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Cost and Time Efficiency Comparison of RISHA and Conventional Construction for Type 36 Post-Disaster Housing in Rua Village, Ternate

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Abstract

Background: The increasing demand for rapid, affordable, and reliable housing has encouraged innovation in construction methods, including the RISHA modular system. However, its cost and time efficiency compared with conventional construction remain debated, especially in post-disaster and remote areas.
Objective: This study aims to compare the construction costs and implementation time of the RISHA (*Rumah Instan Sederhana Sehat*) modular construction method and the conventional construction method for a Type 36 single-story house.
Methods: This research employed a comparative quantitative approach. Data analysis included: (1) calculating work volume for each work category, (2) conducting unit price analysis based on the Ministry of Public Works and Housing's Standard Unit Price Analysis (*Analisis Harga Satuan Pekerjaan*, AHSP) and Regional Standard Unit Prices (*Harga Satuan Pokok Kegiatan*, HSPK), (3) preparing the Cost Budget Plan (*Rencana Anggaran Biaya*, RAB), and (4) calculating implementation time using the work coefficient method.
Results: The results show that the RISHA method required a total cost of IDR 167,918,089.00 and an implementation duration of 56 working days, or 8 weeks. Meanwhile, the conventional method incurred a cost of IDR 172,562,093.00 and required 75 working days, or 11 weeks. Thus, RISHA construction provided cost savings of 2.69% and time efficiency of 25% compared with the conventional method. Although the cost of the RISHA superstructure was higher due to the use of precast components, significant savings in foundation and wall work, along with an accelerated construction timeline, made RISHA a more efficient overall alternative.
Conclusion: Therefore, it can be concluded that the RISHA method offers advantages in cost and time efficiency for constructing a simple Type 36 house in the context of this study.

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INTRODUCTION

The construction sector in Indonesia has grown significantly in line with population growth and the increasing demand for decent, safe, and affordable housing. Through various programs, such as simple housing development and subsidized housing, the government continues to promote the use of construction methods that are efficient, fast, and high quality

(Mulyawan et al., 2023; PUPR, 2021; Rakyat, 2016).

Conventional construction methods remain the most widely used approach. These methods offer advantages in terms of design flexibility and ease of implementation, but they also have several weaknesses, including relatively long construction times, dependence on weather conditions, varying labor productivity, and the potential for material waste (Afkhamiaghda & Elwakil, 2023; Alsaadi & Acar, 2021; Rahman & Hidayat, 2020). As an innovation, the Ministry of PUPR developed the *Rumah Instan Sederhana Sehat* (RISHA) technology. This system is a modular precast reinforced-concrete building system that can be assembled quickly onsite using a knock-down construction concept. RISHA is designed for gradual development and is relatively easy to apply in mass housing development and post-disaster housing (Mulyawan et al., 2023; PUPR, 2021; Rakyat, 2016).

Nevertheless, the field implementation of RISHA construction still faces various challenges. One aspect that is often a major consideration is construction cost. The initial cost of producing precast panels, the need for specialized supporting equipment, and the limited availability of factories supplying RISHA components in various regions have created the perception that RISHA construction is more expensive than conventional construction (Muliawan, 2018; Waris et al., 2024). Based on these issues, a study is needed to objectively compare RISHA construction and conventional construction, particularly in terms of cost and implementation time. This study aims to: (1) determine the construction costs of the RISHA and conventional methods, (2) determine the construction duration of both methods, and (3) compare the cost and time efficiency of the two methods in the construction of a type 36 house.

Post-disaster housing reconstruction represents one of the most challenging contexts for construction project management globally. The United Nations Office for Disaster Risk Reduction (Agarwalla & Parida, 2026; UNDRR, 2020) reported that, between 2000 and 2019, natural disasters displaced more than 24 million people annually, creating an urgent demand for rapid, cost-effective, and structurally sound housing solutions. In Indonesia, a disaster-prone archipelago, the challenge is particularly acute. The National Disaster Management Agency (BNPB) documented 5,402 natural disaster events between 2010 and 2023, many of which destroyed thousands of housing units and triggered large-scale reconstruction programs (Bencana, 2024). The government's standard response has included both conventional construction and modular approaches such as RISHA (*Rumah Instan Sederhana Sehat*), yet systematic evidence comparing their efficiency in specific regional contexts remains limited.

Previous comparative studies of RISHA and conventional methods, such as those by Gunata and Pratama (2023), Sulistiana et al. (2024a), and Waris et al. (2024), have primarily been conducted in Java and Sulawesi. These studies generally found that RISHA offers modest cost advantages and significant time savings, particularly in superstructure work. However, they have not critically assessed local logistical constraints such as the limited regional availability of precast panels, transportation costs to remote islands, and the capacity of local labor forces to handle modular assembly, all of which are critical in Eastern Indonesian contexts such as Ternate. This gap in context-specific research constitutes the novelty and urgency of the present study.

