much as possible the loading factor of each measured variable to each principal component is made close to 0 (varimax rotation).

In interpreting the measurable variables to be in the right latent variable should consider the weight of the loading factor. According to [22], loading factor of 0.71 or higher can be considered ”excellent”, 0.63 is ”excellent”, 0.55 can be considered ”good”, 0.45 can be considered ”fair ”, and 0.32 is” bad”. From these considerations, the weight of loading is limited to 0.45 (between 0.32 and 0.45) informing latent variables. Measurable variables with factor loading weight below 0.45 will be ignored and weighted minus (-). However, measurable variables that have an adjacent loading factor weight (e.g., 0.42 and 0.45, although below 0.45) are placed in latent variable positions that have adjacent / continuous meanings because adjacent weights show almost the same tendency of the answer respondents.

From the result of factor analysis, ten parameters represent the application of green building concept on residential building based on community perspective (see table 4). The 10 parameters are then given names that are deemed to represent measurable variables such as ”occupant behaviour”, ”technology and construction”, ”appropriate site development”, ”lighting and air-conditioning”, ”environmentally friendly materials”, ”properness and greening”, ”building utility”, ”design & innovation”, ”local source pre-fabrication material”, and ”energy-saving electrical appliances”.

As with the GBCI Greenship Home rating tool, the measurable variables that make up the parameters can be considered as criteria of the category. Table 4 shows that the ”occupant behavior” parameter represents the criteria of ”electricity-saving behavior,” ”water-saving behavior,” ”household waste management behavior,” ”eco-friendly behavior,” ”organic & inorganic waste processing,” ”planting by the user,” and” follow environmental care activities.” Then the parameters of ”technology & construction” represent the criteria of ”using green roof”, ”installing vertical garden”, ”waste processing of construction”, ”alternative power generation feature”, ”eco-friendly construction process”, ”building automation feature”,” minimize ecosystem destruction during construction”, “eco-friendly maintenance processes”, and ”carbon footprint calculations from building materials”. The other parameters follow successively ”appropriate site development,” ”lighting & air-conditioning,” with the criteria that shape it, and so on until ”electrical energy-saving equipment.”

The sequence of factor analysis indicates a latent variable that is more dominant than other latent variables. From the set of 10 parameters, it can be seen that the parameters that are in front (left-no.1 in Table 4) are more dominant variables than those behind (right-no.10 in Table 4). The findings show that the ”occupant behavior” parameter is the most dominant parameter compared to other parameters. The sequence is followed by ”technology & construction,” ”appropriate land,” ”lighting & respiratory” and other parameters to ”energy-saving electrical equipment.”

To prove the reliability of the measurable variables that make up the parameters using internal-consistent reliability that used to measure two or more concepts at the same time and see the agreement level from respondents. One type of internal-consistent authenticity, which is coefficient alpha or commonly called Cronbach’s alpha [23]. Cronbach’s Alpha is a measure that used to see the level of reliability or agreement of respondents in the answer. This size has values ranging from 0 to 1. The greater the value or close to the number 1, the greater the level of reliability. Cronbach α value of each measured variable answers from respondents ranged in the number 0.967-0,9684 with an average of **0.9676**. This value shows the reliability of the data is very good because it exceeds 0.9 and closes to 1. Excellent reliability represents the effectiveness of this research in forming a theory, in this case, related to the parameters of green concept implementation in residential building.

There is a difference between the findings of this study which represents the community perspective and Greenship Home which represents the expert’s perspective on categorizing the application of green concepts in residential homes. Greenship Home, previous research, and these current research findings need to be compared with each other to see more clearly the differences and gaps between the three. Benchmarking of green concept was done with three stages of comparison of equality, percentage, and criteria in its category.

Table 4: Parameter / latent variable of factor analysis results with varimax rotation of 10 principal components (author's analysis).

