

The Constraint Factors for Implementation of Green Construction Concept in Building Development Project in West Sumatra Province

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ABSTRACT

The construction development in West Sumatra province has not applied much green construction concept. This study aims to identify obstacles in implementing green construction in building construction projects and recommend appropriate solutions for local contractors in overcoming obstacles in their implementation. This research is quantitative descriptive research through the use of questionnaire surveys to selected respondents. The results of data analysis with the parameter ranking weighting method, significant obstacle factors were obtained, including; The implementation of green construction needs longer duration; Lack of ideal guidelines and operational standards regarding the implementation of green construction; The increase of project costs in purchase and management of construction materials; Unreadiness in recruiting professionals and project risks in the project closing out due to specific contract forms. Based on the results, it is expected that the government establishes operational guidelines for the implementation of green construction, prepares an adapted budget and schedule for green construction, professional training and appropriate risk mitigation plan related to green construction contracts.

Keywords: Building; Green Concept, Construction, Constraint Factors, Implementation

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INTRODUCTION

West Sumatra Province is nowadays trying to improve the development of facilities and infrastructure in line with the increasing population and regional economic growth. Absolutely, increased development will have an impact on economic, social and environmental aspects. Building projects, if not managed properly can produce construction waste and produce air, water, sound, soil and environmental pollution around the construction [14]. In addition, buildings are considered to play a major role in the depletion of natural and energy resources and contribute to increasing greenhouse gas emissions which are considered to be the cause of global warming and also buildings use up the world water capacity and increase global waste production. So far, building construction in West Sumatra has not applied the concept of green construction much. Building projects with a green construction concept are the Pasar Atas Bukittinggi and Pasar Pariaman Projects. By leastwise implementation of the green construction concept in building construction in the Province of West Sumatra, this issue is important to study. This study aims to identify the constraining factors by contractors in implementing green construction concept in construction projects and recommending better solutions to overcome these problems.

According to Ministerial Regulation of Public Housing and General Works No. 21 of 2021, a building is a physical embodiment of the results of construction work that is integrated with its location, partially or wholly above and or in the ground and or water, which functions as a place for human beings to carry out their activities, both for residential or residence, religious activities, business activities, social, cultural activities or special activities. Meanwhile, green buildings are buildings that meet building technical standards and have significantly measurable performance in saving energy, water and other resources through the application of green building principles in accordance with their functions and classifications in each stage of construction.

Green construction is one of the goals of sustainable development that starts from the planning stage, project scheduling, material conservation, land use, construction waste management, material storage and protection, healthy work environment, creating an environmentally work environment, selection and operation of construction equipment and documentation [5], efficiently usage of energy and resources as well as low cost and prioritizing profit balance by not damaging health, safety and sustainability [13]. In implementing green construction, there are still many obstacles and obstacles that must be experienced by contractors. Following are some reviews of previous studies related to constraint in implementing the green construction concept which can be shown in table 1.

Table 1 : The constraint factors for implementing green construction based on previous studies

Code	Constraint Factors	References
F1	Increased costs for purchasing and managing construction materials	[6]
F2	It is necessary to increase the duration to implement the green construction concept on site.	[6], [7]
F3	Unavailability of a list of environmentally friendly products and material quality issues.	[1]
F4	Not yet or no understanding of green construction principles	[4]
F5	Lack of capacity of suppliers or subcontractors to innovate solutions to green construction issues	[1], [7], [9]
F6	Lack of contractor experience in working on projects using green construction concept	[1]
F7	Lack of professional competency (knowledge and expertise)	[11], [7], [9]
F8	There is no internal management structure that implements the green construction concept	[1]
F9	Lack of management and technical capacity to formulate green product specifications	[11]
F10	The usage of natural resources and waste production	[2]
F11	The lack of management team coordination in operational area	[1]
F12	Lack of contractor knowledge about technology in implementing green construction	[6], [8]
F13	Inadequate of regulations and laws in implementing green construction buildings	[1], [7], [11]
F14	Unavailability of ideal guidelines and standards for implementing sustainable construction	[3], [8]
F15	Unavailability of incentives or commissions in implementing sustainable construction	[1], [7], [8], [11]
F16	Lack of public knowledge for the importance of green construction	[4], [7]
F17	Reluctance to change work patterns have been carried out for years	[4]
F18	The differences of perception among project stakeholders in the green construction concept	[1]