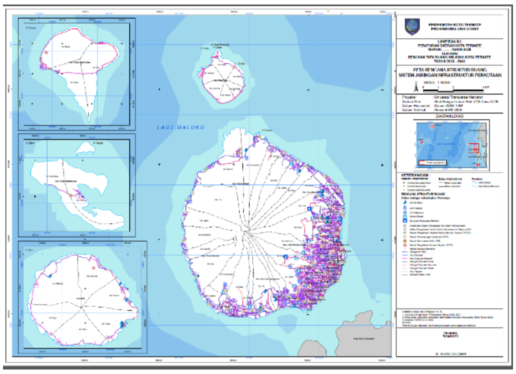
The research gap addressed by this study concerns the absence of a comparative cost-time analysis of RISHA and conventional construction specifically in the Maluku Islands context following a flash flood disaster. The 2024 Ternate flash flood (Bencana, 2024) created a reconstruction scenario with distinct characteristics: remote island geography, limited precast component supply chains, and urgent community needs. While the RISHA system was designed precisely for rapid deployment under such conditions (Mulyawan et al., 2023; Rakyat, 2016), no published study has quantified its actual efficiency advantages in this specific context. The novelty of this research lies in providing empirical evidence from a real post-disaster reconstruction project in Eastern Indonesia, where the results may differ from those obtained in regions of the country with more developed supply chains.

METHOD

This study is a comparative quantitative study because it involves numerical calculations of construction costs and implementation time to compare two construction methods. This design enables an objective comparison between the two construction methods (RISHA modular vs. conventional) by measuring quantitative variables, including work volume, unit price, total cost, and implementation time. The comparative approach also facilitates the identification of significant differences that can serve as the basis for policy recommendations in the context of post-disaster development.

Research Overview

This study was conducted in Rua Urban Village, Ternate City, North Maluku Province. The object of the study is a simple one-story type 36 residential house built as part of a post-flash-flood housing area in Ternate City in 2024 (Bencana, 2024).


(a)


(b)

Figure 1. (a) Map of Ternate City, (b) Research Location

Data Collection

To obtain accurate and relevant data, the data collection method used two main sources, as follows: (1) Secondary data included previous scientific journal articles, project documents such as working drawings, work volume calculations, the Cost Budget Plan (*Rencana Anggaran Biaya*—RAB), the project Gantt schedule or CPM (Critical Path Method), field inspection reports, and minutes of coordination meetings. (2) Primary data were obtained through direct field observations of the permanent housing development project following the flash flood disaster in Rua Urban Village, Ternate City.

Data Analysis

The analysis was carried out through four main stages, each supported by relevant statistical techniques.

Work Volume Analysis

The total volume was calculated by work category, including structural, architectural, MEP, and other related work, for each construction method. A normality test using the Kolmogorov–Smirnov test was conducted to determine the distribution of the volume data.

Unit Price Analysis

The average unit price was calculated for each work item and then compared between the RISHA and conventional construction methods. If the data were normally distributed, the independent-samples t-test was used; otherwise, the Mann–Whitney U test was applied.

Preparation of the Cost Budget Plan (RAB)

The total project cost was obtained by multiplying the work volume by the unit price and then summing the results. One-way analysis of variance (ANOVA) was used to assess differences in average costs between the construction methods, assuming homogeneity of variance based on Levene's test.

Implementation Time Calculation

The total project duration, measured in days, was calculated from the start date to the completion date. Survival analysis using the Kaplan–Meier method was used to describe the distribution of implementation time, and curve comparisons were conducted using the log-rank test. Linear regression, or the Cox proportional hazards model when censored data were present, was used to identify factors influencing implementation time, with the construction method as the main independent variable.

RESULTS AND DISCUSSION

Results

RISHA Modular Construction

The research subject used as the case study was a simple one-story Type 36 residential house. The construction data were obtained from the post-flash-flood permanent housing relocation project (*Huntap*) in Rua Urban Village, Ternate City (Bencana, 2024). To provide a clear overview of the spatial configuration and the locations of the structural elements, the building plans are presented in Figures 2 and 3.

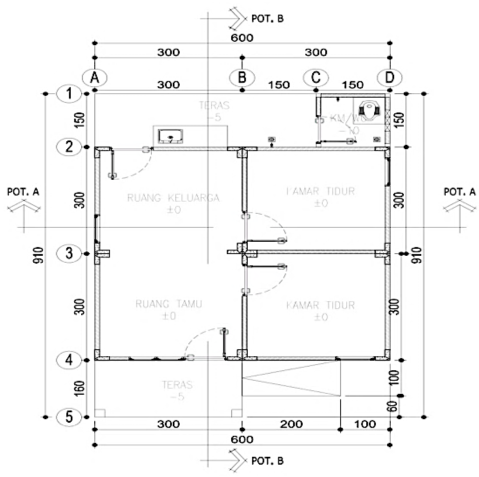


Figure 2. Housing Plan

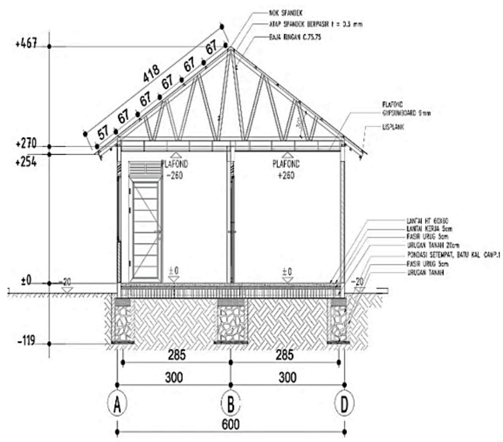


Figure 3. Section A-A of the Type 36 House Building

Conventional Construction

The floor plan and height of the conventional house were designed to be the same as those of the RISHA house. The substructure, comprising the foundation, and the superstructure, comprising tie beams, columns, and beams, refer to the ASN II Development Project in North Maluku Province, which uses common standard dimensions for simple housing construction using conventional methods.