Criteria (Measurable Variables) \ Parameter (Latent Variables)	1 Occupant Behaviour	2 Technology & Construction	3 Appropriate Site Development	4 Lighting & Air-Conditioning	5 Environmentally Friendly Material	6 Pproperness & Greening	7 Building Utility	8 Design & Innovation	9 Local Source Pre-Fabrication Materials	10 Energy-Saving Electrical Appliances
Electricity Saving Behavior	**0,82**	0,20	0,14	0,17	0,20	0,07	0,03	0,03	0,02	0,20
Water saving behavior	**0,79**	0,09	0,19	0,28	0,01	0,14	0,11	0,16	0,01	0,10
Household Waste Management Behavior	**0,77**	0,36	0,18	0,02	0,17	0,21	0,12	0,06	0,01	0,01
Eco-Friendly Behavior	**0,66**	0,11	0,17	0,26	-0,05	0,17	0,34	0,20	0,25	-0,13
Organic & Inorganic Waste Processing	**0,60**	0,38	0,20	0,16	0,33	0,13	0,10	0,19	-0,33	-0,01
Planting By User	**0,58**	0,20	0,11	0,11	0,09	0,12	0,14	0,32	0,24	-0,16
Following Environmental Care Activities	**0,49**	0,24	0,18	0,40	0,47	0,05	-0,07	0,17	-0,11	0,12
Using Green Roof	0,07	**0,80**	0,11	0,11	0,08	0,25	0,18	0,13	0,04	-0,04
Installing Vertical Garden	0,22	**0,73**	0,14	0,14	0,26	0,20	0,00	-0,02	-0,03	-0,02
Waste Processing of Construction	0,41	**0,65**	0,07	0,09	0,26	0,10	0,22	0,05	0,19	0,04
Alternative Power Generation Features	0,24	**0,60**	0,11	0,01	0,17	0,04	0,33	0,35	0,01	0,12
Eco-Friendly Construction Process	0,43	**0,57**	0,09	0,33	0,23	0,28	0,03	0,18	0,05	0,10
Building Automation Feature	0,06	**0,57**	0,29	-0,11	0,20	0,15	0,17	0,27	0,15	0,27
Minimizing Ecosystem Destruction During Construction	0,43	**0,55**	0,15	0,49	0,11	0,13	0,13	0,02	0,00	0,06
Eco-Friendly Maintenance Process	0,43	**0,54**	0,09	0,32	0,28	0,13	0,10	-0,06	0,21	0,08
Carbon Footprint Calculations From Building Materials	0,30	**0,52**	0,07	0,02	0,49	0,05	0,12	0,20	0,27	0,00
Social Facilities & Public Facilities	0,10	0,08	**0,80**	0,12	0,14	-0,02	0,12	0,00	0,13	0,18
Infrastructure & Utilities	0,10	-0,02	**0,79**	0,17	-0,06	0,17	0,04	-0,01	-0,01	-0,22
Pest Management	0,09	0,23	**0,75**	0,20	0,11	0,06	0,16	0,12	-0,04	0,05
Handling of Rainfall Runoff	0,20	0,19	**0,70**	0,07	0,07	0,26	0,05	0,20	-0,12	0,01
Near the bus stop and the station	0,20	0,16	**0,58**	0,33	0,03	0,06	0,18	0,04	0,26	0,30
Adequate Ventilation	0,12	-0,04	0,30	**0,73**	-0,08	0,17	0,12	0,22	0,00	0,12
Natural Light According to SNI Standard	0,30	0,20	0,30	**0,64**	0,08	0,21	0,18	0,14	0,10	0,01
Construction Process Must Be Efficient	0,29	0,23	0,23	**0,63**	0,06	0,10	0,36	0,05	0,23	-0,11
Artificial Lights In accordance SNI	0,44	0,14	0,27	**0,56**	0,29	0,26	-0,04	0,17	0,09	0,04
Reduces Air Space Contamination	0,38	0,14	0,23	**0,52**	0,14	0,40	0,31	0,10	-0,03	0,02
Re-used Materials	0,04	0,26	0,00	-0,03	**0,79**	-0,01	0,21	0,11	0,15	0,08
Material 3R	0,18	0,23	0,08	0,01	**0,79**	0,05	0,28	0,10	0,03	0,10
Materials Production Process Environmental Management System	0,21	0,19	0,09	0,44	**0,59**	0,16	0,11	0,15	0,05	-0,05
Minimum Space Requirement 9 M2 / person	0,05	0,21	0,19	0,08	0,03	**0,79**	0,08	0,12	0,04	0,05
Noise Level In accordance with SNI	0,34	0,20	0,09	0,19	0,06	**0,72**	0,21	0,15	0,06	0,08
Planting Trees on Building Land	0,38	0,19	0,16	0,24	-0,12	**0,54**	0,10	0,10	0,29	0,02
Vegetation Land	0,21	0,13	0,44	0,22	0,16	**0,51**	0,05	0,10	0,12	-0,16
Legal Wood	0,34	0,30	0,09	0,36	0,39	**0,46**	-0,14	0,13	0,12	0,16
Using Grease Trap And Septic Tank	0,04	0,20	0,12	0,03	0,44	0,16	**0,66**	0,09	0,22	0,08
Water Meter	0,35	0,06	0,31	0,05	0,07	0,29	**0,59**	0,25	0,02	0,21
Rain Water Shelter and Reuse	0,12	0,35	0,25	0,20	0,29	0,14	**0,59**	0,30	0,00	-0,13
Water Saving Equipment Technology	0,31	0,14	0,30	0,23	0,25	0,13	**0,55**	0,17	0,09	0,28
AC Without HCFC	0,12	0,15	0,13	0,35	0,15	-0,02	**0,53**	0,19	-0,07	-0,08
Watering Plants Without Primary Water Source	-0,10	0,19	0,05	0,23	0,37	0,42	**0,41**	0,29	0,02	0,12
Not Using AC	0,10	-0,04	0,02	0,21	0,25	0,22	0,10	**0,67**	0,04	0,19
Design Innovation	0,25	0,37	0,13	0,07	0,15	0,12	0,26	**0,66**	0,10	-0,21
Design & Reducing Material	0,21	0,16	0,43	0,21	-0,02	0,01	0,29	**0,60**	0,03	0,22
House Optimization Planning	0,33	0,31	0,12	0,10	0,13	0,21	0,33	**0,59**	0,04	-0,13
Involving Building Experts	-0,04	0,44	0,12	0,32	0,22	-0,02	-0,11	**0,46**	0,41	-0,04
Sub Metering	0,33	0,04	0,52	0,11	-0,01	0,19	0,23	**0,43**	0,03	0,06
Local Materials	0,12	0,12	0,01	0,24	0,33	0,30	0,11	0,29	**0,59**	0,10
Prefabricated Materials	0,15	0,27	0,08	-0,04	0,41	0,42	0,13	-0,05	**0,54**	0,07
Electric Appliances labeled 'Energy Saving'	0,20	0,17	0,17	0,14	0,28	0,10	0,13	0,12	0,10	**0,72**
The existence of Home and Environmental Technical Guidelines	0,28	0,21	0,23	0,30	0,32	-0,05	0,19	0,24	0,26	**-0,46**

