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ARCHITECTURAL ASSESSMENT OF BUILDING RELIABILITY AT SALAMAN AL-FARITSI MOSQUE, UNNES

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ABSTRACT

Building reliability stands as a fundamental consideration in architectural planning and construction. According to Indonesian Law No. 28 of 2002, all buildings must comply with both administrative and technical standards that align with their intended purposes. These technical requirements encompass spatial planning specifications and structural reliability standards, which include the building's capacity to withstand load-bearing demands and its ability to mitigate fire and lightning risks. Consequently, buildings—particularly those serving vital functions or public interests—require rigorous quality oversight and functional viability assurance throughout their design and operational phases. This research examines the Salman Al-Faritsi Mosque at the Faculty of Engineering, focusing on both structural integrity and architectural design elements. The methodology employed combines observational techniques with Participatory Rural Appraisal (PRA) approaches, engaging community members in a collaborative assessment process. This participatory framework ensures accurate collection of physical field data while incorporating community input and preferences into the evaluation. The initial phase of this research yielded design alternatives for community consideration and approval, specifically addressing the mosque's interior layout and mihrab design. These approved concepts will serve as construction implementation guidelines. This study aims to establish a comprehensive framework for mosque building reliability that can be implemented across the UNNES campus and potentially adapted for mosque construction beyond the university grounds. The resulting reliability planning documentation is intended to provide practical guidance throughout the architectural design process.

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1. INTRODUCTION

The contemporary educational landscape is undergoing unprecedented transformation, particularly within higher education institutions. This evolution is driven by technological advancement, enhanced communication systems, and intensifying global competition. Such development inevitably influences pedagogical approaches, educational standards, institutional rankings, and overall academic framework.

In the context of sustainable campus development, building reliability has received insufficient attention, especially within complex educational environments like universities. Consequently, UNNES requires comprehensive guidelines for each facility to ensure compliance with both administrative and technical standards that align with specific building functions while meeting holistic safety requirements. Critical considerations for building reliability include structural stability and durability, along with comprehensive protection systems against fire hazards and lightning strikes. Indonesian Law No. 28 of 2002 concerning Buildings mandates that all structures must satisfy administrative and technical requirements corresponding to their designated functions. [1]

Building regulations typically vary across different regions based on local conditions and requirements. Nevertheless, these regulations generally share common principles, particularly regarding building reliability standards. Building reliability encompasses two fundamental components: administrative compliance and technical reliability, which includes technical specification requirements for both design and construction phases. Public buildings are buildings that function as places for people to gather, hold meetings, and carry out other public activities, such as religious, educational, recreational, sports, and shopping.[2]

Semarang State University (UNNES) has declared itself a Conservation University since March 10 2010[3]. State Universities (UNNES) have become legal entities focused on self-reliance in financing the teaching and learning process, management, research, and various other aspects of implementation that need to be addressed. UNNES's vision for becoming a Conservation University is also evolving, with nine pillars of conservation development aligned with its potential.

One such development is the development of infrastructure on the Sekaran Gunungpati Semarang campus, specifically for the implementation of teaching and learning processes and services for the academic community. The planning and construction of UNNES's campus

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infrastructure began in the 1990s, and in 2014, UNNES gets a grant for campus construction funds from IDB (Islamic Development Bank). One of the new buildings at UNNES is the Al-Faritsi Mosque, Faculty of Engineering. This building serves as the primary facility, serving as a place of worship and spiritual activities for all activities within the Faculty.[4]

Building reliability requirements include safety, health, comfort, and convenience requirements. Religious buildings, as referred to, include mosques[2]. A building is defined as a physical construction integrated with its site location, positioned partially or entirely above and/or on land and/or water, serving as a space for human activities including residential, religious, commercial, social, cultural, or specialized functions. Building maintenance encompasses activities that preserve structural reliability along with infrastructure and facilities to ensure continuous functionality. Periodic inspections involve systematic reliability assessments of entire buildings or specific components, materials, and infrastructure within predetermined timeframes to verify functional compliance. Vital buildings are structures serving significant public interests, requiring enhanced maintenance and supervision protocols to improve and sustain building reliability. The reliability of structural components that can be observed in the room is limited to the sub-components of columns, main beams, sub-beams, column-beam joints, ceiling hangers, and stair plates/beams. The mosque building damage inspection was conducted based on PU Ministerial Regulation No.28 Tahun 2002 concerning Guidelines for Building Maintenance and Care. The building damage assessment only focuses on the structure and architecture[5].

The Al-Faritsi Mosque at the Faculty of Engineering, UNNES, represents one of the institution's newest architectural additions. This facility serves as the primary worship center and spiritual hub for all activities within the Faculty of Engineering. Designed with green open space orientation, the Al-Faritsi Mosque symbolizes spiritual service and religious devotion within the engineering faculty environment. Beyond maintenance and supervision requirements, buildings must provide functional suitability guarantees, ensuring continued compliance with administrative and technical requirements according to their designated purposes. This study analyzes the Al-Faritsi Mosque Building at the Faculty of Engineering, UNNES, focusing on structural reliability and architectural elements that influence overall building dependability. The research aims to establish exemplary standards and guidelines for mosque building reliability across the UNNES campus.

