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Budget Plan Analysis for Office Building Maintenance Costs: A Case Study of a 7-Storey Building

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Abstract The aspect of building maintenance is also as important as the planning and implementation process of a construction project, and the maintenance concept must be prepared before the project is completed. However, usually when the construction is completed, the building owner does not carry out maintenance and upkeep according to schedule. One of the causes is limited funds. Maintenance is less noticed due to several factors, namely maintenance activities that are considered not urgent, the maintenance organizational structure that is not prepared, and building managers who consider maintenance to be a technical problem and not related to the purpose of the building's function. The purpose of this study was to develop a budget plan for maintenance on high-rise buildings in Bojonegoro, Indonesia. This study uses a quantitative descriptive approach and refers to the Decree of the Minister of Public Works Regulation Number: 24 / PRT / M / 2016 in 2016 and Indonesian National Standard (SNI). The results obtained indicate that the largest damage costs are found in architectural components, with a cost of Rp 78,505,230.40 ($4,618 USD). Furthermore, the maintenance costs for structural components amount to Rp 7,769,621.60 ($457 USD), and those for utility components to Rp 19,556,222.00 ($1,150 USD). Thus, the total maintenance cost of high-rise buildings in Bojonegoro, Indonesia, is currently estimated at Rp 105,831,073.00 ($6,225 USD). These data indicate that the majority of the maintenance budget is focused on architectural components.

Keywords Multi-storey Building, Budget Plan, Maintenance Costs

1. Introduction

Building construction refers to structures generally used to carry out various activities, both private and public, by humans, such as residence, worship, education, offices, and other uses [1]. The function of a building can be durable if the building is well maintained and cared for. In certain areas, many newly built buildings have already seen a decline in the performance value of the buildings [2]. The decline in building performance is caused by the building being damaged, both at the component level and the sub-element level. Buildings, like other construction goods, will experience damage [3]. Building damage is a process of weakening the strength and resistance of construction and building materials to external loads or their own weight, exceeding their capacity [4]. One of the factors that causes a decrease in the functional value of a building is the maintenance and care [5]. In addition, building damage occurs due to various things, such as shrinkage of building components, the age of the building, the influence of human activities, natural behavior, the influence of excessive functional loads and the influence of chemicals and insects [6].

Building maintenance in Indonesia, according to the Regulation of the Minister of Public Works Number:

24/PRT/M/2016 article 1 paragraph 2, is the process of repairing or replacing parts of a building, components, building materials, facilities and infrastructure so that the building remains functional [7]. Before maintenance occurs on the building, regular maintenance should be carried out so that the reliability of the components is always in good condition, and maintenance and care are carried out with a periodic inspection schedule. The durability of a building is determined by the quality of its maintenance. Periodic inspections on building structures are carried out on each component and element of the building, the schedule for which can be carried out every day, every week, every month, every three months, every six months, every year, and it is also possible for a longer period. Initially, building maintenance was only cleaning; while now cleaning is only the initial process of building maintenance, with periodic cleaning, it can slow down the process of building damage [5].

Building damage is a defect or failure in the function, performance, management or requirements of a building that reduces services for its users. If this condition is left untreated, over time, there will be a decrease in quality and eventually the building will be destroyed [8], [9]. According to the Regulation of the Minister of Public Works Number 24/PRT/M/2016 concerning Guidelines for Building Maintenance and Care, the intensity of building damage can be categorized into three levels of damage, namely light, moderate and heavy damage [10].

The aspect of building maintenance and care is no less important than the planning and implementation process of a construction project; even the maintenance concept must be prepared before the project is completed [11]. However, when the building has been completed, sometimes the building owner does not carry out maintenance and upkeep according to schedule [12], [13]. This is usually caused by limited funds available to the building owner [14]. Maintenance or care activities are less noticed by building owners due to several factors, starting from maintenance activities that are considered not urgent compared to construction activities, unprepared maintenance organizational structures, and building managers considering building maintenance as only a technical problem and not related to the purpose of the building function [15]. Meanwhile, if the building owner carries out maintenance and care according to plan, the costs incurred will not be as much as the costs when the building components are in poor condition. Therefore, building owners should carry out the maintenance process according to recommendations, so that they can maintain the planned life of the building and maintain the reliability of the components in the building [16]. Building maintenance programs include, among other things, structural systems, roof systems, exterior coverings, ventilation systems, electrical networks, piping, fire safety and building utilities [17].

