Jurnal Teknologi dan Manajemen Industri Terapan (JTMIT) Vol. 5, No. 1, Maret 2026 pp. 568 - 575
P-ISSN: 2829-0232 E-ISSN: 2829-0038

Capital Reserve Strategies for Residential Construction Projects through Gold-Based Fund Allocation

(Case Study of Housing Project in Pekanbaru City)

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ABSTRACT

Housing development project financing generally still relies on interest-based banking mechanisms, which consequently increase the burden of capital costs. On the other hand, construction business actors are required to manage their reserve funds independently to prevent the erosion of fund value due to inflation and rising construction costs. This study aims to analyze the effectiveness of a capital reserve strategy through allocating funds into gold as a value preservation instrument in residential housing development. The research employs a quantitative descriptive approach and comparative analysis using secondary data, including the 2016 Unit Price Analysis (AHSP) and the latest 2024 AHSP, as well as historical gold price data for the period 2016–2024. The case study focuses on the construction of type 36, 45, 56, and 70 houses in Pekanbaru City. The results indicate that the increase in construction costs based on the updated AHSP is relatively conservative and does not impose excessive capital burdens. Furthermore, converting construction costs into gold-equivalent units reveals a potential surplus of up to 55.96%. These findings suggest that allocating funds to gold can serve as an effective long-term financing strategy for contractors and investors in the housing sector, particularly in preserving fund value and improving project financing efficiency.

Keywords: *Capital reserve, unit price analysis (AHSP), gold hedging strategy, construction cost, housing, reserve fund strategy.*

Introduction

Infrastructure and housing development financing is generally dominated by banking institutions through interest-based financing mechanisms as compensation for capital provision. In construction projects, the cost of capital constitutes a critical component that directly influences the overall cost structure and project feasibility [1][2][3]. Financing structures determine not only project viability but also risk exposure and long-term financial sustainability [4][5].

Beyond external financing, construction firms—particularly contractors and private investors—are increasingly required to manage internal capital through the establishment of reserve funds, typically in the form of retained earnings or cash reserves. The primary challenge of this approach lies in preserving the real value of such reserves against inflationary pressures and escalating construction costs over time [6][7]. Construction cost escalation is widely recognized as structural in nature, driven by material price volatility, labor productivity, supply chain fluctuations, and regulatory adjustments [8][5][9].

In Indonesia, the Unit Price Analysis (AHSP) framework is periodically updated to reflect market adjustments and regulatory refinements. However, these revisions are generally conservative to maintain financing stability and prevent excessive cost burdens for industry practitioners [10][11]. Empirical evidence suggests that construction cost growth does not always move in parallel with general inflation due to sectoral characteristics, contractual arrangements, and government intervention [12][13].

From a financial perspective, project risk management literature emphasizes the importance of value preservation strategies to safeguard reserve capital from macroeconomic volatility [4][1]. Within financial markets, gold is widely recognized as a safe haven asset capable of maintaining value during economic uncertainty and inflationary periods [14][15][16]. Empirical studies demonstrate that gold prices exhibit long-term appreciation tendencies and often outperform inflation rates and consumer price increases [17][18][19].

Moreover, portfolio diversification research indicates that allocating capital to gold can reduce real value depreciation compared to holding liquidity in cash form [20][16][21]. However, most of these studies focus on gold as an individual investment or portfolio hedge instrument, with limited exploration of its application as a reserve strategy in construction project financing contexts.

Housing project financing studies further indicate that temporal mismatches between capital accumulation and project realization may significantly reduce financing efficiency when value preservation mechanisms are absent [22][23]. In construction management theory, value creation is not solely determined by technical execution efficiency but also by effective financial strategy and capital allocation decisions [2][8]. Nevertheless, prior research largely separates technical cost analysis from financial hedging instruments, resulting in limited integrated frameworks that combine construction cost standards with financial reserve strategies.

Unlike previous studies that analyze gold primarily as an investment instrument, this research integrates gold-based value preservation with construction cost analysis using the AHSP regulatory framework. Addressing this research gap, the present study evaluates a gold-based reserve strategy over the 2016–2024 period using a residential construction case study in Pekanbaru City. The objective is to measure potential surplus generated by converting construction costs—based on the Indonesian AHSP standard—into gold-equivalent units and comparing their value over time. The findings aim to provide an alternative formulation for long-term capital reserve and investment strategies in the residential construction sector, particularly for contractors and private investors seeking value preservation mechanisms in volatile economic environments.

