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Engineering and Financial Feasibility of Residential Housing Using Greenship Rating Tool Parameters

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Abstract

Green building aims to reduce environmental effect by improving indoor air quality for households and the community. Green buildings use the Greenship Rating Tools evaluation standards to accomplish environmentally sustainable residential development. Purpose of the study: The most important part of this thesis is to do a engineering and financial preliminary study before the construction of houses. Methods: Three home types (48/66, 70/84, and 80/112) will be used to generate Malang Residential Home data for this project. On the basis of BBC, BFC, and GBC, the technical viability will be assessed. The NPV, BCR, IRR, and PBP will be utilized to establish the project's financial viability. Variations in capital proportion, as well as increases or decreases in project revenue and outcome, would all be included when calculating sensitivity. Results: Between 60% and 75% of the BBC's technical feasibility has been determined, whereas BFC is between 0.60 and 1%, and GBC is larger than 10%. To put Malang Residential Housing in the silver level, IDR 1,382,745,228 was the NPV, with a BCR of 1.02, an IRR of 59.75 percent, and a PBP of one year and six months. It was concluded that the project was viable based on the sensitivity of the project's income and results to its viability.

Keywords: Greenship Rating Tool, Engineering Feasibility, Financial Preliminary Study

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INTRODUCTION

Green construction in residential housing reduces environmental concerns by enhancing the health of building occupants and the environment (Altomonte, et. al, 2020). The application concept of green buildings is to examine eco-friendly features, which may be accomplished using the GRT (Greenship Rating Tools) (GBCI, 2014) assessment parameters (Lavagna et al, 2018 and Lien et al., 2016) for housing development. Financial viability will be evaluated using four criteria: NPV (Perz and Fotios, 2017) and, BCR also IRR (Tun et al, 2015), and PBP.

The number of developments in Indonesia is expanding annually (Soon and Tan, 2019), development is often done without respect for the environment,

affecting both the environment and humanity. Today, the idea of sustainable development is frequently applied to development projects in order to minimize their negative environmental effect through the use of green buildings, known as "Green Building" which is applied to reduce environmental concerns by enhancing the quality of the environment (Pardo et al., 2019), which affects the health of building users and the surrounding elements (Mawat et.al, 2019). When applied, the GRT principles create housing that is healthy and sustainable (Shen et al, 2019 and Zhang et al., 2021).

METHODS

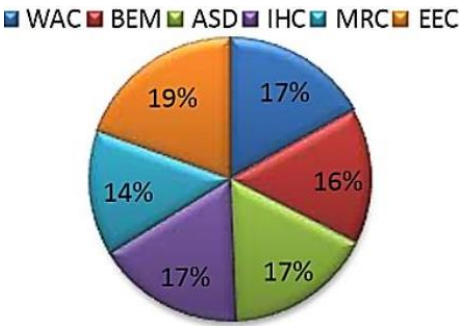
1. Greenship Rating Tool

Each benchmark category has a value point in the scoring system. Using the GRT, users may self-assess their green home to see if it qualifies. The 6 scoring aspects are:

1. ASD (Appropriate Site Development)
2. EEC (Energy Efficiency and Conservation)
3. Water conservation (WAC)
4. Material Resources Cycle (MRC)
5. Indoor Health and Comfort (IHC).
6. Building Environment Management (BEM)

Prerequisites, credit, and bonus are used to assess points on the GRT form Prerequisite evaluation is used to assign points to every criterion. Fig. 1 shows the Greenship Homes proportion in the GRT.

Figure. 1. Rating portion of GRT Greenship Homes



The portion is based on the GRT form's total rating. Platinum is awarded 56-77 points, Gold 43-55, Silver 35-42, and Bronze 26-34. Table 1 shows rankings.

Table 1. GRT Rating

Rating	%	Maximum Value
Platinum	73	58
Gold	57	43
Silver	46	35
Bronze	35	26

Figure 2. GRT rating portion

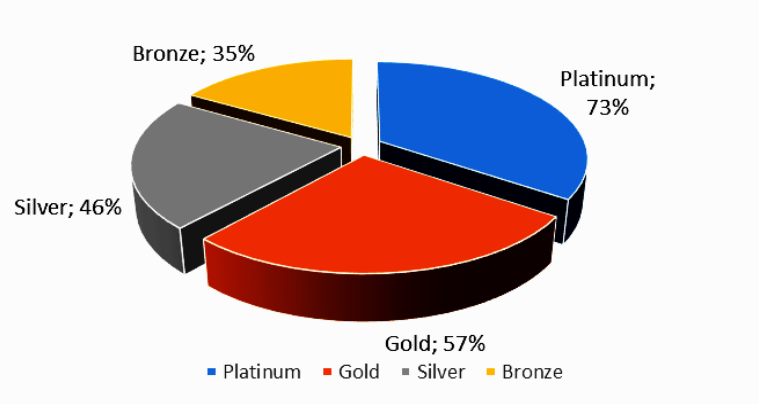


Figure 2 shows that rating in of the house which are divided into 4 levels: Platinum, Gold, Silver and Bronze.