Work Volume

The work volume calculation shows significant differences between the two methods, especially in the substructure, superstructure, and wall work. In the substructure, the RISHA method uses local river-stone foundations, with a total excavation volume of 3.97 m^3 and a river-stone masonry foundation volume of 1.58 m^3. In contrast, the conventional method uses continuous river-stone foundations, with a total excavation volume of 23.67 m^3 and a river-stone masonry foundation volume of 9.65 m^3. In the superstructure, the RISHA method uses P1 panels (78 units), P2 panels (30 units), and P3 panels (30 units) with a bolt-and-plate connection system, whereas the conventional method uses 33 m of tie beams, 27 m of columns, and 36 m of ring beams with standard dimensions. For wall work, the RISHA method has 49.1 m^2 of lightweight brick masonry and 124.11 m^2 of wall finishing, whereas the conventional method has 70.38 m^2 of lightweight brick masonry and 151.20 m^2 of wall finishing.

RISHA Construction Cost Budget Plan

Table 1. RISHA Cost Budget Plan

No.	Work Item Description	Unit	Volume	Unit Price (IDR)	Total Price (IDR)
(1)	(1)	(1)	(1)	(1)	(1) = 4 x 5
A	Substructure Work (Foundation)				3.661.895,54
1	Excavation Work	M^3	397	138.669,39	550.378,82
2	Sand Fill Work	M^3	0,22	262.427,01	57.865,16
3	Foundation Stone Masonry Work	M^3	158	1.125.210,60	1.772.206,70
4	Local Foundation Concrete Work K-175	M^3	934	1.433.088,62	483.667,41
5	Formwork	M^2	2,70	232.655,86	628.170,81
6	Backfill Work	M^3	184	92.378,35	169.606,57
B	Superstructure Work (RISHA)				35.125.998,36
1	RISHA 6x6 Structural Panel Installation	Unit	1,00	35.125.998,36	35.125.998,36
C	Wall Work				30.602.480,69
1	Lightweight Brick Wall Installation	M^2	49,10	288.197,56	14.149.117,08
2	RISHA Panel Covering with Gypsum	M^2	14,40	69.679,27	1.003.381,53
3	Wall Plastering	M^2	98,19	77.776,92	7.636.947,30
4	Wall Skim Coat	M^2	124,11	62.952,30	7.813.034,79
D	Sopi-Sopi Work				7.321.087,81
1	Sofi-Sopi Lightweight Brick Wall Installation	M^2	10,44	288.197,56	3.008.782,58
2	Sofi-Sopi Practical Column Work	M^3	3,48	123.874,95	431.084,84
3	Sofi-Sopi Beam Work	M^3	13,84	163.296,23	2.260.019,76
4	Sofi-Sopi Wall Plastering	M^2	11,52	77.776,92	895.990,17
5	Sofi-Sopi Wall Skim Coat	M^2	11,52	62.952,30	725.210,46
E	Roof Work				29.314.685,13

No.	Work Item Description	Unit	Volume	Unit Price (IDR)	Total Price (IDR)
1	C75 Lightweight Steel Roof Truss Installation	M^2	34,56	416.950,35	14.409.804,03
2	Lightweight Steel Batten Installation	M^3	112,00	21.011,74	2.353.314,33
3	Spandek Roof Covering Work	M^2	70,08	127.753,85	8.952.990,10
4	Ridge Installation	M^3	3,00	74.967,38	599.739,00
5	GRC Fascia Board Installation 0.8x20 cm	M^3	32,72	91.651,52	2.998.837,66
F	Door and Window Work				18.008.875,02
1	UPVC Door Panel PJ1 Installation	Unit	1,00	4.957.687,86	4.957.687,86
2	UPVC Door Panel P1 Installation	Unit	3,00	2.443.575,20	7.330.725,60
3	UPVC Window Panel J1 Installation	Unit	3,00	1.906.820,52	5.720.461,56
G	Ceiling Frame and Covering Work				20.211.568,44
1	Hollow 35x35 Ceiling Frame Installation	M^2	57,57	281.411,06	16.200.272,06
2	Gypsum Ceiling Installation	M^2	57,57	69.679,27	4.011.296,38
H	Floor Covering Work				11.358.335,85
1	Subfloor Fill Soil Work	M^3	6,27	92.378,35	579.397,01
2	5 cm Thick Subfloor Sand Fill	M^3	1,57	262.427,01	411.485,55
3	5 cm Thick Subfloor Lean Concrete (K-100)	M^3	1,57	1.334.813,56	2.092.987,66
4	HT 60x60 Floor Tile Work	M^2	31,36	263.854,13	8.274.465,63
I	Painting Work				12.313.162,24
1	Exterior Wall Painting	M^2	73,58	72.617,33	5.342.834,72
2	Interior Wall Painting	M^2	76,46	55.265,12	4.225.305,44
3	Ceiling Painting	M^2	57,57	47.683,12	2.745.022,08
Total					167.918.089,07

Based on the unit price analysis and work volume for each work item, the construction cost budget plan (*Rencana Anggaran Biaya* [RAB]) for the RISHA method was prepared. The complete details of the RAB are presented in table 2.

