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VISUAL ANALYSIS OF BUILDING DAMAGE LEVEL AT SEBELAS MARET UNIVERSITY DORMITORY

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Abstract

The structural integrity of a building is a primary parameter in ensuring the safety and security of its occupants. Over time, structural and non-structural performance tends to degrade due to building age, environmental factors, and usage intensity. This study aims to analyze the physical damage level of Building E at the Sebelas Maret University (UNS) Student Dormitory to provide a technical basis for building maintenance and repair management. The research methodology involved a technical evaluation through visual inspection of both structural and non-structural elements. The analysis results indicate that within the structural elements, the highest damage percentage was found in beams at 20.43%, followed by columns at 0.16%, while stair elements showed no damage. Regarding non-structural elements, the dominant damage occurred in wall finishing/paint at 6.86%, followed by ceilings at 1.96%, and window components at 0.5%. Other elements, including light brick walls, doors, and floor coverings, remained in good condition with no identified damage. The cumulative calculation shows that the total damage percentage for Building E of the UNS Student Dormitory is 3.28%. Based on building damage classifications, this value falls well below the 30% threshold, categorizing the building as having light damage. As a follow-up measure, optimization of periodic preventive maintenance management is required to prevent further degradation and ensure the long-term functional sustainability of the building.

Keywords: *Damage Evaluation, Structural Elements, Non-Structural Elements, Student Dormitory, Maintenance Management.*

INTRODUCTION

In the construction of a building, sound structural planning is the primary factor in ensuring the robustness and safety of its occupants. Building structures are designed to withstand dead loads, live loads, and environmental loads such as wind, rain, and earthquakes. However, structural performance is not permanent and will experience degradation over time. Structural and non-structural element degradation is generally caused by the building's age, weathering, and the intensity of its usage. If not addressed with an adequate maintenance system, this can lead to physical damage that results in a decline in building function. According Sucipto, factors such as low initial design quality and the lack of routine maintenance are the main causes of the declining feasibility of a building (Tito Sucipto, 2009).

Efforts to maintain building conditions so that they remain functional must be carried out through maintenance and repair activities. Mulyandari & Saputra explain that maintenance serves as a preventive measure, while repair is curative, aimed at fixing or replacing damaged building components (Mulyandari and Saputra, 2011). The Student Dormitory of Universitas Sebelas Maret (UNS) is a facility that serves as a residence for students during their study period. With the building having entered several years of usage, physical damage has begun to appear in several structural and non-structural elements. If left unaddressed, this damage has the potential to compromise the comfort, safety, and functional feasibility of the building. Therefore, the author is interested in visually analyzing the damage level of the Universitas Sebelas Maret student dormitory building to evaluate the condition of structural and non-structural elements and to provide a basis for maintenance recommendations based on the actual level of damage.

LITERATURE REVIEW

A building is defined as the physical realization of construction work that forms an integrated whole with its specific site location. Its existence may be situated entirely or partially above the ground, underground, and/or within water areas. These buildings function as spaces that support various human activities, including residential purposes, religious worship, economic activities, social and cultural endeavors, as well as other specialized purposes (Regulation of the Minister of Public Works Number: 24/PRT/M/2008 Concerning Guidelines for Building Maintenance and Care).

Building Maintenance

Referring to the provisions in the Minister of Public Works Regulation No. 24 of 2008, building maintenance encompasses a series of activities aimed at ensuring that the function and performance of a building, including all its supporting facilities, remain optimal. These measures are undertaken to ensure that the building meets the established functional feasibility standards. Maintenance can be categorized into several types, classified according to their characteristics and implementation objectives: (1) Planned Maintenance. This refers to maintenance activities predetermined within an organized work system. This process involves thorough planning, control over the activities performed, and administrative recording to document all designed stages of maintenance implementation. (2) Preventive Maintenance. This type of maintenance is carried out periodically at specific time intervals or based on predefined technical parameters. Its primary objective is to prevent damage and minimize the possibility of performance degradation in equipment or building components before an actual functional failure occurs. (3) Corrective Maintenance. This is implemented as a response to damage or functional failures that have already occurred. Activities in this category include efforts to restore building components or devices to their functional state, either through direct repair processes or the replacement of damaged elements. (4) Emergency Maintenance. This refers to maintenance actions carried out immediately in critical situations to prevent greater risks or hazards. This type of maintenance is urgent and typically performed without long-term planning, as it demands a rapid response to threats of serious damage.