Managing office building maintenance is a significant challenge in facility management because operation and maintenance costs (OPCs) often represent a significant proportion of a building's overall life-cycle cost (LCC), particularly for high-rise buildings [18]. Life-cycle cost theory suggests that to maintain a building's performance, safety, comfort, and efficiency, maintenance budgets must be systematically planned from the outset and encompass routine, preventive, replacement, and unforeseen expenses. For example, Nugroho et al. [19] found that in a government office building in Surabaya, the O&M cost accounted for approximately 39.48% of total building expenditure over eight years, while initial costs and energy costs also significantly contributed to the total LCC. Similarly, Abuhussain et al. [20] developed a framework for estimating maintenance and operational costs that takes sustainability into account, emphasizing the importance of cost forecasting based on historical data and external factors such as inflation and material cost escalation.

In the context of facility management, building maintenance is generally divided into several types, namely routine maintenance which is carried out daily or weekly to maintain the cleanliness and basic function of the facility; preventive maintenance which is carried out periodically to prevent damage to building systems and components; corrective maintenance which is carried out after damage or functional disruption occurs; and predictive maintenance which utilizes data and technology to predict the optimal time for repairs before damage occurs.

As a regency with continuously growing economic activity, Bojonegoro Regency, Indonesia, is experiencing a significant increase in the construction and use of office buildings. This situation demands effective and planned maintenance cost management to ensure optimal building operations [21]. A seven-story office building requires a budget that is not only focused on maintaining the physical condition, but also on efforts to maintain the function of other facilities. Without a budget planning analysis that covers the entire life cycle of the building, the risk of unexpected costs and a reduction in the effective lifespan of components is very high, which can ultimately increase total maintenance costs in the long term

2. Materials and Methods

The research method used for this research is a type of quantitative descriptive approach, which emphasizes its analysis on numerical data (numbers) processed using statistical methods. This research describes quantitative data obtained related to the condition of the subject or phenomenon of a population [10]. The research object in this study is a seven-story office building. This building was chosen because it represents the characteristics of typical office buildings, in terms of installation systems, floor area, and usage intensity [22]. The analysis focuses on identifying maintenance costs and projecting annual and

medium-term budgets to support facility management decisions. Furthermore, the direct observation method in the field was chosen to obtain data related to the type of damage that occurred in the research object building. In this study, there are two types of data used, namely:

Primary Data

Data are collected directly, not from previously conducted data collection. In this study, building construction refers to structures generally used for various activities, focusing on office buildings. Primary data used is all data collected in the form of types of damage that occur in buildings [21].

Secondary Data

Data are obtained through relevant data that have been researched and collected by other parties related to the research problem. In this study, the secondary data used is a general description of activities and other things related to the maintenance that has been carried out.

Furthermore, the data will be analyzed using a method that refers to the Regulation of the Minister of Public Works Number: 24 / PRT / M / 2016 of 2016 and the Indonesian National Standard (SNI) [7].

This research framework focuses on a seven-story office building used as the object of study to analyze maintenance costs. The study categorizes building damage into three main categories: minor, moderate, and serious. Minor damage encompasses minor disruptions that do not disrupt primary functions. Moderate damage encompasses damage to components that require immediate repair to prevent further damage [23]. Meanwhile, serious damage encompasses structural or critical component damage that impacts occupant safety.

The research analysis then incorporates these damage categories into the building's maintenance budget planning, encompassing the total annual budget. Each damage category is associated with a specific maintenance cost estimate, facilitating budget allocation calculations based on repair priorities and damage frequency. With this framework, the study provides a comprehensive overview of effective budget allocation, determines appropriate maintenance strategies, and provides recommendations for improving maintenance cost efficiency while maintaining the function and safety of the seven-story office building, as shown in Figure 1.