Table 2. Recapitulation of the RISHA Construction Cost Budget Plan

Work Description	Total Price (IDR)
Substructure Work (Foundation)	3.661.895,54
Superstructure Work (RISHA)	35.125.998,36
Wall Work	30.602.480,69
Sopi-Sopi Work	7.321.087,81
Roof Work	29.314.685,13
Door and Window Work	18.008.875,02
Ceiling Frame and Covering Work	20.211.568,44
Floor Covering Work	11.358.335,85
Painting Work	12.313.162,24
Total Amount	167.918.089,07
Rounded	167.918.089,00

Based on the recapitulation results in Table 2, the total cost of a Type 36 simple house using the RISHA method is IDR 167,918,089.00.

Conventional Construction Cost Budget Plan

Based on the unit price analysis and work volume for each work item, the Construction Budget Plan (*Rencana Anggaran Biaya* [RAB]) for the conventional method was obtained. The complete details of the RAB are presented in table 3.

Table 3. Cost Budget Plan for the Conventional Method

No.	Work Item Description	Unit	Vol.	Unit Price (IDR)	Total Price (IDR)
A	Substructure Work (Foundation)				18.591.735,51
1	Excavation Work	M^3	23,76	138.669,39	3.294.784,75
2	Sand Fill Work	M^3	1,32	262.427,01	346.403,65
3	Rubble Stone Work	M^3	5,28	643.166,92	3.395.921,32
4	Foundation Stone Masonry Work	M^3	9,65	1.125.210,60	10.861.095,32
5	Backfill Work	M^3	7,51	92.378,35	693.530,46
B	Superstructure Work				14.612.063,34
1	Tie Beam Work 10 cm x 15 cm	M^3	33,00	163.296,23	5.388.775,45
2	Column Work 11 cm x 11 cm	M^3	27,00	123.874,95	3.344.623,77
3	Ring Beam Work 10 cm x 11 cm	M^3	36,00	163.296,23	5.878.664,12
C	Wall Work				40.749.725,72
1	Lightweight Brick Wall Installation	M^2	70,38	288.197,56	20.283.402,24
2	Wall Plastering	M^2	140,76	77.776,92	10.947.910,96
3	Wall Skim Coat	M^2	151,20	62.952,30	9.518.412,52
D	Sopi-Sopi Work				7.321.087,81
1	Sopi-Sopi Lightweight Brick Wall Installation	M^2	10,44	288.197,56	3.008.782,58
2	Sopi-Sopi Practical Column Work	M^3	3,48	123.874,95	431.084,84
3	Sopi-Sopi Beam Work	M^3	13,84	163.296,23	2.260.019,76
4	Sopi-Sopi Wall Plastering	M^2	11,52	77.776,92	895.990,17
5	Sopi-Sopi Wall Skim Coat	M^2	11,52	62.952,30	725.210,46
E	Roof Work				29.314.685,13
1	C75 Lightweight Steel Roof Truss Installation	M^2	34,56	416.950,35	14.409.804,03
2	Lightweight Steel Batten Installation	M^3	112,00	21.011,74	2.353.314,33
3	Spandex Roof Covering Work	M^2	70,08	127.753,85	8.952.990,10
4	Ridge Installation	M^3	8,00	74.967,38	599.739,00
5	GRC Fascia Board Installation 0.8x20 cm	M^3	32,72	91.651,52	2.998.837,66
F	Door and Window Work				18.008.875,02
1	UPVC Door Panel PJ1 Installation	Unit	1,00	4.957.687,86	4.957.687,86
2	UPVC Door Panel P1 Installation	Unit	3,00	2.443.575,20	7.330.725,60
3	UPVC Window Panel J1 Installation	Unit	3,00	1.906.820,52	5.720.461,56

No.	Work Item Description	Unit	Vol.	Unit Price (IDR)	Total Price (IDR)
G	Ceiling Frame and Covering Work				20.211.568,44
1	Hollow 35x35 Ceiling Frame Installation	M^2	57,57	281.411,06	16.200.272,06
2	Gypsum Ceiling Installation	M^2	57,57	69.679,27	4.011.296,38
H	Floor Covering Work				11.068.637,34
1	Subfloor Fill Soil Work	M^3	3,14	92.378,35	299.698,51
2	5 cm Thick Subfloor Sand Fill	M^3	1,57	262.427,01	411.485,55
3	5 cm Thick Subfloor Lean Concrete	M^3	1,57	1.334.813,56	2.092.987,66
4	HT 60x60 Floor Tile Work	M^2	31,36	263.954,13	8.274.465,63
I	Painting Work				12.683.714,84
1	Exterior Wall Painting	M^2	73,58	72.617,33	5.342.934,72
2	Interior Wall Painting	M^2	83,16	55.265,12	4.595.858,04
3	Ceiling Painting	M^2	57,57	47.683,12	2.745.022,08
Total Amount					172.562.093,14

Table 4. Recapitulation of the Conventional Construction Cost Budget Plan

Work Description	Total Price (IDR)
Substructure Work (Foundation)	18.591.735,51
Superstructure Work (RISHA)	14.612.063,34
Wall Work	40.749.725,72
Sopi-Sopi Work	7.321.087,81
Roof Work	29.314.685,13
Door and Window Work	18.008.875,02
Ceiling Frame and Covering Work	20.211.568,44
Floor Covering Work	11.068.637,34
Painting Work	12.683.714,84
Total Amount	172.562.093,14
Rounded	172.562.093,00

Based on the recapitulation results presented in Table 4, the total cost of a Type 36 simple house constructed using the conventional method is IDR 172,562,093.00, which is consistent with the cost recapitulation in Table 4.