2. Investment

Investment is the cost invested in preparing the business needs to be ready to operate properly (Dolzer and Kriebaum, 2022 and Marsiwi et al., 2019).

3. Budget Plan

The budget is the price of the building that is calculated carefully and meets the requirements (Jrade and Jalaei, 2014). Several utilizations have been introduced as:

1. Basic Building Coefficient (BBC)
2. Building Floor Coefficient (BFC)
3. Green Basic Coefficient (GBC)

The project cost estimate generates a cost budget, which, depending on necessity and timing, may be a Project Cost Budget (PCB) document or a Final Cost Budget (FCB).

4. Project Investments

The process of building a house needs assistance from several resources, including development fund, construction materials, human resources and construction equipment.

5. A Feasibility Study for a Project

In addition to being exhaustive, a feasibility study must be able to give the findings of a quantitative analysis of the expected benefits relative to the necessary resources.

6. Technical Aspect

At this stage of engineering feasibility analysis, there are some steps, namely:

a. Analysis of engineering specifications of the house that must meet standard code such as space for a garage, living room, family room, bedroom, bathroom space, and green open space.
b. Carrying out the technical analysis of the land. The land arrangement of the house must adhere to the provisions of the Basic Building Coefficient (BBC), Building Floor Coefficient (BFC), and Green Basic Coefficient (GBC). Each parameter has a feasibility standard that has been listed in the code for small housing as the eligible BBC is set to 60–75%, the eligible BFC is set to 0.6–1.2, and the eligible GBC is 10%.

7. Non-Technical Considerations

At this stage, there are various calculation steps as:

a. Land cost and legality
b. Construction cost
c. The cost of facilities, infrastructure, and public facilities Operational costs
d. Determination of house building price

8. Financial Eligibility

The typical method for determining the financial viability of a project or investment is to study the cash flow predicted in and out over the life of the project or investment, i.e., by using selection criteria which is commonly used on projects are based on the cash flow, and steps taken are:

1. Estimating project income and expenses, which include fee for licensing and building costs
2. Establish the selling price and profit margin.
3. Conduct a cash flow analysis
4. Net Present Value (NPV)

Using the eligibility criteria, if the NPV is positive, the project proposal is acceptable but if the NPV is less than zero, hence the proposal should be rejected.

5. Benefit Cost Ratio (BCR)

Evaluate projects in the public he public sector. In this case the emphasis is on to benefits for the public interest and not the company's financial benefits. If the BCR value are more than 1, the project is declared feasible, and vice versa.

6. Internal Rate of Return (IRR)

Internal rate of return (IRR) is the flow of return that generate NPV of cash inflow = NPV of cash flow go out. If the IRR > the *required rate of return* (RRR), the project is accepted.

a. Pay Back Period (PBP)

The payback period is a period required to return the capital of an investment, calculated from net cash flow. The eligibility criteria come to not feasible investment when PBP > economic life of the project, and feasible if vice versa.

Malang Residential Housing is located on Tasikmadu, in the district Lowokwaru, Malang City, East Java. This estate will be established in total land area of 2 ha. Phase 1 development is carried out with 3 types of units houses, namely 48/66, 70/84, and 80/112 type. The objects used for the study area are depicted in Fig. 3 and Fig. 4.

Figure. 3. Layout of the housing

Figure. 4 The studied area from Google Earth

The research data that will be carried out in this paper, for feasibility study is covering the information on the Malang Residential House (MRS) site plan, drawing, the CBP for providing financial analysis:

1. Direct queries and answers with the developer and picture data can reveal the anticipated material's technical parameters.
2. Basic unit price for Malang city.
3. Regulation No. 14/PRT/M/2013 of Indonesia concerning Guidelines for the Procurement of Construction Works and Consulting Services.
4. Malang City Regional Regulation No. 4 of 2011 relating to the Malang City Spatial Plan 2010–2030 Form Document for GRT for Residential Houses
5. Sales Value of Tax Objects (SVTO) data of lands in Malang City, to calculate CBP.
6. The Bank Indonesia interest rate is used to calculate the financial feasibility value.

The Greenship rating ranks ecologically friendly buildings based on benchmark points to be implement.

1. Cost Budget Plan calculation

The types of costs in construction projects are known as the cost budget plan (CBP) and implementation budget plan (IBP). The basic unit prices data for Malang City are shown in Fig 5.

The actual cost of the project is shown as an IBP, assuming that the contract value CBP contains 10% for the contractor's profit and general overhead expenses. While the real project cost or IBP is divided into direct cost and indirect cost or overhead for the project is assumed as 5% of the CBP.