Method Research

This study employs a quantitative descriptive approach with a comparative analysis design to evaluate the effectiveness of a capital reserve strategy through fund allocation in gold as a value preservation mechanism. The research object consists of single-storey residential houses of types 36, 45, 56, and 70, using Pekanbaru City as the case study area. All data used in this study are secondary data obtained from official and publicly available sources, including the 2016 Unit Price Analysis (AHSP), the updated 2024 AHSP, as well as historical gold price and inflation rate data for the period 2016–2024.

The first stage of the research involved determining the bill of quantities based on standardized technical assumptions for single-storey residential buildings to eliminate design bias across housing types. The main work items analyzed include reinforced concrete elements (sloof, columns, and ring beams), brick masonry walls, ceramic flooring, plastering and skim coating, painting works, ceilings, lightweight steel roof trusses, and roof coverings. The second stage consisted of calculating construction costs by multiplying the quantity of each work item by the respective unit prices from the 2016 and 2024 AHSP, resulting in a comparative Bill of Quantities (BoQ) and cost estimate. The level of cost escalation was then calculated in terms of percentage changes and nominal differences between the two periods.

The third stage involved financial analysis by converting the total construction cost in 2016 into gold-equivalent units based on the gold price in that year, and subsequently recalculating its equivalent value in 2024. This approach was applied to measure the potential surplus gap generated by the gold-based reserve strategy compared to construction cost increases and general inflation. The analysis was conducted using a descriptive-comparative method by examining three primary indicators: the inflation index, the AHSP cost escalation index, and the gold price index over time.

The research findings are presented in four main formats: (i) volumetric tables of work items across housing types, (ii) comparative tables of unit prices and total construction costs, (iii) index graphs illustrating the movement of construction costs, gold prices, and inflation during the 2016–2024 period, and (iv) tables presenting the surplus gap analysis based on gold conversion. These results are comprehensively discussed to identify both technical and financial implications, followed by conclusions summarizing the effectiveness of the proposed capital reserve strategy for construction practitioners and housing sector investors.

Result and Discussion

Result

The initial stage of the study involved identifying four types of simple residential houses—Type 36, 45, 56, and 70—representing variations in building area within the middle-income housing segment. Subsequently, a quantity take-off (volumetric calculation) was conducted for the main building components, including reinforced concrete elements (sloof beams, columns, and ring beams), brick masonry walls, ceramic flooring, plastering and skim coating, painting works, ceilings, lightweight steel roof trusses, and roof coverings. The summarized results of the quantity calculations are presented in Table 1.

Table 1. Quantity of selected work Items for each housing type

Work Item	Unit	Type 36	Type 45	Type 56	Type 70
Reinforced Concrete (Sloof/Column/Ring Beam)	m^3	6,5	8	10	12,5
Brick Masonry	m^2	108	135	168	210
Ceramic Flooring	m^2	36	45	56	70
Plastering and Skim Coating	m^2	216	270	336	420
Wall Painting	m^2	216	270	336	420
Ceiling Installation	m^2	36	45	56	70
Lightweight Steel Roof Truss	m^2	54	68	84	105
Roofing	m^2	54	68	84	105

Table 1 presents a comparison of the quantities of major work items across housing Types 36, 45, 56, and 70, indicating a proportional increase in volume relative to the building area. The volume of reinforced concrete increased from 6.5 m³ in Type 36 to 12.5 m³ in Type 70, reflecting the addition of structural elements corresponding to larger building dimensions. Brick masonry area increased significantly from 108 m² to 210 m², demonstrating a direct correlation between floor area and wall as well as partition requirements. Finishing works, including plastering, skim coating, and painting, exhibit quantities approximately twice the wall area due to application on both sides of the surfaces. The areas of ceramic flooring and ceiling installations increase linearly with building size, whereas the quantities of lightweight steel roof trusses and roof coverings show relatively higher increases compared to floor area, influenced by roof slope geometry and overhang extensions. Overall, the table illustrates a consistent and systematic volumetric growth pattern across housing types, providing a reliable basis for subsequent comparative construction cost analysis.

Following the quantity analysis, the relevant AHSP work items contributing to the execution of each building component were identified. The results of this classification are presented in Table 2.