Work Time Analysis

To determine the time required for each work item, the first step is to determine the number of workers. In this study, the number of workers is assumed to be five for each work item. The duration of each work item is calculated using the following equation:

$$\mathbf{T} = \frac{\mathbf{V\ x\ K}}{\mathbf{N}}$$

Notes:

T = Time
K = Labor Coefficient
V = Work Volume
N = Number of Workers

Work Time Analysis of the RISHA Method

The analysis of the work time calculation for each work item can be seen in the table 5.

Table 5. RISHA Work Time Schedule

No.	Work Item Description	Total Price (IDR)	Weight (%)	Month 1 (Week 1)	Week 2	Week 3	Week 4	Month 2 (Week 5)	Week 6	Week 7	Week 8
A	Substructure Work (Foundation)	3.661.895,54	2,18	0,33	0,03	1,06	0,29	0,37	0,10		
B	Superstructure Work (RISHA)	35.125.998,36	20,92								
B1	RISHA 6x6 Structural Panel Installation	35.125.998,36									
C	Wall Work	30.602.480,69	8,43			4,55	4,65				0,60
D	Sopi-Sopi Work	7.321.087,81		1,79	0,26	1,35	0,53		0,43		
E	Roof Work	29.314.685,13		4,29	4,29	1,40	5,33	0,36			1,79
F	Door and Window Work	18.008.875,02		2,95	4,37	3,41					
G	Ceiling Frame and Covering Work	20.211.568,44						9,65	2,39		
H	Floor Covering Work	11.358.335,85		0,35	0,25	1,25	4,93				
I	Painting Work	12.313.162,24		3,18	2,52	1,63					
	Total Amount	167.918.089,07	100	31,53	7,69	11,38	15,81	5,08	9,65	10,94	7,93

Based on the construction duration analysis presented in Table 5, the construction of a simple one-story Type 36 house using the RISHA construction method requires a total of 8 weeks, or 56 working days.

Work Time Analysis of the Conventional Method

The analysis of the work time calculation for each work item can be seen in the table 6.

Table 6. Conventional Work Time Schedule

NO	Work Item Description	Total Price (IDR)	Weight %	Month 1 Week 1	Week 2	Week 3	Week 4	Month 2 Week 5	Week 6	Week 7	Week 8	Month 3 Week 9	Week 10	Week 11
(1)	(2)		(6)=4x5											
A	SUBSTRUCTURE WORK (FOUNDATION)	18.591.735,51	10,77	1,91										
1	Foundation Excavation Work		1,91	0,20										
2	Foundation Sand Fill Work		0,20	1,97										
3	Rubble/River Stone Work		1,97	6,29										
4	Foundation Stone Masonry Work		6,29		0,40									
5	Backfill Work		0,40	0,00	8,46	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
B	SUPERSTRUCTURE WORK	14.612.063,34	8,46		3,12									
1	Tie Beam Work 10 cm x 15 cm		3,12		1,94									
2	Column Work 11 cm x 11 cm		1,94		3,40									
3	Ring Beam Work 10 cm x 11 cm		3,40	0,00	0,00	11,74	0,00	0,79	5,55	3,67	1,84	0,00	0,00	0,00
C	WALL WORK	40.749.725,72	23,59			11,74								
1	Lightweight Brick Masonry		11,74					0,79	5,55					
2	Wall Plastering		6,34							3,67	1,84			
3	Wall Skim Coat		5,51	0,00	0,00	3,30	0,00	0,00	0,00	0,52	0,42	0,00	0,00	0,00
D	SOPI-SOPI WORK	7.321.087,81	4,24			1,74								
1	Sopi-Sopi Lightweight Brick Masonry		1,74			0,25								
2	Sopi-Sopi Plastering		0,25			1,31								
3	Sopi-Sopi Skim Coat		1,31							0,52				
4	Additional Sopi-Sopi		0,52								0,42			

NO	Work Item Description	Total Price (IDR)	Weight %	Month 1				Month 2				Month 3		
				Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11
	Plastering													
5	Additional Sopi Skim Coat		0,42	0,00	0,00	0,00	6,26	8,98	0,00	0,00	0,00	1,74	0,00	0,00
E	ROOF WORK	29.314.685,13	16,98				6,26	2,09						
1	C75 Lightweight Steel Roof Truss Installation		8,35					1,36						
2	Lightweight Roof Tile Installation		1,36					5,18						
3	Spandex Roof Covering Work		5,18					0,35						
4	Fascia Board Installation		0,35									1,74		
5	GRC Installation 0.8x20 cm		1,74	0,00	0,00	0,00	0,00	10,42	0,00	0,00	0,00	0,00	0,00	0,00
F	DOOR AND WINDOW WORK	18.008.875,02	10,42					2,87						
1	UPVC Door Frame PJ1 Installation		2,87					4,24						
2	UPVC Door Leaf P1 Installation		4,24					3,31						
3	UPVC Window Leaf J1 Installation		3,31	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	3,13	6,25	2,32
G	CEILING FRAME AND COVERING WORK	20.211.568,44	11,70									3,13	6,25	
1	Hollow 35x35 Ceiling Frame Installation		9,38											2,32
2	Gypsum Ceiling Cover Installation		2,32	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	6,32	0,00	0,00
H	FLOOR COVERING WORK	10.923.788,09	6,32									0,08		
1	Subfloor Fill Soil Work		0,08									0,24		
2	5 cm Thick Subfloor Sand Fill		0,24									1,21		
3	5 cm Thick Subfloor Lean Concrete (K-100)		1,21									4,79		
4	Ceramic Floor Tile Work		4,79	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	7,53
I	PAINTING WORK	13.014.476,55	7,53											3,09
1	Exterior Wall Painting		3,09											2,85
2	Interior Wall Painting		2,85											1,59
3	Ceiling Painting		1,59											
	TOTAL	172.748.005,61	100											
	Weekly Weight (%)			10,37	8,86	15,04	6,26	20,19	5,55	4,19	2,26	11,19	6,25	9,85
	Cumulative Weight (%)			10,37	19,23	34,27	40,53	60,72	66,27	70,46	72,72	83,91	90,16	100,01