9. Sensitivity Analysis

The results of the sensitivity analysis are obtained by changing the value of a variable and then seeing how it affects investment. Changed parameters include the following:

a. Own capital and bank loans
b. Changes in spending

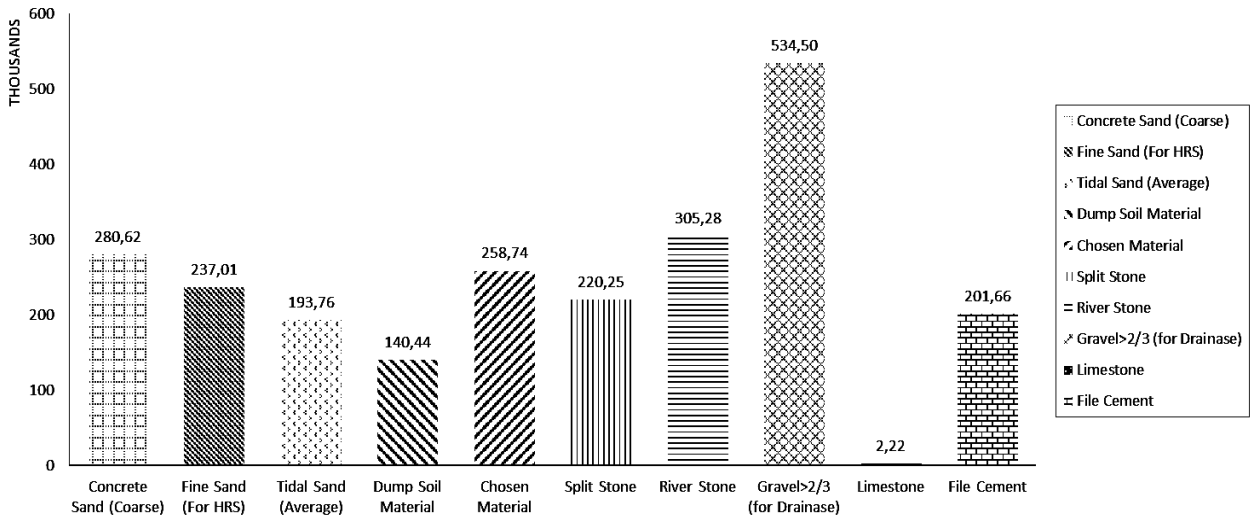
Changes in income

RESULT AND DISCUSSION

Engineering Feasibility Analysis

According to the code, the arrangement of houses must pay attention to the environment and must adhere to the provisions of the BBC, BFC, and GBC. The level of achievement of technical feasibility can be seen in Table 4.

Table 4. The Level of Achievement BBC, BFC, GBC



Type	Building Base Area (m2)	BBC	BBC achievement level	BFC	BFC achievement level	GBC	GBC achievement level
48/66	39.63	60.04%	WORTHY	0.727	WORTHY	38.45%	WORTHY
70/84	52.58	62.59%	WORTHY	0.833	WORTHY	21.43%	WORTHY
80/112	67.96	60.68%	WORTHY	0.714	WORTHY	34.85%	WORTHY

Engineering Feasibility of the land and building

The development of the Malang Residential House, consists of 3 types of houses, namely: 48/66 residential house type consist of: Plot area = 66 m^2, Number of floors = 2, Floor area 1 = 21 m^2, Floor area 2 = 27 m^2, Carport area = 18.63 m^2, Terrace area = 1 m^2 and Green area = 25.38 m^2, 70/84 residential house type which consist of: Plot area = 84 m^2, Number of floors = 2, Floor area 1 = 41 m2, Floor area 2 = 29 m^2, Carport area = 21.15 m^2, Terrace area = 1.85 m^2 and Green area = 18 m^2 and 80/112 residential house type which consist of: Plot area = 112 m^2, Number of floors = 2, Floor area 1 = 36 m^2, Floor area 2 = 44 m^2, Carport area = 31.96 m^2, Terrace area = 5 m^2 and Green area = 39.04 m^2