2. RESEARCH METHODOLOGY

One way to understand the differences between qualitative and quantitative methods is by understanding the study of knowledge, known as epistemology. Referring to the philosophy of epistemology, the assumptions of qualitative and quantitative approaches in the research field differ.[6] This study employs a mixed-method approach combining primary and secondary data collection through literature reviews and field observations. The research focuses on gathering theoretical foundations and empirical data from the Al-Faritsi Mosque building at the Faculty of Engineering, Unnes, Sekaran Gunungpati Campus. The collected data undergoes descriptive analysis to derive meaningful insights. The methodology adopts a problem-solving design framework that prioritizes issue identification at the project's inception. This approach begins with hypothesis formulation or preliminary problem-solving strategies that serve as the foundation for subsequent analysis, refinement, and development phases. The process draws upon: prior experience and expertise; established general guidelines; and designer expectations regarding appropriate procedural steps. Field inspections and data collection were conducted using qualitative methods and visual observations of the building's physical condition. The reliability assessment process begins with determining the assessment classification, followed by collecting project data in the form of building maintenance and repair history, conducting a visual field inspection, and then conducting an assessment using the assessment classification.[7]

The evaluation process utilizes a numerical scoring system based on predetermined maximum weight standards. For instance, when establishing a maximum weight value of 10, field observations determine the appropriate scoring based on the following criteria:

1. Initial Reliability Value

   Baseline assessment of structural integrity and performance capacity.

2. Total Floor Area and Component Analysis

   Floor area and other structural components are evaluated using percentage-based assessments (%). Each building floor receives a standardized base value of 100 for calculation purposes.

3. Damage Level Assessment

   Similar to floor area evaluation, damage assessment employs percentage-based scoring to quantify deterioration levels.

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4. Reduction Factor

   This represents natural depreciation or degradation affecting building component reliability over time. Each floor exhibits varying reduction levels due to different usage patterns and environmental exposure.

5. Reliability Value Calculation

   This metric results from computational analysis incorporating initial reliability values, maximum reliability thresholds, reduction factors, and component damage levels. For architectural components, the assessment follows this formula:

   NK = (floor area - damage level) × NKA / 100

6. Interpretation and Final Assessment

   The interpretation phase represents the culmination of the evaluation process, encompassing both individual component assessments and cumulative values contributing to the overall reliability assessment (NKS). The scoring methodology maintains consistency with the established maximum weight standards, ensuring systematic evaluation based on field observation data.

   The building administration requirements specifically serve as a first step in inspecting the reliability of buildings, and generally aim to ensure orderly administration of spatial use regulations and orderly development for the common good of a development area. Every building must meet these administrative requirements.[8]

2.1 Building Reliability Study

The concept of building reliability remains underexplored in the development of conservation-focused campuses, particularly within complex educational ecosystems like universities. Consequently. UNNES requires comprehensive guidelines for each facility to ensure compliance with both administrative protocols and technical specifications that align with building functionality while satisfying holistic safety standards. Critical considerations for building reliability include the capacity to maintain structurally sound and resilient construction that can effectively prevent and mitigate fire and lightning-related hazards.

Indonesian Law No. 28 of 2002 concerning Buildings mandates that all structures must fulfill administrative and technical prerequisites corresponding to their designated functions (Chapter IV, Article 7 (1)). These technical specifications encompass building layout standards and structural reliability criteria (Chapter IV, Article 7 (3)), which incorporate safety, health, comfort,

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and convenience parameters appropriate to the building's intended use. Building structures regulations typically exhibit regional variations reflecting local environmental conditions and requirements. Nevertheless, these regulations generally maintain consistent frameworks focused on ensuring structural reliability standards.[1]

In general, the reliability of building structures can be divided into two main categories: administrative and technical. Technical reliability includes the technical specifications required for the design and construction process. Administrative reliability is regulated by building construction regulations and includes the completeness of permits, tax payments, ownership certificates, security, changes, maintenance, plan drawing approval, work stoppage orders, and permitted loads on a building. Meanwhile, technical reliability includes an explanation of requirements for structural components, lighting, ventilation, vertical transportation, piping, walls, and doors. The Technical Requirements Guidelines for Buildings state that a building meets the requirements if it:

- Safety
- Health
- Comfort
- Convenience

2.2 Building Quality

Building quality refers to the condition of a building that ensures its function is suitable for its intended purposes or concept. A building's quality system is determined by its design criteria and process. Design criteria are the requirements necessary for a quality design that represent the needs, goals, concepts, and ideas determined at the beginning of the design process. One factor that must be considered when planning a building is its reliability. Building reliability is the building's ability to perform its intended function. Therefore, every building serving the public needs to be monitored for quality and ensure its proper functioning.[7]

1. Functional Design Criteria: These are criteria related to the function of a building. These criteria are described by the pattern of activities that occur in a building, resulting in a relationship between the necessary spaces/components.