Based on the time calculation analysis presented for the construction of a simple one-story Type 36 house using the conventional construction method, the total time required is 11 weeks, or 75 working days.

Discussion

Cost Comparison between the RISHA Method and the Conventional Method

Based on the comparative analysis of the *Rencana Anggaran Biaya* (RAB), or Cost Estimate, for the construction of a simple one-story Type 36 house, the RISHA method and the conventional method show different cost values. The cost difference between the two methods is in table 7.

Table 7. Recapitulation of Cost Comparison between the RISHA and Conventional Methods

	Work Item Description	RISHA	Conventional
A	Substructure Work (Foundation)	3.661.895,54	18.591.735,51
B	Superstructure Work (RISHA)	35.125.998,36	14.612.063,34
C	Wall Work	30.602.480,69	40.749.725,72
D	Sopi-Sopi Work	7.321.087,81	7.321.087,81
E	Roof Work	29.314.685,13	29.314.685,13
F	Door and Window Work	18.008.875,02	18.008.875,02
G	Ceiling Frame and Covering Work	20.211.568,44	20.211.568,44
H	Floor Covering Work	11.358.335,85	11.068.637,34
I	Painting Work	12.313.162,24	12.683.714,84
	Rounded	167.918.089,00	172.562.093,00

Based on the analysis results in Table 7, which show cost differences by work item, the cost differences between the two construction methods are as follows.

Cost Difference in Substructure Work (Foundation)

The cost analysis of substructure work (foundation) shows that the RISHA method generates significant savings compared with the conventional method. The cost required for the foundation using the RISHA method is IDR 3,661,895.54, whereas the conventional method reaches IDR 18,591,735.51. The cost difference between the two methods is IDR 14,929,839.97, indicating that the RISHA method is approximately 80.3% more economical than the conventional method. This cost difference is mainly caused by differences in the type and volume of foundation work. The RISHA method uses local river-stone foundations, whereas the conventional method applies continuous river-stone foundations according to the type 36 house plan (Sulistiana et al., 2024a; Waris et al., 2024). The continuous foundation configuration in the conventional method results in greater material and labor volumes, thereby increasing the total costs incurred.

Efficiency of the Substructure (Foundation)

One of the most notable findings from this analysis is the very small cost weight of substructure work (foundation), which accounts for only 2.18% of the total cost, or IDR 3,661,895.54. RISHA technology transfers building loads centrally through column points; therefore, it does not require a continuous and deep river-stone foundation along the house walls. Local foundations (*umpak*/pad footings) with K-175 concrete are sufficient to support the load over an area of 36 m^2. This finding shows that RISHA can significantly reduce substructure construction costs.

Cost Difference in Superstructure Work

The cost analysis of superstructure work shows that the conventional method is more economical than the RISHA method. The cost required for the conventional method is IDR 14,612,063.34, whereas the RISHA method reaches IDR 35,125,998.36. The cost difference between the two methods is IDR 20,513,935.02, indicating that the RISHA method is approximately 140.4% more expensive than the conventional method. This significant difference is mainly caused by differences in the construction systems used. The RISHA method uses precast concrete structural components produced in factories, whereas the conventional method relies on structures built directly on site. Factors contributing to the higher cost of RISHA include production costs, specialized connection systems, and more complex supporting technology and equipment (Afkhamiaghda & Elwakil, 2023; Hidayat & Prasetyo, 2020; Liu & Lu, 2021).

Roof work accounts for 17.46% of the total cost. The budget of IDR 29,314,685.13 is dominated by the procurement of C75 lightweight steel roof trusses and spandex roof coverings. This material selection is highly appropriate for economical housing because of its strong weather resistance and low weight.

Cost Difference in Wall Work

The cost analysis of wall work shows that the RISHA method generates significant savings compared with the conventional method. The cost required for wall work using the RISHA method is IDR 30,602,480.69, whereas the conventional method reaches IDR 40,749,725.72. The cost difference between the two methods is IDR 10,147,245.03, indicating that the RISHA method is approximately 25% more economical than the conventional method. This difference is mainly caused by variations in volume, particularly in lightweight brick masonry, plastering, and wall-finishing work. In the conventional method, the larger work volume and the more material- and labor-intensive implementation process lead to higher costs (Gunata & Pratama, 2023).