Categories of House Types

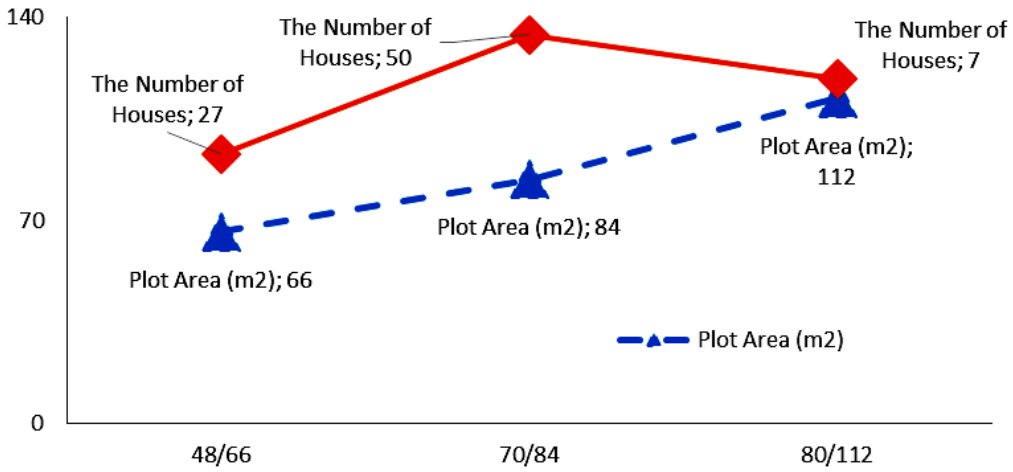
A small plot house which (Land area 54 - 120 m^2, BBC = 60-75 %, BFC = 0.60-1.2, RTH minimum of 10% of the total area, TLB = 1–2 floors), House on a medium-sized plot (medium density) where (Land area 120 - 600 m^2, BBC = 50–60%, BFC = 0.50-1.2, RTH minimum of 20% of the total area, TLB = 1–2 floors) and House on a large plot (low density) where (Land area 600-2,000 m^2, BBC = 30-50 %, BFC = 0.3-1.25, RTH minimum of 30% of the total area, TLB = 1–4 floors). Based on Malang regional regulation, the classification of existing house buildings in Malang Residential House can be seen in Table 5.

Table 5. Classification of House Types

No	Type	Plot Area (m2)	The Number of Houses	Category of Houses
1	48/66	66	27	A modest house on a small plot
2	70/84	84	50	A modest house on a small plot
3	80/112	112	7	A modest house on a small plot

Fig. 6 shows the type 70/84 is the most popular, with 50 times purchased compared to type 80/122, which usually considered by the buyer as too wide at that time, or type 48/66, which considered too small for family.

Figure 6. The market for houses by type



Regional RTH Analysis

Based on the location of the Malang Residential House which is located in the city center, the minimum use of green space is 10% of the total area according to the Malang City Regulation Number 4 of 2011. Based on the data of greenhouse land = 1858.38 m^2, garden green land = 1213.33 m^2, green field = 197.97 m^2, the total green area for residential area is 3269.67 m^2. RTH can be calculated as:

$$\text{RTH Area} = \frac{\text{Green space for residential development}}{\text{Total Residential Surface Area}}$$

$$= \frac{3269{,}67}{20640.1}$$

$$= 0{,}16 = 16\ \%\ \text{(worthy)}$$

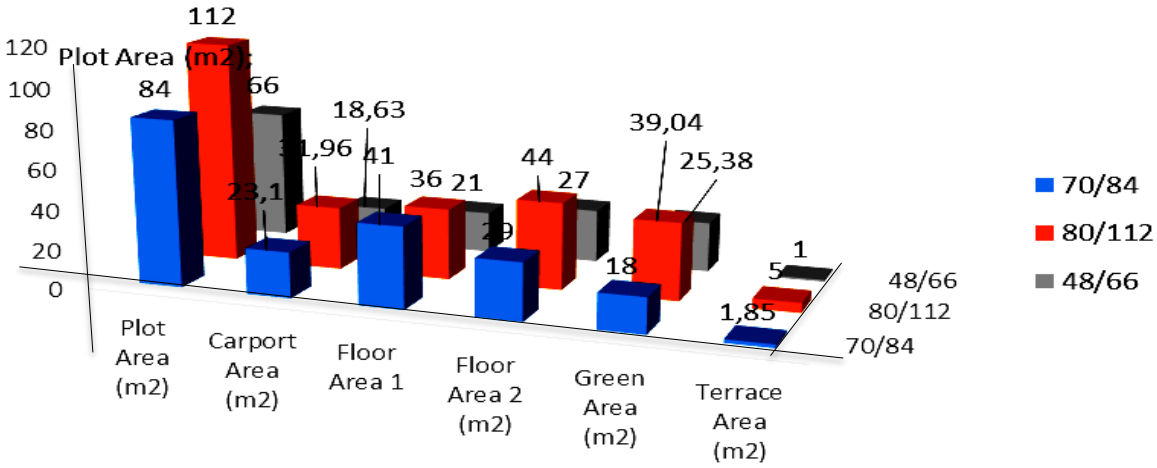
Analyzing BBC, BFC, and GBC

Table 4.2 shows the results of an analytical study of the building area on the kinds 48/66, 70/84, and 80/112 based on regional code about the Spatial Planning of the City of Malang in 2010 – 2030. Based on Table 6 and Fig. 7, the building area for each type of house will be used to calculate the BBC, BFC, and GBC values per plot with a calculation analysis in accordance with regional code, with calculation details as follows:

Table 6 Type of Building Area Analysis 48/66, 70/84, 80/112

No	Type	Plot Area (m2)	Carport Area (m2)	Floor Area 1	Floor Area 2 (m2)	Green Area (m2)
1	48/66	66	18.63	21	27	25.38
2	70/84	84	23.15	41	29	18
3	80/112	112	31.96	36	44	39.04