In the first stage, comparisons are made by grouping categories that are equivalent to each other (see Table 5). This comparison shows that there is an equivalent category in all of its concepts, but some are equivalent to only two concepts and not equivalent to 1 other concept. This inequality shows the gap between the three ideas. If these two studies (first and current research) are considered to be unified, then two categories findings are not in GBCI that is ”eco-friendly construction” or ”technology & construction” and ”occupant behavior.” The first invention is ”eco-friendly construction” or ”technology and construction.” The construction criteria already exist in the ”building environment management” on Greenship for public buildings, but not a category in Greenship Home. Construction is critical in applying the green concept in line with Slabbert [24] which explains that a truly sustainable building should also consider environmentally sound processes during construction and operation of the building. Also, the use of appropriate environmentally sound technologies is also crucial as a means to harmonize economic and environmental aspects in sustainable development [25].

The ”occupant behavior” parameter is the second finding of the comparison that does not appear in GBCI. The related behaviors in green concept implementation are important in line with Noiseux & Hostetler [26] which states that green development that ignores environmental awareness in behavior will limit the application of the green concept, making it difficult to maintain and preserve the environment. Therefore, the level of environmental awareness and behavior among owners and the home occupant is essential to implement a more sustainable green concept. Such behavior may be referred to as pro-environmental behavior which means behavior that deliberately tries to minimize negative impacts to the environment both natural and guided [27].

Furthermore, in the second phase comparison done by grouping the categories based on the percentage level shown in Table 6. In Greenship Home, the most significant or most dominant percentage is the category of ”energy efficiency and conservation” by 19.48 percent followed by ”appropriate site development,” ”water conservation,” ” indoor health and comfort” by 16.88 percent, and so on. In contrast to previous research that was dominated by ”eco-friendly design” by 39.44 percent, ”greening on the building” by 26.06 percent, ”green construction” by 10.56 percent and so on until the lowest. While in current research, the most dominant category or parameter is ”occupant behavior” by 16.20 percent, followed by ”technology & construction” by 14.35 percent, ”appropriate site development” by 12.12 percent and so on the lowest ”electrical energy-saving appliances” of 4.15 percent. The comparison shows that there are three important aspects of applying different green concepts to each other. GBCI focuses more on energy efficiency and conservation; previous research focused more

Table 5: Comparison of Greenship Home-GBCI, previous research, and this study (author's analysis).