Figure 1. Research framework

3. Results and Discussion

3.1. Identification of Building Damage

Before determining maintenance costs, the initial step is to identify the level of damage to each building component. This process involves several stages, namely:

1. Building Component Inventory: Compile a list of all structural and non-structural elements, such as walls, floors, roofs, electrical installations, and mechanical systems.
2. Visual Observation and Technical Measurement: Conduct physical inspections to detect damage, ranging from cracks, deformation, corrosion, to leaks, and record the severity quantitatively and qualitatively.
3. Damage Level Classification: Determine the damage category, for example, minor (requiring minor repairs), moderate (requiring significant repairs), and serious (requiring rehabilitation or replacement).
4. Damage Cause Analysis: Analyze causal factors, such as humidity, material age, or excessive loads, to understand treatment priorities.
5. Maintenance Cost Documentation and Determination: The results of damage identification and classification are used as the basis for calculating the maintenance costs for each component, which are then summed to obtain an estimate of the total building maintenance budget.

The results of the identification of the research object are presented in Table 1.

Table 1. Types of minor damage that occur in high-rise buildings

Field	Component	Type of damage	Volume	Unit
Structure	Wall	Crack 0.075 – 0.6 cm	2.34	M^2
	Column	Crack 0.075 – 0.6 cm	1.41	M^2
	Beam	Crack 0.075 – 0.6 cm	0.09	M^2
Architecture	Wall Coverings	Dull/peeling paint	804.57	M^2
	Column Cover	Dull/peeling paint	190.08	M^2
	Door Cover	Dull/peeling paint	22.08	M^2
	Window Coverings	Dull/peeling paint	0.93	M^2
	Ceiling Cover	Dull/peeling paint	731.38	M^2
	Terrace Wall Coverings	Dull/peeling paint	190.70	M^2
	Terrace Pillar Cover	Dull/peeling paint	89.76	M^2
	Plate Cover Upper Roof	Dull/peeling paint	97.39	M^2
Utilities	Light bulb	No flame	35.00	piece

Table 2. Types of moderate damage that occur in high-rise buildings

Field	Component	Type of damage	Volume	Unit
Structure	Wall	Crack > 0.6 cm	5.44	M^2
	Column	Crack > 0.6 cm	8.56	M^2
Architecture	Door	Broken key	6.00	piece
		Hinge Replacement	3.00	piece
	Bathroom Door	Broken key	2.00	piece
	Window	Broken key	25.00	piece
		Hinge Replacement	4.00	piece
	Window Wind Rights	Damaged	16.00	piece

Table 1 presents an inventory of building components, the type of damage, and the volume of the affected area. Volumes for structural and architectural components, such as walls, columns, ceilings, and cladding, are recorded in square meters (m^2) because repairs or maintenance are performed based on surface area. For example, a wall with peeling paint measuring 804.57 m^2 would be counted as an area that requires repainting. Meanwhile, for utility components such as lighting, volumes are recorded in units (pieces) because repairs involve replacing individual elements. These data cover three main areas: structure, which includes major elements such as cracked walls, columns, and beams; architecture, which includes cladding and paint on walls, columns, doors, windows, ceilings, and roofs; and utilities, which include mechanical or electrical components [24]. The recorded volumes are used as the basis for calculating maintenance costs per component, which are then summed to obtain an estimate of the total building maintenance budget. Thus, Table 1 not only provides quantitative information but also serves as a systematic guide for budget planning and prioritizing maintenance actions. Furthermore, identification of the type of moderate damage is carried out. The identification results are listed in Table 2.

Table 2 above lists various building components that suffered moderate damage, along with their volumes and units. In the structural area, walls and columns experienced cracks [25] greater than 0.6 cm wide, covering an area of 5.44 m^2 and 8.56 m^2, respectively, so repairs were performed based on surface area. Meanwhile, in the architectural area, moderate damage primarily affected doors, windows, and related elements, such as broken locks or hinges that needed to be replaced. The volume of damage to these components was recorded in units (pieces), as repairs involved replacing each element individually. For example, six doors had broken locks, three hinges were replaced, two bathroom door locks were broken, and several windows had damage to their locks, hinges, or specific window sections. These data were used as the basis for calculating maintenance costs per component, which were then summed to obtain an estimate of the total building maintenance budget. This approach allowed repair priorities to be determined based on the degree of moderate damage and the volume of affected elements. Furthermore, identification of the type of severe damage is carried out. The identification results are listed in Table 3.