Figure 7. Area configuration of each housing type



1. 48/66 House Type

Having a land area of 66 m2, the calculation of BBC, BFC, and GBC is as follows:

$$BBC = \frac{Building\ Base\ Area}{Project\ Area}\ x\ 100\% = \frac{39.63}{66}\ x\ 100\%$$

$$= 60.64\%$$

$$BFC = \frac{Total\ Floor\ Area\ of\ the\ Building}{Project\ Area} = \frac{(21+27)}{66}$$

$$= 0.727$$

$$GBC = \frac{Open\ Space\ Area}{Project\ Area}\ x\ 100\% = \frac{25.38}{66}\ x\ 100\%$$

$$= 38.45\%$$

2. 70/84 House Type

Having a land area of 84 m2, the calculation of BBC, BFC, and GBC is as follows:

$$BBC = \frac{Building\ Base\ Area}{Project\ Area}\ x\ 100\% = \frac{52.58}{84}\ x\ 100\%$$

$= 62.59\%$

$$BFC = \frac{Total\ Floor\ Area\ of\ the\ Building}{Project\ Area} = \frac{(41+29)}{84}$$

$= 0.833$

$$GBC = \frac{Open\ Space\ Area}{Project\ Area}\ x\ 100\% = \frac{18}{84}\ x\ 100\%$$

$= 21.43\%$

3. House Type 80/112

Having a land area of 112 m2, the calculation of BBC, BFC, and GBC is as follows:

$$BBC = \frac{Building\ Base\ Area}{Project\ Area}\ x\ 100\% = \frac{67.96}{112}\ x\ 100\%$$

$= 60.68\%$

$$BFC = \frac{Total\ Floor\ Area\ of\ the\ Building}{Project\ Area} = \frac{(36+44)}{112}$$

$= 0.714$

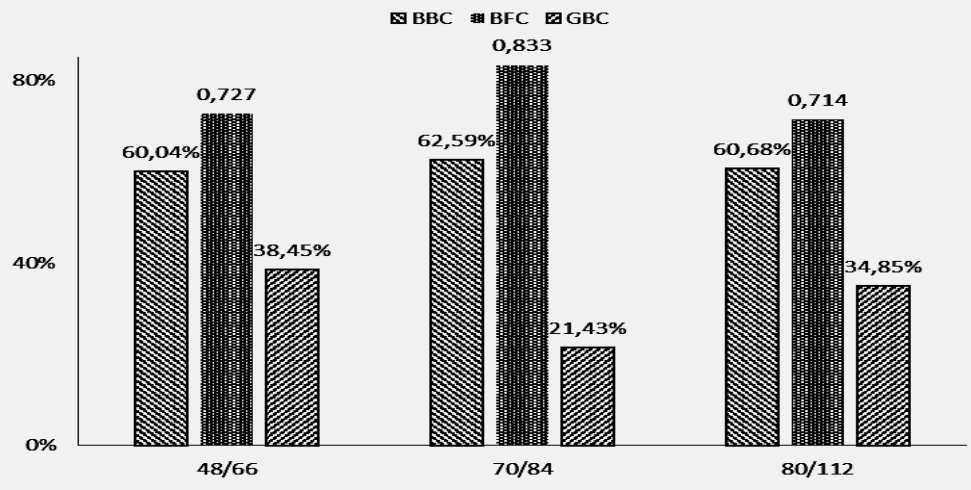
$$GBC = \frac{Open\ Space\ Area}{Project\ Area}\ x\ 100\% = \frac{39.04}{112}\ x\ 100\%$$

$= 34.85\%$

Table 7 shows the proportion of BBC, BFC, and GBC attainment levels based on the calculation findings

Type	Building Base Area (m^2)	BBC	BBC achievement level	BFC	BFC achievement level	GBC	GBC achievement level
48/66	39,63	60,04%	WORTHY	0,727	WORTHY	38,45%	WORTHY
70/84	52,58	62,59%	WORTHY	0,833	WORTHY	21,43%	WORTHY
80/112	67,96	60,68%	WORTHY	0,714	WORTHY	34,85%	WORTHY

Figure. 8. The Values of residential housing



Based on the Table 7 and Fig. 8 it can be stated that residential housing is worthy to be developed.

6. An examination of the parameters of the GRT

This GRT evaluation was created to evaluate new homes, existing and rebuilt homes, appropriate land use, efficiency and conservation, cycles and material resources, health and comfort in room, and building environmental management.

7. Appropriate land use classification:

In the appropriate land use category, the location and land use, including green areas, supporting infrastructure, community accessibility, pest control, public transportation, and handling of rainwater are considered.

8. Category of energy efficiency and conservation

The energy efficiency and conservation category, namely energy use, including sub-meters, artificial lighting, air conditioning, heat reduction, household appliances, energy-saving and renewable energy sources.