Table 2. AHSP categories by work type

No	Work Item	Unit	AHSP Type Applied	AHSP Category (PUPR)	Technical Description
1	Reinforced Concrete (Sloof, Column, Ring Beam)	m³	AHSP Reinforced Concrete Work	Structural	Includes reinforcement installation, formwork, and concrete casting
2	Brick Masonry	m²	AHSP Brick Masonry Work	Architectural	Red bricks/blocks including mortar
3	Ceramic Flooring	m²	AHSP Ceramic Floor Finishing Work	Architectural	Includes adhesive, grout, and installation
4	Plastering and Skim Coating	m²	AHSP Plastering and Skim Coating Work	Architectural	Applied to both sides of walls
5	Wall Painting	m²	AHSP Painting Work	Architectural	Interior and exterior wall paint
6	Ceiling Installation	m²	AHSP Ceiling Work	Architectural	Gypsum/triplek ceiling including framing
7	Lightweight Steel Roof Truss	m²	AHSP Lightweight Steel Roof Structure Work	Architectural / Roof Structure	Includes truss, battens, and installation
8	Roofing	m²	AHSP Roof Covering Work	Architectural	Concrete/metal roof tiles including accessories

Table 2 presents the classification of major work items along with the corresponding AHSP categories applied, structured in accordance with the regulatory framework issued by the Ministry of Public Works and Housing (PUPR). Reinforced concrete works are categorized under structural components and refer to the AHSP provisions covering reinforcement installation, formwork, and concrete casting. Meanwhile, brick masonry, ceramic flooring, plastering and skim coating, painting, and ceiling works fall within the architectural category, with technical specifications encompassing materials, adhesives, and installation methods. Lightweight steel roof trusses are classified under roof structural components, including material supply, fabrication, and structural assembly, whereas roof coverings are categorized within architectural works, covering the installation of roof tiles or alternative covering materials along with supporting accessories. Overall, the table demonstrates that all cost components analyzed in this study are aligned with the official AHSP regulatory structure, ensuring that the cost calculations are grounded in a systematic regulatory framework and are technically accountable.

The analysis was subsequently extended to cost estimation using both the 2016 and 2024 AHSP standards. The tabulated results of these calculations are presented in Table 3.

Table 3. AHSP unit price identification

No	Work Item	Unit	AHSP 2016 (Rp)	AHSP 2024 (Rp)	Delta (Rp)	Change (%)
1	Reinforced Concrete (Sloof/Column/Ring Beam)	m³	4.250.000	4.750.000	500.000	11,80%
2	Brick Masonry	m²	165.000	185.000	20.000	12,10%
3	Ceramic Flooring	m²	235.000	265.000	30.000	12,80%
4	Plastering and Skim Coating	m²	92.000	105.000	13.000	14,10%
5	Wall Painting	m²	38.000	45.000	7.000	18,40%

No	Work Item	Unit	AHSP 2016 (Rp)	AHSP 2024 (Rp)	Delta (Rp)	Change (%)
6	Ceiling Installation	m²	185.000	210.000	25.000	13,50%
7	Lightweight Steel Roof Truss	m²	285.000	320.000	35.000	12,30%
8	Roofing	m²	195.000	225.000	30.000	15,40%

Table 3 presents a comparison of unit prices between the 2016 and 2024 AHSP standards, showing a general increase across all work items. The highest percentage increase occurred in wall painting works at 18.40%, followed by roof covering works at 15.40%, and plastering and skim coating at 14.10%. Meanwhile, reinforced concrete works recorded an increase of 11.80%, and brick masonry increased by 12.10%, reflecting higher material and labor costs in both structural and architectural components. In nominal terms, the largest absolute difference was observed in reinforced concrete works, with an increase of IDR 500,000 per cubic meter, indicating a substantial contribution to the overall construction cost. Although all work items experienced price adjustments, the percentage increases remain within a moderate range (approximately 11–18%), suggesting that the AHSP revision during this period was gradual and relatively conservative. This condition indicates that the construction cost structure underwent controlled adjustments without extreme fluctuations between periods. The increase is primarily attributed to revisions in labor coefficients and refinements in construction execution methods.

Subsequently, a recap of the total estimated construction costs was conducted for each housing type—Types 36, 45, 56, and 70. The summarized results are presented in Table 4.