Table 3. Types of serious damage that occur in high-rise buildings

Field	Component	Type of damage	Volume	Unit
Structure	-	-	-	-
Architecture	Bathroom Door	Replacement	5	piece
	Window	Replacement	2	piece
	Floor Coverings	Ceramic replacement 40 x 40 cm	48	piece
	Floor Coverings	Ceramic replacement 30 x 30 cm	20	piece
	Ceiling	Replacement	118.71	M^2
Utilities	Light fittings	Damaged/Replacement	17	piece
	Double Switch	Damaged/Replacement	7	piece
	Double Socket	Damaged/Replacement	6	piece
	Single Socket	Damaged/Replacement	9	piece
	Squat Toilet	Damaged/Replacement	2	piece
	Urinary	Damaged/Replacement	1	piece
	Water faucet	Damaged	4	piece

Table 3 above lists various building components that suffered serious damage, along with their volumes and units. In the architectural field, serious damage was observed in five bathroom doors, which required replacement due to damage to the door structure and hinges, resulting in the doors not being able to open or close properly. Causes of this damage included intensive use, high humidity in the bathroom area, and the aging of the materials, making minor repairs insufficient and requiring full replacement to ensure functionality and safety. Furthermore, serious damage was found in windows, floors, and ceilings, requiring replacement or repair based on the extent of the damage and the affected surface area. Furthermore, 48 tiles measuring 40 x 40 cm and 20 tiles measuring 30 x 30 cm required replacement, as well as 118.71 m² of ceilings requiring replacement. Meanwhile, in the utilities sector, serious damage occurred to various mechanical and electrical devices, including lights (17 units), double switches (7 units), double sockets (6 units), single sockets (9 units), squat toilets (2 units), urinals (1 unit), and water taps (4 units). The volume of damage was recorded in units (pieces) for utility components and surface area (m²) for architectural components, because repairs were carried out based on the number of units replaced or the surface area repaired. This data became the basis for calculating maintenance costs per component, which were then used to calculate the total building maintenance budget, as well as determining repair priorities based on the level of seriousness of the damage and the area or number of elements affected.

3.2. Maintenance Costs

Building maintenance costs are calculated based on the volume of damage data collected through field observations. Each damaged building component, whether structural, architectural, or utility, is recorded in the relevant units, such as square meters (m^2) for surfaces or units (pieces) for individual elements [19]. The volume of maintenance work is then multiplied by the unit price of the work to obtain the cost per component. These maintenance costs are then sorted by the level of damage, namely light, moderate, and heavy, allowing for more structured budget calculations and clear repair priorities. With this approach, maintenance cost estimates are not only quantitatively accurate but also provide a basis for efficient and strategic maintenance planning, according to the condition and level of damage of each building component. The calculation results for maintenance costs can be seen in Tables 4 to 6.

Table 4. Maintenance costs for minor damage that occurs in multi-storey buildings

Field	Component	Volume	Unit	Unit price (Rp)	Amount (Rp)
Structure	Wall	2.34	M^2	424,690	993,774
	Column	1.41	M^2	443,890	625,884
	Beam	0.09	M^2	443,890	39,950
Architecture	Wall Coverings	804.57	M^2	27,900	22,447,503
	Column Cover	190.08	M^2	27,900	5,303,232
	Door Cover	22.08	M^2	44,600	984,768
	Window Coverings	0.93	M^2	44,600	41,478
	Ceiling Cover	731.38	M^2	27,900	20,405,502
	Terrace Wall Coverings	190.70	M^2	27,900	5,320,530
	Terrace Pillar Cover	89.76	M^2	27,900	2,504,304
	Plate Cover Upper Roof	97.39	M^2	27,900	2,717,181
Utilities	Light bulb	35.00	piece	35,000	5,250,000
Total cost					**64,974,490**

Table 5. Maintenance costs for moderate damage that occurs in multi-storey buildings