Wall work accounts for 18.22% of the total cost, and the use of lightweight bricks (hebel) makes a major contribution to this cost item, with a value reaching IDR 14.14 million. Lightweight bricks were selected because they are consistent with the RISHA concept, which requires lightweight infill wall materials so that the precast structure is not excessively burdened.

The comparative analysis of the total construction cost for a simple one-story type 36 house shows a significant difference. The total cost using the RISHA method reaches IDR 167,918,089.00, whereas the conventional method requires IDR 172,562,093.00. Thus, there is a cost difference of IDR 4,829,916.00. This indicates that the application of the RISHA method in this study is approximately 2.69% cheaper than the conventional method (Pratama & Gunata, 2023; Salim et al., 2021).

Factors Influencing Cost Differences

Foundation Structure

The RISHA method uses local river-stone foundations that are simpler and more efficient in terms of material and labor use. Meanwhile, the conventional method applies continuous river-stone foundations, which require larger material volumes and more complex implementation. This contributes to higher costs in the conventional method.

Superstructure

Superstructure work in the RISHA method uses precast concrete components that can be mass-produced; however, these components involve higher production and delivery costs. On the other hand, conventional construction allows more flexible manual methods, but it does not always achieve the same level of cost efficiency.

Wall Work

The cost of wall work in the RISHA method is lower because it uses lightweight concrete blocks and more efficient plastering techniques compared with the conventional method, which requires more materials and labor. More economical material use in the RISHA method contributes to a reduction in total cost.

Comparison of Work Time between the RISHA Method and the Conventional Method

The comparative analysis of the implementation time for constructing a simple one-story Type 36 house using the RISHA and conventional methods shows differences in work duration. The difference in construction time between the two methods can be seen in Figure 4.

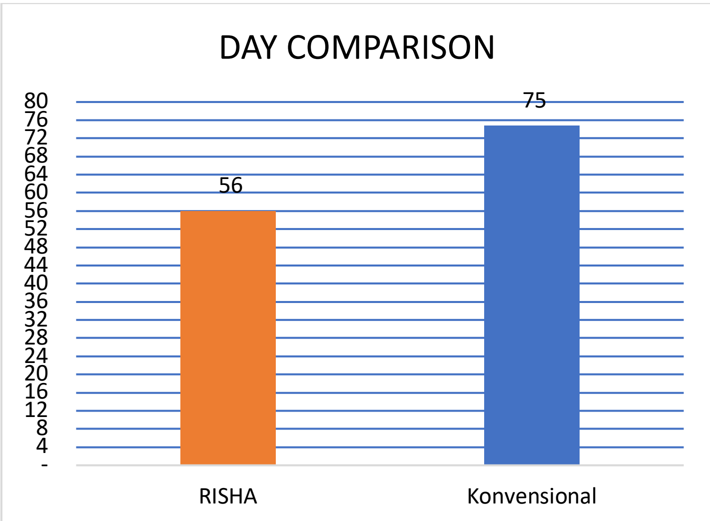


Figure 4. Graph of Work Time Comparison between the RISHA and Conventional Methods

Based on Figure 4, the comparative analysis of work duration shows a significant difference between the RISHA method and the conventional method. Work using the RISHA method requires 8 weeks, or 56 working days, while the conventional method requires 11 weeks, or 75 working days. Thus, there is a time difference of 19 days, indicating that the RISHA method achieves a time saving of approximately 25.33% compared with the conventional method. Conversely, the conventional method requires approximately 33.93% more time than the RISHA method (Nugroho, 2022; Wicaksono et al., 2023).

Cumulative Work Time Efficiency

Based on the work-time analysis in this study, the RISHA method required 56 working days, or 8 weeks, while the conventional method required 75 working days, or 11 weeks. This represents a time saving of approximately 25.33% in favor of the RISHA approach.

This acceleration demonstrates that Graph 4 does not merely illustrate efficiency on paper but also reflects indirect cost savings in the field. A shorter construction period automatically reduces non-material operational costs, such as daily labor wages, construction support equipment rental costs, including scaffolding, and field management and supervision costs (Putri & Lestari, 2024; Suryadi et al., 2021).

Factors Causing Time Differences

Construction Process

The RISHA method uses precast concrete panels produced in factories and requires only on-site assembly. This standardized production process accelerates implementation time. In contrast, the conventional method often involves slower manual work and requires more time for completion (Wicaksono et al., 2023).

Labor Use

In the RISHA method, a simpler structural system and the use of ready-to-install materials make it possible to reduce the number of workers required and minimize waiting time. Meanwhile, the conventional method often requires more labor to complete various construction stages, thereby extending the project duration (Salim et al., 2021; Sulistiana et al., 2024b).

Assembly Efficiency

With an efficient and standardized connection system, the RISHA method enables a faster assembly process than the conventional method. This process reduces the possibility of delays caused by technical problems during construction.

Resource Management

In the RISHA method, resource use can be planned and organized more effectively. This reduces the possibility of delays caused by logistical problems or material availability, which often occur in conventional projects.

Time Efficiency

The RISHA method not only saves costs but also shortens construction time. With a faster construction period, additional costs related to labor and equipment rental are also reduced.