Building Repair and Care

Referring to the Minister of Public Works Regulation No. 24/PRT/M/2008 concerning the guidelines for building maintenance and repair, building care is defined as a series of activities encompassing the repair or replacement of building elements, including structural components, construction materials, and other supporting facilities, with the aim of ensuring the building continues to meet functional feasibility criteria (curative maintenance). Meanwhile, Sari *et.al* state that repair work does not only focus on maintaining the functional continuity and durability of the building but also includes maintenance actions and the replacement of damaged components (Sari *et.al,* 2024). Building care can also be understood as a continuation of preventive maintenance activities, where the repair or replacement of building elements is carried out to ensure the building remains fit for function and can be utilized as intended. According to Taufiqullah (2023), there are two commonly applied building care patterns in practice, namely: (1) Rehabilitation. Activities aimed at repairing damaged parts of a building so that they can be restored to their intended use. (2) Renovation. The repair of buildings experiencing significant damage while maintaining their original function. In the renovation process, changes to architectural, structural, or utility aspects can be adjusted to meet new requirements (Taufiqullah in Fadhillah, 2025).

Building Damage

According to the Minister of Public Works Regulation No. 24 of 2008, the level of building damage is classified into three categories: light damage, moderate damage, and heavy damage. Each category is described as follows: (1) Light Damage. This category includes damage occurring primarily to the non-structural elements of the building, such as roofing, ceilings, floor finishes, and infill walls. This type of damage is minor and can be repaired without requiring major structural intervention, with a damage percentage of less than 30% of the total building components. (2) Moderate Damage. This refers to damage affecting some non-structural elements and/or certain structural components, such as floors or roof trusses. In this case, the building structure must not have a tilt exceeding 1%, the damage level at column and beam joints must not exceed 30%, and deformations must remain within permissible limits. The repair process involves replacing or fixing elements without the need for total demolition. Generally, moderate damage ranges from 30% to 45%. (3) Heavy Damage. Included in this category is damage

occurring to the majority of building components, both structural and non-structural. Although repairable, this damage is severe enough that the building can only function properly again after significant repairs are undertaken. The percentage of structural damage in this category exceeds 45%.

Factors Causing Building Damage

As Indonesia is a tropical country, it experiences a high level of vulnerability to building damage and the accelerated weathering of construction materials beyond their design life. According to Lippsmeier (1980) several factors that accelerate such damage include: (1) Natural Disasters. Events such as earthquakes, storms, heavy rainfall, and floods that can severely damage the building structure. (2) Temperature and Humidity. Variations High temperature fluctuations and humidity levels accelerate wood decay and trigger cracking in concrete. (3) Building Pests. Termites and ants are common threats in tropical regions; it is estimated that approximately 10% of buildings experience termite infestations. (4) Inappropriate Material Selection. The use of building materials that are not resistant to local environmental conditions accelerates the rate of deterioration. (5) Chemical Factors. Exposure to acidic compounds or salts that accelerate the degradation of concrete. (6) Material Age. Every material has a different rate of quality degradation, making the age of the material a crucial factor in building durability (Lippsmeier in Andeswastoto, Hanantatur., & Islah, Muhammad, 2018).

Classification of Building Components

The purpose of classifying building components is to identify the specific elements of a building that require a calculation of their damage percentage. These provisions refer to the Minister of Public Works Regulation Number 22/PRT/M/2008 concerning the Guidelines for Building Maintenance and Repair. For greater clarity, the Classification of Building Components proposed by Hafiz (2016), as cited in Saputra, Anggi., Sudirman., Fikri., and Muhammad (2024) and Fadhillah, Ainul (2025), is presented below.