Field	Component	Volume	Unit	Unit price (Rp)	Amount (Rp)
Structure	Wall	5.44	M^2	424,690	2,310,313
	Column	8.56	M^2	443,890	3,799,698
Architecture	Door	6.00	piece	169,600	1,017,600
		3.00	piece	40,100	120,300
	Bathroom Door	2.00	piece	135,900	271,800
	Window	25.00	piece	23,700	592,500
		4.00	piece	31,900	127,600
	Window Wind Rights	16.00	piece	25,700	411,200
Total cost					**8,651,012**

Table 4 shows the calculation of building maintenance costs based on the volume of damage to various components collected through field observations. Each component, whether structural, architectural, or utility, has its volume recorded using relevant units, such as square meters (m^2) for surfaces and units (pieces) for individual elements. The cost per component is calculated by multiplying the volume of damage by the unit price. For example, a 2.34 m^2 structural wall with a unit price of Rp 424,690 results in a repair cost of Rp 993,774 ($58.46 USD), a 1.41 m^2 column with a unit price of Rp 443,890 results in Rp 625,884 ($36.81 USD), and a 0.09 m^2 beam with a unit price of Rp 443,890 results in Rp 39,950 ($2.35 USD). For the architectural field, wall coverings of 804.57 m^2 with a unit price of Rp 27,900 resulted in Rp 22,447,503 ($1,320.44 USD), column coverings of 190.08 m^2 resulted in Rp 5,303,232 ($311.95 USD), door coverings of 22.08 m^2 resulted in Rp 984,768 ($57.92 USD), window coverings of 0.93 m^2 resulted in Rp 41,478 ($2.44 USD), ceilings of 731.38 m^2 resulted in Rp 20,405,502 ($1,200.32 USD), terrace wall coverings of 190.70 m^2 resulted in Rp 5,320,530 ($313.03 USD), terrace column coverings 89.76 m^2 yielded Rp 2,504,304 ($147.31 USD), and the roof covering of 97.39 m^2 yielded Rp 2,717,181 ($159.83 USD). Meanwhile, for the utilities sector, replacing 35 lamps at a unit price of Rp 35,000 yielded Rp 5,250,000 ($308.82 USD). After all components were calculated, the cost per component was added up to obtain the total building maintenance cost, which was Rp 64,974,490 ($3,822.61 USD). This method allows for systematic and accurate maintenance cost estimation and facilitates prioritizing repairs based on the level of damage and the required budget.

Table 5 above shows the calculation of building maintenance costs for moderate damage based on the volume of damage to various components collected through field observations. In the structural area, a 5.44 m^2 wall with a unit price of Rp 424,690 results in a repair cost

of Rp 2,310,313 ($135.90 USD), while an 8.56 m ²column with a unit price of Rp 443,890 results in a repair cost of Rp 3,799,698 ($223.51 USD). In the field of architecture, 6 units of doors with a unit price of Rp 169,600 generate Rp 1,017,600 ($59.86 USD), an additional 3 units with a unit price of Rp 40,100 generate Rp 120,300 ($7.08 USD), 2 units of bathroom doors with a unit price of Rp 135,900 generate Rp 271,800 ($15.99 USD), 25 units of windows with a unit price of Rp 23,700 generate Rp 592,500 ($34.85 USD), an additional 4 units with a unit price of Rp 31,900 generate Rp 127,600 ($7.51 USD), and 16 units of upper windows (Window Wind Rights) with a unit price of Rp 25,700 generate Rp 411,200 ($15.99 USD). $24.19 USD). After all components were calculated, the total building maintenance cost for moderate damage reached Rp 8,651,012 ($508.30 USD). This approach allows for systematic and accurate budget planning and facilitates prioritizing repairs based on the level of damage and the volume of affected components.