The comparison between the two methods shows that the RISHA method provides significant cost advantages while maintaining quality and enabling a more efficient completion time. This makes the RISHA method a better option in the context of post-disaster simple housing development, where speed and cost efficiency are highly important (Nugroho, 2022; Wicaksono et al., 2023).

Quality, Durability, and Maintenance Considerations

Beyond cost and time, a comprehensive comparison of construction methods must also consider building quality, structural durability, and long-term maintenance costs. RISHA panels are manufactured under factory-controlled conditions, which theoretically ensures more consistent concrete quality, at K-175 or higher, compared with field-mixed concrete in conventional methods, where quality control is affected by on-site variables (Nugroho, 2022; Rakyat, 2016). The bolt-and-plate connection system used in RISHA is designed to be demountable and re-erectable, which can be advantageous in disaster-prone areas where relocation may be necessary. However, the long-term performance of RISHA connections under repeated seismic and wind loading conditions in North Maluku's high-hazard environment requires further study (Wicaksono et al., 2023). In terms of maintenance, RISHA panel surface finishing using gypsum board may require periodic maintenance, while conventional plastered brick walls generally have well-understood maintenance cycles (Afkhamiaghda & Elwakil, 2023; Hidayat & Prasetyo, 2020). The cost comparison in this study does not include life-cycle maintenance costs, which is a limitation acknowledged by the authors.

Risk Analysis of RISHA Implementation

Several implementation risks specific to RISHA construction in Ternate City must be acknowledged. First, there is the risk of panel availability. RISHA precast components must be manufactured in specialized facilities, none of which currently operate in North Maluku Province. Therefore, components must be shipped from Sulawesi or Java, increasing lead times and transportation costs, particularly during adverse weather seasons, when inter-island sea routes may be disrupted (Muliawan, 2018; Ruanda et al., 2025). Second, there is transportation and logistics risk. The island geography of Ternate creates inherent supply-chain vulnerabilities. Heavy precast panels require appropriate heavy-equipment handling and port facilities, which may not always be readily available in the context of urgent post-disaster response (Haigh & Li, 2026; Liu & Lu, 2021). Third, there is dependence on component manufacturers. The RISHA supply chain depends on a limited number of licensed precast panel manufacturers. Any disruption to manufacturing or delivery schedules can delay the entire construction timeline, potentially negating the time-efficiency advantage documented in this study (Putri & Lestari, 2024). Fourth, there is the practical significance of the cost difference. The 2.69% cost saving, equivalent to IDR 4,644,004.00, observed in this study is relatively modest in absolute terms for a single Type 36 house. However, when scaled to mass housing programs, for example, 500 units, the aggregate saving would reach approximately IDR 2.32 billion, a figure with clear practical significance for public housing budgets (Salim et al., 2021; Sulistiana et al., 2024b). Therefore, the dominant advantage of RISHA in the context of this study lies in time efficiency, at 25.33%, rather than cost efficiency, at 2.69%.

The comparison of implementation time between the two methods shows that the RISHA method offers better efficiency in terms of work duration. With a significant time difference, the application of RISHA not only accelerates the construction process but also has the potential to accelerate recovery for communities affected by disasters. This time advantage is a crucial aspect in the context of post-disaster development, where speed often determines the success of rehabilitation and reconstruction (Afkhamiaghda & Elwakil, 2023; Rahman & Hidayat, 2020; Suryadi et al., 2021).

CONCLUSION

Based on the analysis and discussion of the construction of a simple one-story Type 36 house, the following conclusions can be drawn: (1) The construction implementation cost using the RISHA method is IDR 167,918,089.00, while the conventional method costs IDR 172,562,093.00. Therefore, the RISHA method is 2.69% more economical. (2) The implementation duration of the RISHA method is 56 working days, or 8 weeks, while the conventional method requires 75 working days, or 11 weeks. Therefore, the RISHA method is 25% faster.

Within the scope of this single-case study in Rua Village, Ternate City, the RISHA method offers a more efficient solution than the conventional method, with cost savings of 2.69% and time savings of 25%. The modular and knock-down nature of RISHA components shortens the critical path of the construction schedule. These findings suggest that RISHA can be a viable and efficient option for post-disaster Type 36 housing projects in similar island contexts in Eastern Indonesia, subject to the logistical and supply chain conditions discussed. Further research involving multiple case studies and sites is recommended before these findings can be more broadly generalized.

This study has several limitations that should be acknowledged. First, the analysis is based on a single case study of one Type 36 house constructed using each method in one specific location, namely Rua Village, Ternate City, which limits the generalizability of the findings. Second, the cost comparison does not include life-cycle maintenance costs, land costs, or indirect project management costs beyond field supervision. Third, the study does not evaluate structural quality outcomes, such as compressive strength testing or long-term durability assessments. Fourth, the time analysis assumes a constant workforce of five workers per work item, which may not reflect actual field conditions. Future studies should address these limitations through multisite comparative analyses and life-cycle cost assessments.

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AUTHOR CONTRIBUTION STATEMENT

Rais D. Hi. Yusuf contributed to the conceptualization, research design, data collection, analysis, and preparation of the original manuscript. Joni Hermanto contributed to methodology development, data interpretation, validation, and critical review of the manuscript. Muhammad Yusri Abdul Gani contributed to supervision, technical evaluation, manuscript refinement, and final review. All authors collaboratively contributed to the completion of this research, approved the final version of the manuscript, and take responsibility for the integrity, accuracy, and accountability of the work.

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