F19	Lack of communication and interest among the parties involved in the project toward the implementation of green construction concepts	[6], [11]
F20	The difficulty of determining a company vision and mission for sustainable construction	[11]
F21	Lack of a structured framework to help sustainable projects.	[1]
F22	The company unreadiness in recruiting professionals	[11]
F23	Requires companies to have international certificates (ISO 14001, ISO 9001, ISO 45001)	[11]
F24	The difficulty of exploring the local market as well as efforts to increase competitiveness.	[1]
F25	Unavailability of materials and equipment used to implement green construction	[6]
F26	The high cost of maintaining buildings using the concept of green construction	[4]
F27	Hiring experts from abroad for green construction training	[3]
F28	Need to integrate quality environmental management into plan and operation	[2]
F29	The assumption is that the aesthetics of the structure will be reduced if the green concept implemented	[6]
F30	The risks on project handover due to different contract	[6]

METHODS

The research is quantitative descriptive research conducted during the Covid-19 pandemic in 2021. This study aims to provide an overview of the constraints and challenges experienced by local contractors in implementing the green construction concept based on their perspective. The research respondents are contractors who are members of GAPENSI and GAPEKSI who located in several cities in West Sumatra Province. The research instrument uses a questionnaire survey by distributing questionnaire forms either directly for contractors located in the city of Padang and use Google Form for contractors located out of the Padang city. The steps for conducting the research are the following;

1. Preliminary study

Studying the concept of green construction, reviewing regulations for implementing green construction and previous studies related to the constraint factors of implementing green construction and observing the phenomenon of building projects in West Sumatra province.

2. Formulating the problem statement and objectives

Based on the results of the preliminary study, problem statements and research objectives were determined.

3. Data collection

Developing questionnaire instrument, data collection is carried out through distributing questionnaires directly or through Google Form. The rating scale uses Likert scale with the score of each rating scale; Strongly Agree (5), Agree (4), Somewhat Agree (3), Somewhat Agree (2) and Disagree (1). Furthermore, distributing the forms to contractors.

4. Data processing

Identifying respondents profile, conducting validity and reliability testing, met, then tabulating the data for determining the weight of constraint factors using the parameter ranking analysis method.

The validity test uses the product moment correlation formula which can be formulated as follows [10].

$$r_{xy} = \frac{n(\sum XY) - (\sum X)(\sum Y)}{\sqrt{(n \sum X^2 - (\sum X)^2)(n \sum Y^2 - (\sum Y)^2)}} \quad (1)$$

Which,

r_{xy} = the product moment correlation

n = the number of respondents

$\sum X$ = total score X

$\sum Y$ = total Y Score

$\sum XY$ = the sum of the products of variable X and variable Y

$\sum X^2$ = the sum of squares of variable X

$\sum Y^2$ = the sum of squares of variable Y

The reliability test uses Cronbach's Alpha formula which can be formulated as follows [10]

$$r_{11} = \left[\frac{K}{K-1} \right] \left[1 - \frac{\sum \delta_b^2}{V_t^2} \right]$$

(2)

Which,

r_{11} = the value of Cronbach's Alpha

K = the number of statement

$\sum \delta_b^2$ = the number of variable variants

V_t^2 = the sum of varians

Parameter ranking analysis can be formulated as follows;

$$W = (w_1 + w_2 + w_3 + \dots + w_n)$$

(3)

$$W_j = (n - r_j + 1) / \sum (n - r_p + 1)$$

(4)

Which,

W_j = normal weight of the parameter

n = number of parameters

r_p = position parameter

r_j = parameter ranking position

5. Results and Discussion

Describe the findings during the research and the results of processing the questionnaire data and discuss the findings and results.