Table 4. Summary of total project cost and cost per square meter by housing type

Type	Area (m²)	Total 2016 (Rp)	Rp/m² (2016)	Total 2024 (Rp)	Rp/m² (2024)	Delta (Rp)
36	36	114.565.000	3.182.361	129.785.000	3.605.139	15.220.000
45	45	142.915.000	3.175.889	161.910.000	3.598.000	18.995.000
56	56	177.740.000	3.173.929	201.360.000	3.595.714	23.620.000
70	70	222.175.000	3.173.929	251.700.000	3.595.714	29.525.000

Table 4 presents a comparison of the total construction costs by housing type between the 2016 and 2024 AHSP standards, both in terms of total value and cost per square meter. Overall, all housing types experienced consistent cost increases, with the largest nominal difference observed in Type 70 at IDR 29,525,000, while Type 36 recorded an increase of IDR 15,220,000. When analyzed on a cost-per-square-meter basis, the average construction cost increased from approximately IDR 3.17–3.18 million/m² in 2016 to around IDR 3.59–3.61 million/m² in 2024. This pattern indicates that the cost escalation is relatively proportional to building area, without disproportionate increases in any particular housing type. Furthermore, the cost per square meter remains relatively homogeneous across housing categories, suggesting that the underlying construction cost structure exhibits consistent baseline characteristics for each housing type.

Overall, the table reinforces the finding that the AHSP revision resulted in moderate and systematic cost adjustments, providing a reliable foundation for subsequent comparative analysis of cost escalation levels. The overall cost comparison is illustrated in Figure 1.

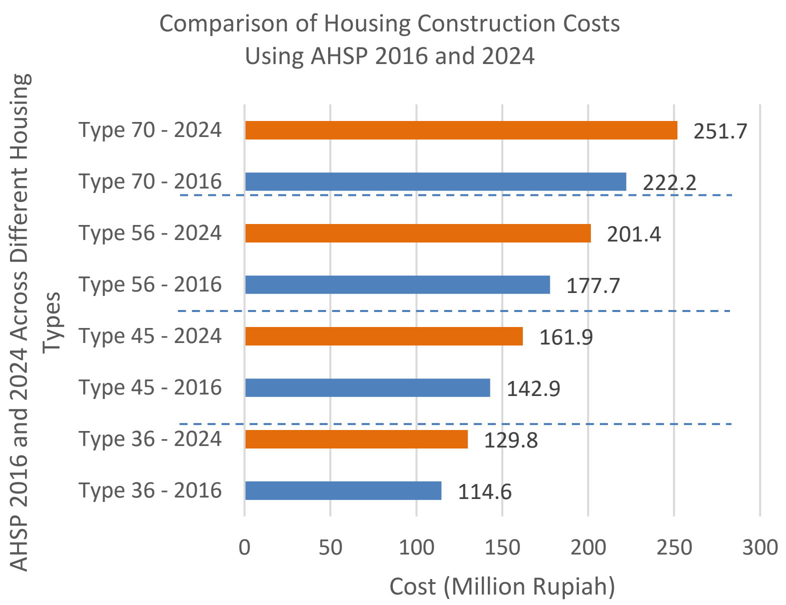

Figure 1. Comparison chart of construction costs across housing types

The analysis was subsequently extended by comparing these findings with the potential reserve value generated through gold-based allocation. The comparison was conducted by plotting gold price movements over the 2016–2024 period. The equivalency approach applied involved converting the construction cost of each housing type into its corresponding gold weight (in grams) based on the gold price in the base year. This method allows for the evaluation of value preservation by comparing the gold-equivalent investment against construction cost requirements in subsequent years. The results of this comparative analysis are presented in Table 5 and illustrated in Figure 2.

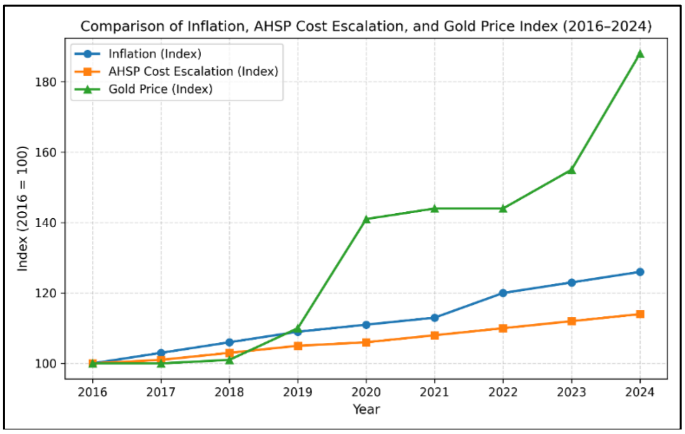

***Figure 2**. Comparison chart of housing construction cost changes, inflation, and gold commodity prices*
Source: World Gold Council gold price database (2016–2024), processed by authors.