Table 6 shows the calculation of building maintenance costs for serious damage based on the volume of damage to various architectural and utility components that have been collected through field observations. In the field of architecture, 5 bathroom doors with a unit price of Rp 445,340 resulted in a cost of Rp 890,680 ($52.39 USD), 2 windows with a unit price of Rp 994,220 resulted in Rp 1,988,440 ($116.97 USD), 48 40 x 40 cm floor tiles with a unit price of Rp 230,750 resulted in Rp 11,076,000 ($651.53 USD), 20 30 x 30 cm floor tiles with a unit price of Rp 222,760 resulted in Rp 4,455,200 ($261.48 USD), and a ceiling area of 118.71 m ² with a unit price of Rp 111,240 resulted in Rp 13,204,300 ($776.73 USD). In the utilities sector, 17 lamps with a unit price of Rp 10,000 generate Rp 170,000 ($10.00 USD), 7 double switches with a unit price of Rp 25,000 generate Rp 175,000 ($10.29 USD), 6 double sockets with a unit price of Rp 25,000 generate Rp 150,000 ($8.82 USD), 9 single sockets with a unit price of Rp 15,000 generate Rp 135,000 ($7.94 USD), 2 squat toilets with a unit price of Rp 635,800 generate Rp 1,271,600 ($74.80 USD), 1 urinal with a unit price of Rp 1,286,770 generate Rp 1,286,770 ($75.69 USD), and Four water taps with a unit price of Rp 65,780 generate Rp 263,120 ($15.48 USD). The total building maintenance cost for serious damage reaches Rp 19,556,222 ($1,150.95 USD). This calculation provides a systematic basis for determining the maintenance budget, repair priorities, and resource allocation according to the level of damage and the volume of affected components.

Table 6. Maintenance costs for serious damage to multi-storey buildings

Field	Component	Volume	Unit	Unit price (Rp)	Amount (Rp)
Architecture	Bathroom Door	5	piece	445,340	890,680
	Window	2	piece	994,220	1,988,440
	Floor Covering 40 x 40	48	piece	230,750	110,760
	Floor Covering 30 x 30	20	piece	222,760	44,552
	Ceiling	118.71	M^2	111,240	13,204,300
Utilities	Light fittings	17	piece	10,000	170,000
	Double Switch	7	piece	25,000	175,000
	Double Socket	6	piece	25,000	150,000
	Single Socket	9	piece	15,000	135,000
	Squat Toilet	2	piece	635,800	1,271,600
	Urinary	1	piece	1,286,770	1,286,770
	Water faucet	4	piece	65,780	263,120
		Total cost			**19,556,222**

Table 7. Summary of maintenance costs for high-rise buildings

Field	Amount (Rp)			
	Minor (Rp)	Moderate (Rp)	Heavy (Rp)	
Structure	1,659,609	6,110,012	-	7,769,621
Architecture	59,724,498	2,541,000	16,239,732	78,505,230
Utilities	5,250,000		13,451,490	19,556,222
Total cost				Rp. 105,831,073

The summary table above presents the total estimated building maintenance costs based on the level of damage, namely minor, moderate, and heavy, in each area: structure, architecture, and utilities. In the structural area, maintenance costs for minor damage reach Rp 1,659,609 ($97.62 USD), moderate damage Rp 6,110,012 ($359.41 USD), so the total for the structure is Rp 7,769,621 ($457.03 USD). In the architectural field, the maintenance costs for minor damage are Rp 59,724,498 ($3,513.79 USD), moderate damage Rp 2,541,000 ($149.47 USD), and heavy damage Rp 16,239,732 ($954.69 USD), so the total architecture costs reach Rp 78,505,230 ($4,617.95 USD). Meanwhile, in the utility field, the costs for minor damage are Rp 5,250,000 ($308.82 USD) and heavy damage is Rp 13,451,490 ($791.85 USD), so the total utility is Rp 19,556,222 ($1,150.67 USD). By summing all areas and levels of damage, the total building maintenance cost is estimated at Rp 105,831,073 ($6,225.65 USD). This summary facilitates understanding of budget allocation based on damage levels and component types, while also providing a basis for decision-making regarding building maintenance priorities.

The overall analysis of the types of damage to the structure, architecture, and utilities areas, namely minor, moderate, and serious, revealed that the architecture area experienced all three types of damage [26]. The damage data for the architecture area can be seen in Figure 2.