6. Conclusions

Summarize the findings and results of the research and provide recommendations for future research considering some of the deficiencies in the research conducted.

RESULTS AND DISCUSSION

The characteristics of respondent

The characteristics consist are company size, experience, and location. The respondents who filled out and returned the questionnaire forms distributed in West Sumatra obtained from 23 contractor companies from the small to large one. Companies size data include; 4% contractor company with large size, 57% contractor company with medium size and 39% contractor company with a small size can be seen in Figure 1. Companies experience data include; 9% have experience implementing building projects < 5 years, 9% have experience implementing building projects 5-10 years and 82% have experience implementing building projects > 10 years totalling 19 companies can be seen in Figure 2. 74% in Padang city, 9% companies in Solok Selatan district, 5% in West Pasaman district, 4% in Pariaman city, 4% in the Bukittingi city and 4% in the Payakumbuh city and it can be seen in Figure 3. It can be concluded that the profiles of the respondents represented are medium size company, with more than 10 years of experience and located in the city of Padang.

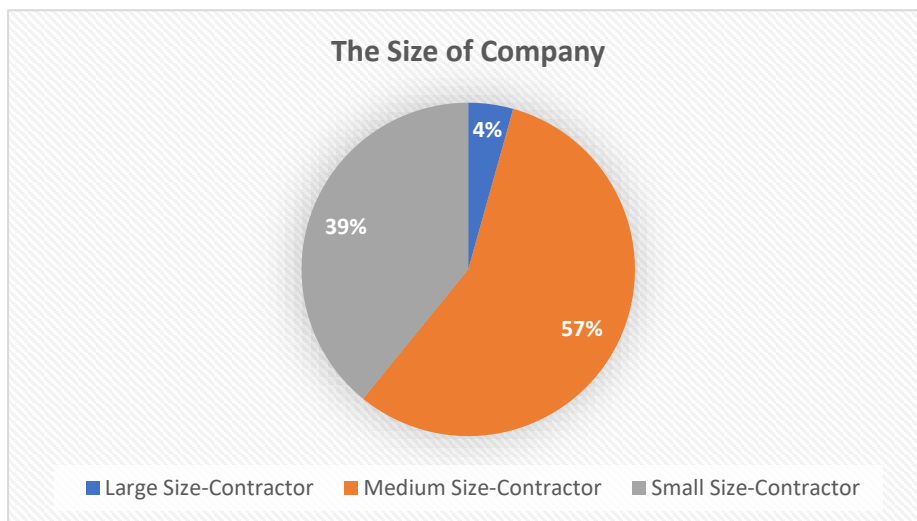