Table 5. Summary of potential surplus through the gold reserve strategy across housing types

Type	Construction Cost 2016 (Rp)	Gold Reserved in 2016 (gram)	Gold Value in 2024 (Rp)	Construction Cost 2024 (Rp)	Surplus (Rp)
36	114.565.000	194,51	294.679.075	129.785.000	164.894.075
45	142.915.000	242,64	367.599.703	161.910.000	205.689.703
56	177.740.000	301,77	457.175.042	201.360.000	255.815.042
70	222.175.000	377,21	571.468.803	251.700.000	319.768.803

Table 5 presents the simulation results of a gold-based reserve strategy initiated in 2016 and its implications for residential construction cost requirements in 2024. By converting the 2016 construction costs into gold-equivalent units (grams) and subsequently recalculating their monetary value based on the 2024 gold price, all housing types demonstrate substantial surplus value. The highest surplus is observed in Type 70, amounting to IDR 319,768,803, followed by Type 56 at IDR 255,815,042, Type 45 at IDR 205,689,703, and Type 36 at IDR 164,894,075. These findings indicate that gold price appreciation over the 2016–2024 period outpaced construction cost escalation reflected in the updated AHSP standards. Consequently, allocating reserve funds into gold provided strong long-term value preservation.

Furthermore, the index comparison illustrated in Figure 2 shows that gold price growth significantly exceeded both the general inflation index and the AHSP cost escalation index. While inflation and AHSP adjustments followed relatively moderate and gradual upward trends, the gold price index experienced a pronounced surge, particularly from 2019 to 2024. This divergence in growth rates explains the surplus value observed in the reserve simulation, as funds stored in gold appreciated at a faster rate than construction cost increases. Therefore, both quantitatively and visually, the table and graphical analysis reinforce the argument that a gold-based reserve strategy has the potential to serve as an effective long-term alternative within the residential construction sector.

Discussion

The findings indicate that construction cost escalation based on the comparison between the 2016 and 2024 AHSP standards occurred consistently across all work items, encompassing both structural and architectural components. The increase in unit prices remains within a moderate range, with the largest nominal contribution derived from reinforced concrete works. Structurally intensive components typically dominate total project costs due to their reliance on primary materials such as cement, aggregates, and reinforcing steel, which are highly sensitive to market fluctuations and supply chain dynamics [6][5][24]. Nevertheless, at the aggregate building level, cost increases per square meter remain relatively homogeneous across housing types, indicating the absence of significant cost distortions. This suggests that AHSP revisions were implemented gradually and conservatively to maintain sectoral stability, consistent with established principles of project cost control and financial governance [2][7][8]. From a regulatory standpoint, the construction cost structure during the study period can therefore be categorized as rational and controlled.

In contrast to the moderate escalation observed in AHSP-based costs, the conversion of construction expenses into gold-equivalent units reveals substantially higher value growth. The gold reserve simulation demonstrates significant surplus values across all housing types. These findings align with established literature identifying gold as both a hedging instrument and a haven asset during periods of economic uncertainty [25][15][21]. Empirical studies further confirm that gold exhibits long-term appreciation trends that frequently surpass inflation and general price growth under certain macroeconomic conditions [17][18][19].

The index comparison presented in this study illustrates that gold prices, particularly since 2019, have increased at a significantly faster rate than both the inflation index and the AHSP cost escalation index. This divergence generates a substantial surplus gap when construction costs are evaluated through gold-equivalent metrics. Similar patterns have been observed during periods of global economic turbulence, where gold functions as a counter-cyclical asset capable of preserving purchasing power [16][20][19]. Consequently, in medium- to long-term horizons, allocating reserve funds to gold can enhance purchasing power relative to future construction cost requirements.

The implications of these findings extend the conventional understanding of project cost management. Traditional construction management literature emphasizes technical efficiency, budgeting accuracy, and implementation cost control as primary determinants of financial success [2][8][3]. However, this study demonstrates that pre-construction capital allocation strategies also exert a significant influence on financing effectiveness. In practice, a temporal gap often exists between capital accumulation and project execution. If reserves are maintained solely in cash form, their real value may erode due to inflation and limited growth potential [1][23]. Conversely, diversification into gold, as supported by financial portfolio theory, may serve as a macroeconomic risk mitigation mechanism [16][20].