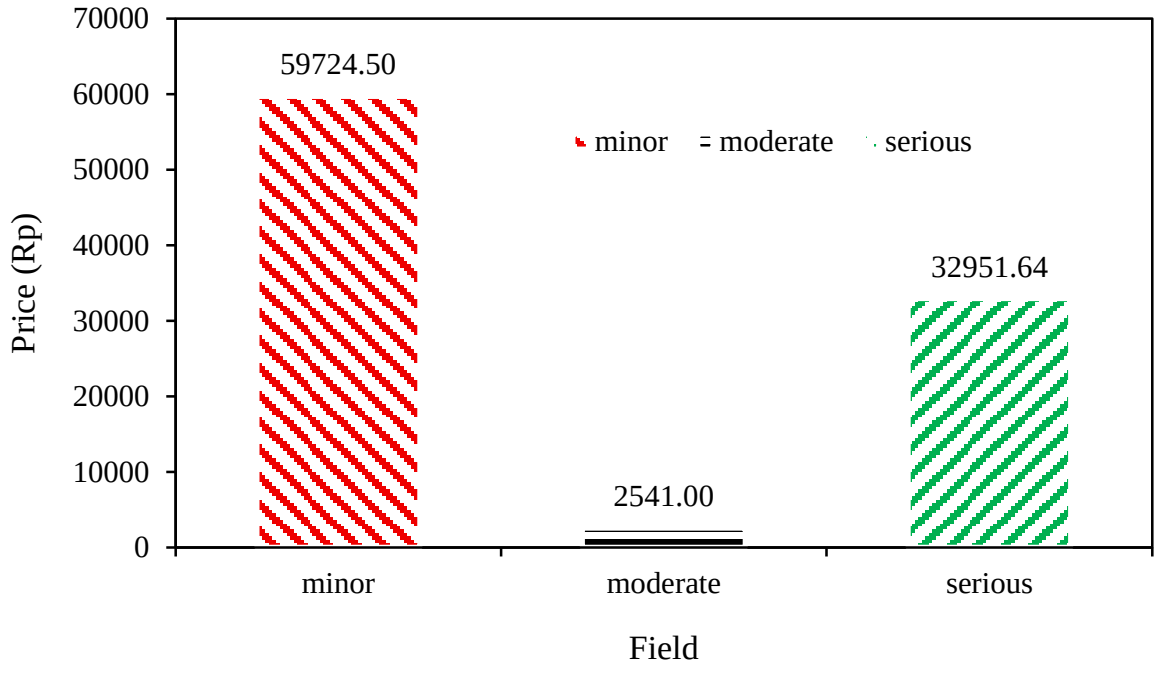

Figure 2. Compilation results of architectural maintenance costs

4. Conclusions

The analysis of building damage data shows that repairs and maintenance were carried out in three main areas: structure, architecture, and utilities, with damage levels categorized as minor, moderate, and severe. Field observations were used to determine the volume of damage to each component, both in square meters (m^2) for surface elements and in units (pieces) for individual elements. This was then multiplied by the unit price to obtain the maintenance cost per component.

Based on the recapitulation, architectural components accounted for the largest portion of costs, at IDR 78,505,230.40 ($4,618 USD), followed by utilities components at IDR 19,556,222.00 ($1,150 USD), and structural components at IDR 7,769,621.60 ($457 USD). Overall, the total maintenance cost for this high-rise building reached IDR 105,831,073.00 ($6,225 USD).

This analysis shows that the majority of the budget is focused on repairing architectural elements, such as wall coverings, ceilings, floors, doors, and windows, while damage to the structure and utilities requires smaller but still significant costs. With this approach, maintenance cost estimation can be carried out systematically and measurably, facilitating repair prioritization, budget allocation, and strategic decision-making to maintain the building's safety, functionality, and comfort.

5. Recommendation

Based on the results of this analysis, it is recommended that building managers or owners apply a similar maintenance cost calculation method to other high-rise buildings, including damage identification, severity classification, and cost estimation per component. This approach aligns with the provisions of Minister of Public Works Regulation No. 24/PRT/M/2008 concerning Technical Guidelines for Building Maintenance and the Indonesian National Standard (SNI), which emphasizes the importance of routine maintenance to ensure the safety, comfort, and function of buildings. By transposing this method to similar building types, managers can determine periodic maintenance schedules, repair priorities, and budget allocation more effectively, while ensuring compliance with applicable regulations and technical standards.

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