Figure 1 : The characteristic of company size

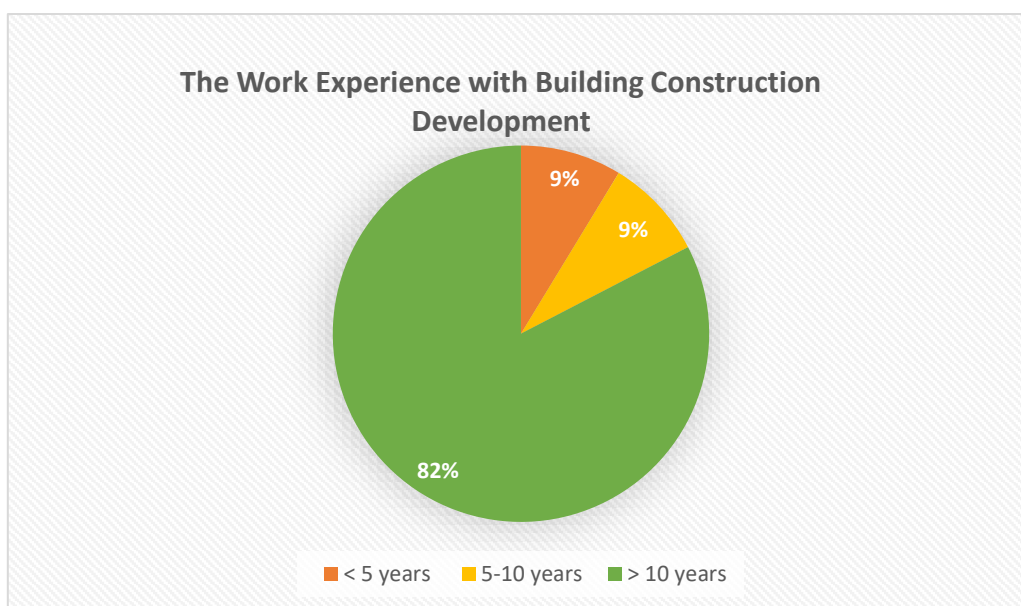


Figure 2 : The characteristic of the work experience with building construction development

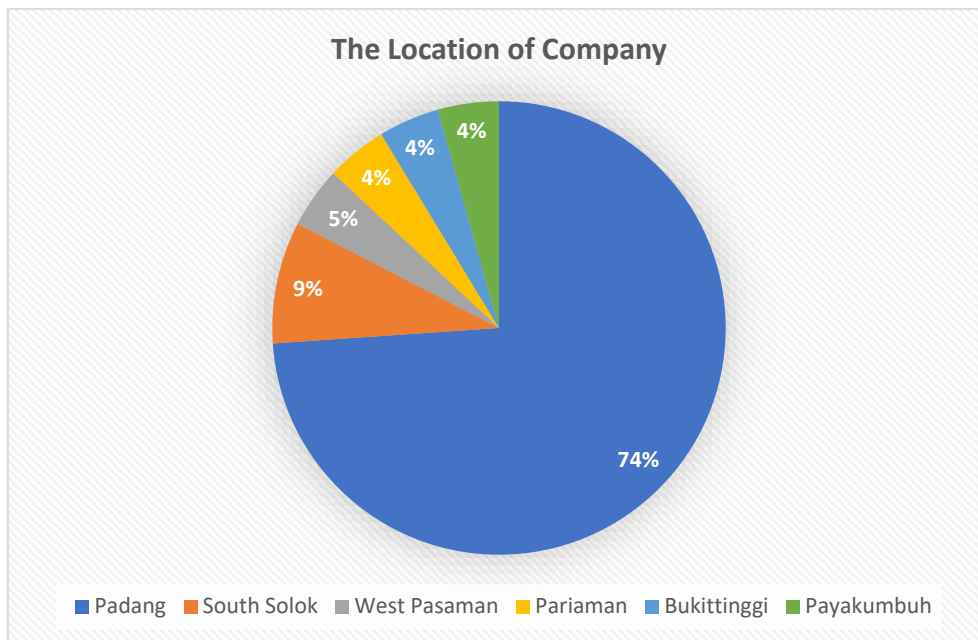


Figure 3: The characteristic of the location

Validity and Reliability Test

It was found that 6 variables were declared invalid and reliable, including F4, F8, F9, F13, F20 and F21 out of 30 variables so that valid and reliable variables could be continued with parameter weighting. A variable is declared valid if $R \text{ count} > R \text{ table}$ where $N = 23$ with $R \text{ table} = 0.413$ and is declared reliable if the Cronbach Alpha value is > 0.6 (strong).

The Mean, Standard Deviation and Weighting Factor

The mean or what is known as the average value is an indicator that can be used to measure the average value of a set of data, while the standard deviation is a statistical value that is used to determine the distribution of data in a population. Determination of ranking is subjective and strongly influenced by the perception of decision making. Weighting factor analysis aims to express how much influence a parameter has on other parameters. Following are the mean values, standard deviation and weighting factors that can be seen in table 2.