Greenship Home (GBCI)	First Qualitative Research	Current Research
Material Resource And Cycle	Environmentally Friendly Material	Environmentally Friendly Material
		Local Source Prefabrication Materials
Appropriate Site Development	-	Appropriate Site Development
Indoor Health and Comfort	Greening in Building	Properness & Greening
Energy Efficiency and Conservation	Energy Efficiency	Lighting & Air-Conditioning
		Energy-Saving Electrical Appliances
Building Environment Management	Eco-Friendly Design	Design & Innovation
-	Eco-Friendly Construction	Technology & Construction
Water Conservation	-	Building Utility
-	Occupants Behaviour	Occupants Behaviour

on eco-friendly building design (focus: designer) while the current study focused more on occupant behavior (focus: user).

Comparison of the third stage is done between the three by grouping the categories and criteria in it. This grouping is adjusted by an equality comparison like the first comparison to see the difference in criteria from each type or parameter (but the third stage comparison table is not shown in this article). Based on the number of criteria, the second study has the most number of 50 criteria, followed by GBCI as many as 37 criteria and the first study of 33 criteria.

Based on these three comparisons, there are several differences between the three green concepts. In Greenship Homes of GBCI, the categories and criteria are made more focused on criteria that can be easily measured when applied by the public whether it is the owner, the designer, the contractor or the user. In the previous research, there were new and more general category naming (such as design, development, behavior) than GBCI. The category shows the basic idea of the green concept in the building that must be applied since the design stage, development to operational. While in this research, the number of categories and criteria obtained most compared to the others. The classes are more holistic to the sustainable concept in residential buildings, but the position of the criteria is a bit off each other and quite difficult to make measurements on several categories.

Table 6: Comparison of categories by percentage (author's analysis).

Greenship Home (GBCI)	%	First Qualitative Research	%	Current Research	%
Energy Eficiency And Conservation	19,48%	Eco-Friendly Design	39,44%	Occupants Behaviour	16,20%
Appropriate Site Development	16,88%	Greening On Buildings	26,06%	Technology & Construction	14,35%
Water Conservation	16,88%	Eco-Friendly Consctruction	10,56%	Appropriate Site Development	12,12%
Indoor Health And Comfort	16,88%	Energy Efficiency	8,45%	Lighting & Air-Conditioning	10,98%
Building Environment Management	15,58%	Occupants Behavior	8,45%	Environmentally Friendly Materials	10,84%
Material Resource And Cycle	14,28%	Environmentally Friendly Materials	7,04%	Properness & Greening	9,28%
				Building Utility	8,84%
				Design & Innovation	8,70%
				Local Source Prefabrication Materials	4,52%
				Energy-Saving Electrical Appliances	4,15%

5. Conclusion

This study indicates the existence of 10 components of the principle (10 latent variables that represent 50 measurable variables) that represent the parameters of green concept implementation in residential building according to community perspective, such as "occupant behavior", "technology and construction", "appropriate site development", "lighting and air-conditioning", "environmentally friendly materials", "properness and greening", "building utility", "design and innovation", "local source prefabrication materials", and "energy-saving electrical appliances". The reliability of the findings data is satisfactory because the value of Cronbach's alpha exceeds 0.9, which indicates the high level of effectiveness of this research in making theory.

Occupant behavior parameters are the most crucial parameter in influencing the green concept implementation in residential building, followed by technology and construction, appropriate site development, lighting and air-conditioning and others to energy saving electrical appliances.

The advantages of categories in the Greenship Homes criteria of GBCI are made more focused on criteria that are easily measured when applied by people, owners, designers, contractors or users. In previous research, there are new and more general categories naming (such as design, development, behavior). The categories show the basic idea of the green concept in the building that must be applied since the design stage, development to operational. This study found the number of categories and criteria obtained more than others. The categories are more holistic to the concept of sustainable in residential buildings, but the position of the criteria is a bit off each other and quite challenging to make measurements on several categories. Therefore, further research is required for the development of more measurable parameters.

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