9. Water conservation classification

Considered criteria in the water conservation category are water use, including water meters, water-saving output devices, use of rainwater, water-saving irrigation, and waste water management (Sayed and Sawant, 2016).

10. Cycle type and material source

This includes the use of materials, including non-ozone-depleting refrigerants, the use of used materials, environmentally friendly materials and production processes, certified wood, pre-fabricated materials, local materials, and carbon footprint.

11. Categories of Indoor Health and Comfort

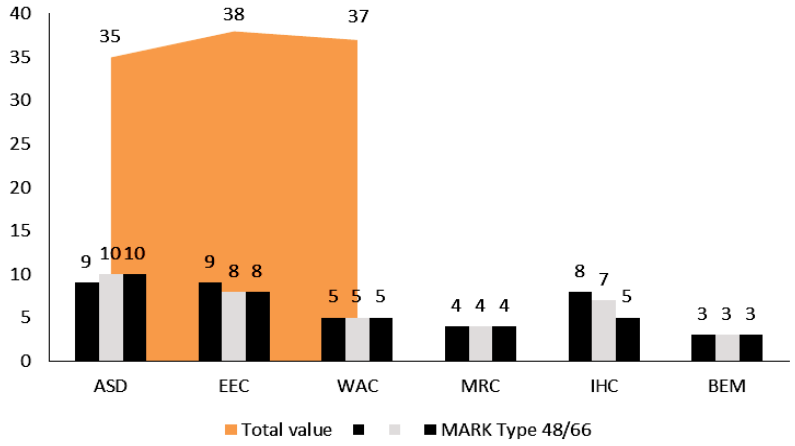
In this terms are space utilization, including air circulation, natural lighting, visual comfort, minimization of pollutant sources, noise level, and spatial comfort.

12. Building environmental management category

The criteria are environmental areas including sustainable construction design, house building guidelines, environmentally friendly activities, waste management, security, innovation, and growing house design. A summary of the results of the GRT form can be seen in Table 8 and Fig. 9.

Table 8. Summary of Assessment Results

CATEGORY	MARK		
	Type 48/66	Type 70/84	Type 80/112
ASD	10	9	10
EEC	8	9	8
WAC	5	5	5
MRC	4	4	4
IHC	5	8	7
BEM	3	3	3
Total value	35	38	37
Rating	*SILVER*	*SILVER*	*SILVER*



According to the GRT, the value of Greenship Homes for each type of house is 35 for houses Type 48/66, 38 for houses Type 70/84, and 37 for houses Type 80/112. Based on these findings, the Greenship Homes for Malang residential house ranking is silver for all building types.

1. Analysis of Non-Technical Feasibility

Calculations on non-technical aspects in the feasibility study include land costs and the legality of the object of the project location; construction costs per house; facilities, infrastructure, and public facilities that exist in the project; and resources used for the benefit of the project.

2. Land Cost Calculation and Legality

Based on the survey, the SVTO value for land in Malang City for the Malang Residential House area is in the range of IDR 1,1 billion to IDR 1,3 billion, but in this calculation, the highest SVTO value of land is IDR 1,3 billion.

Based on the calculation of the land budget plan and legality, it can be determined the price of land per 1 square meter, as:

$$1\ m^2 = \frac{The\ total\ cost\ of\ land}{Land\ Area\ effektif} = \frac{IDR28,616,250,919}{20640.1}$$

= IDR 1,386,439/m^2

The calculation results of the land price per square meter can be used to calculate the land price per plot of each type of house described in Table 9.

Table 9 Land prices for each house type

No	Type	Surface area (m 2)	Land Price / m 2	Total Land Price
1	48/66	66	Rp 1,386,439	Rp 91,504,995
2	70/84	84	Rp 1,386,439	Rp 116,460,903
3	80/112	112	Rp 1,386,439	Rp 155,281,204

Based on Table 9, the total land price for house 48/66, 70/84 and 80/112 type are IDR 91,5 million; IDR 116,46 million and IDR 155,28 million.

1. Estimation of Construction Costs

The basic construction costs for each type of house that have been calculated will be multiplied by the number of each type of house to be built so that the results are obtained as shown in Table 10.

Table 10. Construction cost summary

No.	House Type	Amount	Cost per house	Total Construction Cost
1	48/66	27	IDR 179.592,155.00	IDR 4,848,988,185.00
2	70/84	50	IDR 256,568,191.15	IDR 12,828,409,557.50
3	80/112	7	IDR 301,678,336.50	IDR 2,111,748,355.50
				IDR 19,789,146,098.00

Based on the results in Table 10, the total construction cost for 27 housing units of type 48/66 is IDR 4,85 billion; 50 housing units of type 70/84 amount to IDR 12,83 billion; and 7 housing units of type 80/112 amount to IDR 2,11 billion; so that the total cost of house construction at Malang residential house is IDR 19,79 billion.