Table 1. Classification of Building Components

No.	Component	Sub-Component
1	Roof	Roof Covering / Roof Frame
		Fascia Board & Gutter
2	Ceiling	Ceiling Frame & List Cover
		Ceiling
3	Wall	Column & Ring Beam
		Wall, Plaster & Paint
4	Doors & Windows	Door & Window Frames
		Door & Window Leaves
5	Floor	Floor
		Stairs
6	Foundation	Foundation
7	Utilities	Electrical Installation
		Water Installation & Drainage System

By referring to the results of the building component classification, the damage level of each room can be determined using the approach outlined in Hafiz's (2016) guidelines regarding instruments for room damage data collection (Hafiz's in Saputra, Anggi., Sudirman., Fikri., and Muhammad (2024)., and Fadhillah, Ainul (2025).

Table 2. Damage Calculation Formula

No.	Component	Sub-Component	Formula
1	Roof	Roof Covering / Roof Frame	(Damaged Area : Total Area) × 100%
		Fascia Board & Gutter	(Damaged Area : Total Area) × 100%
2	Ceiling	Ceiling Frame & List Cover	(Damaged Area : Total Area) × 100%
		Ceiling	(Damaged Area : Total Area) × 100%
3	Wall	Column & Ring Beam	(Number of Damages : Total Quantity) × 100%
		Wall, Plaster & Paint	(Number of Damages : Total Quantity) × 100%
4	Doors & Windows	Door & Window Frames	(Total Damages : Total Quantity) × 100%
		Door & Window Leaves	(Total Damages : Total Quantity) × 100%
5	Floor	Floor	(Damaged Area : Total Area) × 100%

No.	Component	Sub-Component	Formula
		Stairs	(Damaged Area : Total Area) × 100%
6	Foundation	Foundation	(Total Damages : Total Quantity) × 100%
7	Utilities	Electrical Installation	(Total Damages : Total Quantity) × 100%
		Water Installation & Drainage	(Total Damages : Total Quantity) × 100%

Meanwhile, the list of components subject to analysis in the Student Dormitory building of Universitas Sebelas Maret (UNS) is as follows:

Table 3. List of UNS Dormitory Building Elements

No.	Structural	Non-Structural
1	Column	Wall
2	Beam	Ceiling
3	Stairs	Floor
4		Door
5		Window
6		Finishing

Building Damage Categories

The classification of building damage levels refers to the provisions established by the Directorate General of Early Childhood Education, Primary Education, and Secondary Education, Ministry of Education and Culture. The legal basis used in this classification refers to the Regulation of the Minister of Public Works No. 24/PRT/M/2008 concerning Guidelines for the Maintenance and Care of Buildings, as well as the Circular Letter of the Minister of Education and Culture No. 46705/MPK.A/SP/2020 concerning the Mechanism for Proposing the Physical Special Allocation Fund (DAK) for the Education Sector for Fiscal Year 2021. For further details, see Tables 4 to 11 (Saputra, Anggi., Sudirman., Fikri., and Muhammad (2024), and Fadhillah, Ainul (2025).

Table 4. Criteria for Determining Column Damage Level

Category	Description of Damage Level	Score	Classification
Very Minor Damage	Column corner chipped; hairline cracks in plaster	0.2	1
Minor Damage	Surface cracks 0.2–1.0 mm wide	0.4	2
Moderate Damage	Surface cracks > 1.0 mm; concrete cover deteriorated, some reinforcement visible	0.6	3
Severe Damage	Reinforcement visible on 4 sides at one point; concrete cover destroyed in several areas	0.8	4
Very Severe Damage	Core concrete destroyed; reinforcement bars bent; column broken	1	5

Table 5. Criteria for Determining Beam Damage Level

Category	Description of Damage Level	Score	Classification
Very Minor Damage	Floor slab vibrates when walked on; hairline cracks < 0.2 mm	0.2	1
Minor Damage	Cracks 0.2–1.0 mm; cracks at mid-span of slab	0.4	2
Moderate Damage	Beam deflects; crack width > 1.0 mm; cracks spread in several areas	0.6	3
Severe Damage	Beam deflects; concrete cover destroyed; reinforcement visible	0.8	4
Very Severe Damage	Beam broken/collapsed; supported slabs and beams also damaged	1	5