Table 1 : The Mean, Deviation Standard and Weighting Factors

Code	Constraint Factors	Mean	Deviation Standard	Weighting Value	Rank
F2	It is necessary to increase the duration to implement the green construction concept on site	4	0,587	0,0745	1
F14	Unavailability of ideal guidelines and standards for implementing sustainable construction	3,97	0,809	0,0714	2
F1	Increased costs for purchasing and managing construction materials	3,93	0,521	0,0683	3
F22	The company unreadiness in recruiting professionals	3,9	0,845	0,0652	4
F30	The risks on project handover due to different contract	3,87	0,681	0,0621	5

F18	The differences of perception among project stakeholders in the green construction concept	3,87	0,776	0,0590	6
F27	Hiring experts from abroad for green construction training	3,87	0,819	0,0559	7
F3	Unavailability of a list of environmentally friendly products and material quality issues.	3,83	0,747	0,0528	8
F5	Lack of capacity of suppliers or subcontractors to innovate solutions to green construction issues	3,83	0,748	0,0497	9
F10	The usage of natural resources and waste production	3,8	0,664	0,0466	10
F29	The assumption is that the aesthetics of the structure will be reduced if the green concept implemented	3,80	0,761	0,0435	11
F19	Lack of communication and interest among the parties involved in the project toward the implementation of green construction concepts	3,8	0,805	0,0404	12
F24	The difficulty of exploring the local market as well as efforts to increase competitiveness.	3,80	0,847	0,0373	13
F16	Lack of public knowledge for the importance of green construction	3,77	0,568	0,0342	14
F7	Lack of professional competency (knowledge and expertise)	3,77	0,817	0,0311	15
F11	The lack of management team coordination in operational area	3,77	0,858	0,0279	16
F15	Unavailability of incentives or commissions in implementing sustainable construction	3,73	0,74	0,0248	17
F25	Unavailability of materials and equipment used to implement green construction	3,70	0,702	0,0217	18
F28	Need to integrate quality environmental management into plan and operation	3,70	0,705	0,0186	19
F12	Lack of contractor knowledge about technology in implementing green construction	3,70	0,750	0,0155	20
F26	The high cost of maintaining buildings using the concept of green construction	3,60	0,675	0,0124	21
F23	Requires companies to have international certificates (ISO 14001, ISO 9001, ISO 45001)	3,6	0,855	0,0093	22
F17	Reluctance to change work patterns have been carried out for years	3,53	0,937	0,0062	23
F6	Lack of contractor experience in working on projects using green construction concept	3,37	0,964	0,0031	24

CONCLUSION

Based on the findings during the research and the results of questionnaire data processing, several conclusions can be drawn, including the following;

- a. The number of research respondents was 23 contractor companies who filled out and returned the questionnaire forms from the 30 forms distributed. The respondent profile is a medium-scale contractor with experience working on building projects for more than 10 years and domiciled in the city of Padang.
- b. Based on the calculation of the validity test with the criterion of the calculated r value $> r$ table, where $N=23$ and the R table value = 0.413, of the 30 variables there are 6 variables that are invalid and reliable, including F4, F8, F9, F13, F20 and F21. Reliability testing on all variables is said to be reliable if Cronbach's Alpha value > 0.6 (strong).
- c. There are 5 (five) significant constraint factors for contractors in implementing green construction, including; Need to increase the duration to implement the green construction concept on site (F2) with the weighting of 0.0745, Lack of ideal operational guidelines and standards regarding the implementation of green construction (F14) with the weighting of 0.0714; Increase in project costs in purchasing and managing construction materials (F1) with the weighting of 0.0683; The company's unpreparedness in recruiting professional staff (F22) with the weighting of 0.0652 and risks that arise during project handover due to different contract forms (F30) with the weighting of 0.0621. Therefore, to overcome this issue, it is expected for the government establishing adequate regulations, guidelines and standards for the implementation of green construction, preparing logical and adjusted project budgets and schedules, having professional training and preparing risk mitigation plan for reducing environmental impacts by contractors.

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