2. Cost of infrastructure, and public facilities

The cost of infrastructure, and public facilities per square meter can be calculated by dividing the total cost by the effective land area of the entire house:

$$\text{per m}^2 = \frac{Total\ Cost}{Land\ Area\ effektif} = \frac{IDR\ 4{,}702{,}297{,}241}{6766}$$

= IDR 694,989/ m^2

The calculation of these costs will be used subsequently to calculate the cost of facilities, infrastructure, and public facilities for each type of house, as detailed in Table 11.

Table 11: Facility, Infrastructure, and Public Facility Costs for Each House Type

No.	House Type	Land Area (m^2)	per m2	Total
1	48/66	66	IDR 694,989	IDR 45.869,274
2	70/84	84	IDR 694,989	IDR 58.379,076
3	80/112	112	IDR 694,989	IDR 77.838,768

Based on the results in Table 11, the total cost of facilities, infrastructure, and public facilities for each type of house for houses type 48/66 is IDR 45,87 million; for houses type 70/84, it is IDR 58,38 million; and for houses type 80/112, it is IDR 77,84 million.

3. Calculation of operational costs

The operational costs calculation includes employee salaries; office expenses; telephone; small equipment costs and consumables; and office telephone costs for field needs such as electricity, clean water, drinking water, sanitation, and so on. Office operational cost and marketing needs are analyzed annually by considering the average inflation for the last 10 years which details can be seen in Table 12.

Table 12. Office and marketing operational cost

Year-	2019 Fees	Cost After Inflation	
0	IDR 95.991.000,00	IDR	95.991.000
1		IDR	100.388.828
2		IDR	104.988.142
3		IDR	109.798.174
TOTAL		**IDR**	**411.166.144**

Based on Table 12, the details of employee salaries for operational costs are IDR 520,8 million per year, and total office and marketing costs are IDR 411.17 million for 3 years. These costs are then calculated as operational costs for a 3-year project, which are detailed in Table 13 as follows.

Table 13 Total Operating Costs for 3 Years

Description	Cost per year IDR	5 years fee IDR	
Employee salary	IDR 520.800.000	IDR	2.083.200.000
Office and Marketing Expenses		IDR	411.166.143
Total Operating Cost		**IDR**	**2.494.366.143**
Operating Cost per m ^{2}			**IDR 368.662**

Based on the results in Table 13, the 0perational cost per square meter can be calculated by dividing the total cost by the effective land area of the entire house plot:

$$\text{per } \frac{Total\ Cost}{Land\ Area\ Effective} \text{m}^2 = \frac{IDR\ 2{,}494{,}366{,}143}{6766}$$

$$= \text{IDR } 368{,}662/\ \text{m}^2$$

The results from the breakdown of costs in Table 13 will be used to calculate operational costs and determine the total operational costs for each type of house plot. Calculation of operational costs for each type described in Table 14.

Table 14 Operating Costs per House Type

No	House Type	Land Area (m ^{2})	Cost / m ^{2}	Cost per Type
1	48/66	66	IDR 368,662	24,331,683
2	70/84	84	IDR 368,662	30,967,596
3	80/112	112	IDR 368,662	41,290,128

Based on the results in Table 14, the operational cost values for each type of house 48/66, 70/84 and 80/112 house type are IDR 24,33 million, IDR 30,97 million, and IDR 41,29 million respectively.

3. Determining the Cost of Building a House

The cost of the building is the sum of the total cost of land, construction costs, facility and infrastructure costs, and operational costs. Summary of housing costs shown in Table 15.

Table 15. The cost of different types of houses

House Type	Land Area (m^2)	Construction cost	Infrastructure costs	Operating Cost	the Cost of House Construction Per Unit
48/66	66	91.504.995	179.592.155	24.331.683	341.298.123
70/84	84	116.450.903	256.568.191	30.967.596	462.375.787
80/112	112	155.281.204	301.678.337	41.290.128	576.088.464

Figure 10 illustrated shows the costs of different types of houses. The calculations to determine the unit cost of building a house type 46/66 are as follows:

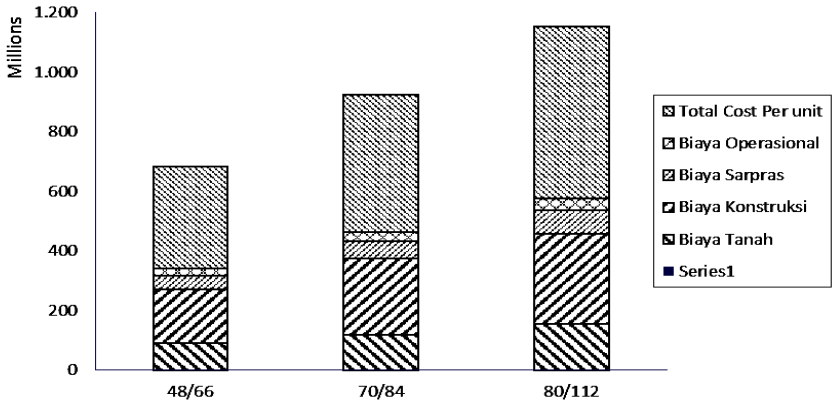
= (Land + Building + Infrastructure + Operating) costs (in million)