Table 6. Criteria for Determining Floor Slab Damage Level

Category	Description of Damage Level	Score	Classification
Very Minor Damage	Hairline cracks < 0.2 mm; cracked beam plaster; cracks at support or span	0.2	1
Minor Damage	Cracks 0.2–1.0 mm at support or span	0.4	2
Moderate Damage	Floor deflects; 1.0 mm cracks spread from center toward column corner; concrete cover destroyed in several areas	0.6	3
Severe Damage	Floor deflects; penetrating cracks; reinforcement visible; concrete cover destroyed	0.8	4
Very Severe Damage	Floor destroyed	1	5

Table 7. Criteria for Determining Wall Damage Level

Category	Description of Damage Level	Score	Classification
Very Minor Damage	Hairline cracks < 0.2 mm; partial paint discoloration	0.2	1
Minor Damage	Visible cracks 0.2–1.0 mm; paint damage spreading	0.4	2
Moderate Damage	Cracks 1–2 mm; partition/ceiling cover detached; partial plaster cracking and peeling paint; major cracks	0.6	3
Severe Damage	Extensive peeling; moss growth; plaster widely detached	0.8	4
Very Severe Damage	Wall collapsed	1	5

Table 8. Criteria for Determining Ceiling Damage Level

Category	Description of Damage Level	Score	Classification
Very Minor Damage	Partial discoloration of ceiling paint	0.2	1
Minor Damage	Widespread paint damage	0.4	2
Moderate Damage	Ceiling opening cover detached	0.6	3
Severe Damage	Severe ceiling sagging with potential major collapse	0.8	4
Very Severe Damage	Ceiling frame collapsed	1	5

Table 9. Criteria for Determining Damage Level of Windows, Doors, Frames

Category	Description of Damage Level	Score	Classification
Very Minor Damage	Partial discoloration of frame paint	0.2	1
Minor Damage	Opening cover cracked	0.4	2
Moderate Damage	Wide cracks in opening cover	0.6	3
Severe Damage	Frame decayed due to water	0.8	4
Very Severe Damage	Frame decayed due to termites	1	5

Table 10. Criteria for Determining Floor Damage Level

Category	Description of Damage Level	Score	Classification
Very Minor Damage	Floor covering scratched	0.2	1
Minor Damage	Several scratches on floor covering	0.4	2
Moderate Damage	Partial detachment of floor covering	0.6	3
Severe Damage	Large portions of floor covering	0.8	4

Category	Description of Damage Level	Score	Classification
	detached		
Very Severe Damage	Floor bursts/detaches	1	5

Table 11. Criteria for Determining Wall Finishing/Paint Damage Level

Category	Description of Damage Level	Score	Classification
Very Minor Damage	Hairline cracks < 0.2 mm; cracked beam plaster; cracks at support or span	0.2	1
Minor Damage	Cracks 0.2–1.0 mm; cracks at support or span	0.4	2
Moderate Damage	Floor deflects; 1.0 mm cracks spread from center toward column corner; concrete cover destroyed	0.6	3
Severe Damage	Floor deflects; penetrating cracks; reinforcement visible; concrete cover destroyed	0.8	4
Very Severe Damage	Floor destroyed	1	5

METHOD

The type of research employed in this study is descriptive quantitative research, combining visual observation and literature review methods. These methods serve as a framework for obtaining data to descriptively represent the problems identified in the object under investigation. The data obtained by the researchers were subsequently analyzed to determine the research findings. The object of this study is the Student Dormitory Building of Universitas Sebelas Maret (UNS) in Surakarta, located at Jalan Kartika III RT 2 RW 8, Ngoresan, Jebres, Surakarta, Central Java Province, Indonesia. The stages of building damage data collection are presented sequentially in the building damage flowchart, followed by the research flowchart. For a clearer understanding, they can be observed as follows:

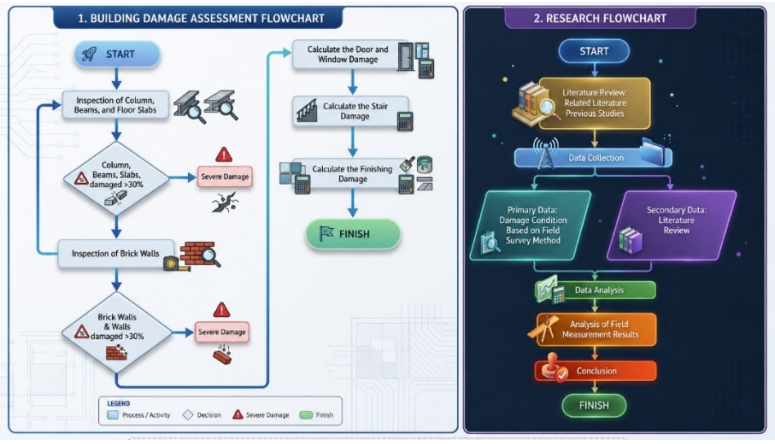

Image 1: Building Damage Assessment Flowchart and Research Flowchart

RESULTS AND DISCUSSION

The damage characteristic analysis stage involves a data calculation process for each damaged building element to produce a measurable percentage of the damage level for each component

Tabel 12. Analysis of Damage Characteristics

No.	Component	Volume of Damage	Total Volume	Result
1	Column	(0,4 x 8) + (0,2 x 364)	372 unit	20,43 %
2	Beam	(0,4 x 2)	494 unit	0,16 %
3	Ceiling	(0,6 x 9,84 m2) + (0,4 x 11,93 m2)	567,93 m2	1,96 %
4	Wall	0 m2	3.812,93 m2	0 %

5	Door	0	125 unit	0 %
6	Window	0,3	139 unit	0,21 %
7	Floor Covering	0 m2	569,73 m2	0 %
8	Stair	0	15 unit	0 %
9	Finishing	(0,4 x 16,33 m2)	4.414,3 m2	6,53 %

The determination of the damage level is conducted through a recapitulation of the damage percentage for each component. The classification of damage types refers to the Minister of Public Works Regulation (Permen PU) No. 28 of 2008, which divides damage categories into three: light damage with a percentage below 30%, moderate damage ranging from 30% to 45%, and heavy damage if it exceeds 45%. Detailed information regarding the recapitulation of the damage percentage results for all components can be seen in the following table:

Tabel 13. Recapitulation of Total Component Damage

Component	**Subcomponent**	**Total Volume**	**Type of Damage**		
			< 30 %	**30 % - 40 %**	**45 %**
Structure	Column	372	20,43 %	-	-
Structure	Beam	494	0,16 %	-	-
Structure	Stair	15	0 %	-	-
Non Structural	Ceiling	567,93 m2	1,96 %	-	-
Non Structural	Wall	3.812,93 m2	0 %	-	-
Non Structural	Door	125	0 %	-	-
Non Structural	Window	139	0,21 %	-	-
Non Structural	Floor Covering	569,73 m2	0 %	-	-
Non Structural	Finishing	4.414,3 m2	6,53 %	-	-

CONCLUSION

Based on the damage calculation results obtained, the following conclusions can be drawn: (1) The damage to the studied structural elements includes columns, beams, and stairs. From these three elements, it can be concluded that the highest damage percentage was experienced by column at 20.43%, followed by beam damage at 0.16%, and the smallest damage percentage was for stairs at 0%. (2) The damage to the studied non-structural elements includes ceilings, lightweight brick walls, doors, windows, and floor coverings. The highest damage percentage was experienced by wall finishing/paint at 6.86%. This was followed by ceiling damage at 1.96%, then window damage at 0.5%, and subsequently by other damage percentages for lightweight brick walls, doors, and floor coverings at 0%. (3). The total damage level percentage for both structural and non-structural elements of Building E of the UNS Student Dormitory is 3.28%. Since the damage percentage is <30%, it is categorized as light damage.

To refine and complete the results of this study, several measures should be taken, including: (2). Preventive efforts against building damage need to be optimized to support the improvement of more effective building maintenance and repair management systems. (2). For researchers conducting similar studies, it is expected that they calculate all structural and non-structural elements comprehensively.

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