Nevertheless, gold-based reserve strategies cannot be detached from global market dynamics. Gold price appreciation during the study period was influenced by macroeconomic uncertainty, geopolitical tensions, and monetary policy shifts [21][18][19]. Therefore, while gold demonstrates value-preserving characteristics, price volatility remains an inherent risk factor. Accordingly, such strategies should be positioned as long-term value management mechanisms rather than short-term speculative instruments.

Within the residential construction context, integrating AHSP-based technical cost analysis with financial reserve strategies provides an alternative financing formulation beyond conventional banking mechanisms [1][4]. This integration bridges construction cost engineering and financial asset management, offering a multidimensional approach to project sustainability.

Overall, the discussion reinforces two principal conclusions. First, AHSP-based construction cost increases during the 2016–2024 period were conservative and controlled, avoiding extreme cost volatility. Second, a gold-based reserve strategy demonstrates substantial effectiveness in preserving and enhancing long-term project financing value. The integration of technical cost governance and financial value preservation enriches the discourse of construction management by incorporating financial resilience as a strategic dimension of sustainable housing development.

Limitations and Future Research

Despite providing useful insights into the potential role of gold-based reserve strategies in preserving construction purchasing power, this study has several limitations that should be acknowledged. First, the analysis is based on historical observations during the 2016–2024 period, in which gold prices experienced a notable upward trend. While this historical performance supports the value preservation argument presented in this research, commodity markets are inherently volatile and influenced by global macroeconomic conditions, monetary policies, geopolitical tensions, and financial market uncertainties. Consequently, future gold price movements may not necessarily replicate the pattern observed during the study period. Therefore, the findings should be interpreted as a historical comparative analysis rather than a guaranteed projection of future performance. Future studies may incorporate volatility modeling, stochastic simulation, or scenario-based analysis to better evaluate the robustness of gold-based reserve strategies under different macroeconomic environments.

Second, this study uses nominal value comparison rather than discounted cash flow analysis. Therefore, the results should be interpreted as a purchasing power comparison rather than net present value evaluation. In conventional financial analysis, the time value of money is a fundamental concept used to assess long-term financial decisions and investment feasibility. The absence of discounting in the current model means that opportunity cost and capital risk are not explicitly incorporated into the evaluation. Future studies may incorporate discount rate adjustments to evaluate the strategy under time value of money principles, including approaches such as Net Present Value (NPV), Internal Rate of Return (IRR), or Discounted Cash Flow (DCF), to provide a more comprehensive financial assessment of gold-based reserve strategies relative to alternative financing instruments.

Third, the analysis does not incorporate transaction costs, bid–ask spread, taxation, storage costs, or security costs associated with gold ownership. These factors may influence the effective return obtained from gold-based reserve strategies and may slightly reduce the net financial advantage when applied in real-world conditions. Future research may incorporate these parameters into a more detailed financial simulation model to provide a more realistic estimation of the economic performance of gold-based reserve strategies in construction project financing.

Finally, the scope of this research is limited to residential construction cost estimation based on standardized AHSP values and a single case study location in Pekanbaru City. Although this approach provides a structured framework for comparative analysis, construction cost structures, regulatory environments, and financial strategies may vary across regions and project types. Future research may extend the analysis to other construction sectors, such as commercial buildings or infrastructure projects, as well as conduct cross-regional comparisons to evaluate the broader applicability of gold-based reserve strategies in construction financing and investment planning.

Conclusion

The results of this study indicate that allocating funds in the form of gold as a long-term reserve mechanism for residential construction projects can generate significant potential surplus, with a reduction in construction cost requirements of up to 55.96% when measured in gold-equivalent units over the 2016–2024 period. These findings suggest that gold effectively functions as a long-term value preservation instrument, particularly for construction business actors such as contractors and investors, in mitigating the impact of rising project implementation costs. Furthermore, the analysis reveals that the increase in unit prices reflected in the updated Unit Price Analysis (AHSP) remains relatively conservative, thereby avoiding excessive financing burdens for industry practitioners. Overall, the combination of moderate AHSP adjustments and a gold-based hedging strategy provides a stable and adaptive financing alternative for residential development projects, particularly within the context of Pekanbaru City.

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