= IDR (91,5 + 179.6 + 45,87 + 24,33) million

= IDR 341,3 million

The results of the calculation of the cost of building a house are said to IDR 341,3 million. Based on the calculation results in Table 15, the cost of building of 48/66, 70/84 and 80/112 house type costs IDR 341,3 million, IDR 462,38 million, and IDR 576,09 million respectively.

Figure. 10 House cost of different type



4. Cash Flow Analysis

The calculation of cash flow in the Malang Residential House development project includes all income and expenses as follows.

a. The financial projection period is 3 years.

b. The number of houses available is 84 units.

c. The percentage of capital provision is 50% own capital and 50% bank loan capital.

d. The total equity and bank loans are IDR 14,625 million each so that the total capital is IDR 29,25 billion.

5. Financial Feasibility Analysis

The expenses consist of the following costs:

a. The price of Land and legality cost

Based on the results of the calculation analysis, it is found that the cost required for a land area of 20640.1 m^2 is IDR 28,62 million.

b. Building Costs

Based on the calculation results, the construction costs per housing unit can be seen in Table 15.

c. Facility, Infrastructure, and Public Facility Costs Based on the results of the calculation analysis, the total cost required is IDR 4,7 billion.

d. Operating Expenses

Based on the results of the calculation analysis, it was found that the cost value for each type of house was described in Table 14.

The advantage that the developer will take later the 2.5% income tax fee is offset by a 2.5% VAT fee of 10% on annual income.

The percentage of capital provision is 50% own capital and 50% bank loan capital, with a term of 3 years for the project financial projection. Total

capital owned and a bank loan of IDR 14,625 million therefore the total capital is IDR 29,25 billion.

The cash flow calculation uses the Minimum Attractive Rate of Return (MARR) based on the rate of return on own capital and the rate of return on loan capital, which is the same as the WACC value of 14.31%. Flow project can be seen in Table 16.

Table 16 The projected cash flow.

year	INCOME (IDR)	EXPENS (IDR)	CUMULATIVE (IDR)
0	29.250.000.000	29.233.041.919	16.958.081
1	16.445.765.611	19.922.164.663	-3.459.440.972
2	29.701.487.971	24.819.001.301	1.423.045.698
3	31.901.989.995	30.902.893.888	2.422.141.805

Based on the calculation of the cash flow value of income and expenditure, the results of the feasibility analysis are obtained, namely:

1. Net Present Value (NPV)

The NPV is obtained from the difference between the current investment value and the value of net cash receipts, with an interest rate of WACC used of 14.31%. The NPV value obtained is IDR 1,382,745,228, thus the investment is said to be feasible and profitable because the NPV value > 0.

2. BCR (Benefit Cost Ratio)

Based on the calculation, the BCR value is 1.02, meaning that the investment is considered feasible and profitable because the value of BCR >1.

3. IRR (Internal Rate of Return)

Because the MARR value is 14.31%, based on the calculation, the investment is considered feasible and profitable because the value of IRR > MARR.

4. Payback Period (PBP)

Based on the calculation, the payback period is obtained, i.e. 1 year and 6 months, so it is said to be feasible because the payback period is greater than the economic life of the project (3 years).

6. Sensitivity Analysis

The results of the sensitivity calculation show that changes in the percentage of capital are not sensitive to the IRR value because changes in own capital and bank loans have reached a percentage of 100%, but the parameters still show that it is feasible.

CONCLUSION

Based on the calculation of engineering feasibility with the parameters GRT and financial feasibility, it can be concluded that: The houses types 48/66, 70/84, and 80/112 has been declared technically feasible because it meets the requirements of city regulation. Completion of assessment points based on the GRT issued by the GBCI on the design of house plans of type 48/66, type 70/84, and type 80/112, with points ranging from 35 to 42, allowing Malang Residential Housing to achieve SILVER. The total land and legality costs in the non-technical/investment feasibility analysis are IDR 28.62 billion; total construction costs are IDR 19.79 billion; the cost of facilities and infrastructure is IDR 4.7 billion; and operational costs are IDR 2.49 billion. Based on the calculation, financial feasibility is determined, with the NPV of IDR 1,382 million > 0; the BCR value of 1.02 > 1; the result of Internal Rate of Return (IRR) of 59.75% > MARR; and the PBP value of 1 year and 6 months > the project's economic life, hence said financially feasible.
Sensitivity analysis shows that changes in the percentage of capital are not sensitive to the IRR parameter.

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