2. Technical Design Criteria: These are the criteria that must be met after the functional criteria have been identified. Technical design criteria are the requirements that must be met when

planning a building based on its intended functions. Technical design criteria are related to the comfort and safety of building users and are closely related to the scale, dimensions, aesthetics, layout, and shape of the building or space.

2.2.1 Building Structure Reliability Assessment

The ultimate goal of an inspection is to evaluate the structural reliability of a building or determine its level of damage. Existing reliability level provisions are used to determine necessary repair or reinforcement methods. In every building structure inspection, the analysis results are used to calculate whether the stress resulting from the structural calculations is smaller than the resistance of the components. If one of the structural components does not meet the technical requirements, the submitted recommendations are general descriptions. Re-analyzing the building structure is based on the assumption that it will function throughout its remaining service life.

Guidelines for Technical Requirements for Buildings, technical requirements for buildings are divided into two areas, namely[9]:

1. Requirements for building and environmental layout consisting of: a) Building architecture b) Provision of space and intensity of building c) Building and Environmental Layout Plan (RTBL) d) Controlling environmental effects e) Building buildings above or below ground, water or public infrastructure/facilities.

2. Requirements for building reliability consisting of: a) Building comfort requirements b) Building safety requirements c) Building convenience requirements d) Building health requirements

The level of reliability can be determined using the condition rating method. According to previous studies conducted by the author, assessments using the condition scale method are based on visual inspections. This numerical assessment is carried out using a scale that describes conditions ranging from very poor to very good. In reality, even though this approach is guided by a condition scale, it is still influenced by subjective assessments. Therefore, the same building structure, if inspected and assessed by different Inspectors, will produce different levels of reliability. A building must meet both administrative and technical requirements for its operation. Technical requirements for a building include building layout requirements and building reliability requirements. To determine whether a building meets these reliability requirements, a building reliability assessment is required. The reliability assessment refers to the 2016 Building

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Reliability Inspection Procedures prepared by the Building Science Center, Ministry of Public Works and Public Housing.

Another approach for reliability assessment is using a reliability index. This method analyzes different levels of reliability. Figure 5 shows four levels of reliability verification: (1) building materials, (2) element cross-sections, (3) structural elements, and (4) structural systems.

2.2.2 Reference Standard for Structural Inspection

Reliability is the level of perfection of a building and its equipment, which ensures the safety, function, and comfort of a building and its environment throughout its useful life. Building reliability is the condition of a building that meets the safety, health, comfort, and convenience requirements of the building in accordance with its specified functional needs.[10] Building reliability is a benchmark for how a building has been technically tested to meet the requirements set by the government. The technical requirements for buildings are regulated in Ministerial Regulation No. 29 of 2006 concerning Guidelines for Technical Requirements for Buildings. This regulation is the legal basis for the technical requirements that a building must meet. [11]Standards are common rules that provide a means of communication, offering certainty and confidence between providers and users of products or services within an agreed-upon context. Why are standards needed? The purpose of creating and implementing standards is related to this question. Thus, determining standards aims to increase efficiency, which should result in lower costs. In the case of inspecting building structures, a standard is obtained so that the inspection method and the determination of the building's reliability level are based on uniform provisions that explain how to visually assess structural damage. Similarly, many still use new building planning standards rather than existing structural inspection standards at the evaluation stage. Although new building planning standards are used in structural analysis, they are not entirely "suitable" to analyze existing building structures. For example, the age of existing buildings must be considered in structural analysis. Ideally, each stage of the building inspection process should refer to technical guidelines or standards to which the inspection team can adhere. The following are the standards used as a reference by the Center for Settlement Research and Development Inspection Team:

1) Initial inspection
    - Review of technical documents, floor plan, and planned dimensions/installed structural components of the building.

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- Visual inspection: General condition of the building, type and pattern of structural damage.

2) Detailed inspection

- Building material testing: Properties of existing building materials
- Structural evaluation: Comparison of the resistance capacity to stress of structural components (columns, beams, and plates)

3) General recommendations

- Descriptive: Recommendations for strengthening or demolition.

3. RESULTS AND DISCUSSION

Reliability building inspection should be done for every building according to laws and regulations. The inspection encompasses four criteria, safety, health, comfort, and convenience (4K). The assessment result should be displayed in simple way to decide a building condition. Reliable condition which covers whole criteria are difficult to be achieved due to the ability of the owner.[12] A building inspection is required to determine the reliability level of an existing building's structure. Up to the detailed inspection stage, the level of reliability is determined based on the results of the structural evaluation. The level of reliability is determined through the structural evaluation stage after the quality of the existing building materials is known. The quality of the materials is determined through a series of destructive and non-destructive tests. The test results reveal the quality of the concrete material, including its compressive strength, homogeneity, and reinforcing steel quality. Data on the quality of existing reinforced concrete materials is then used as input for analyzing the building structure. The final results of the structural analysis determine whether each existing structural component can still bear the design load[13].

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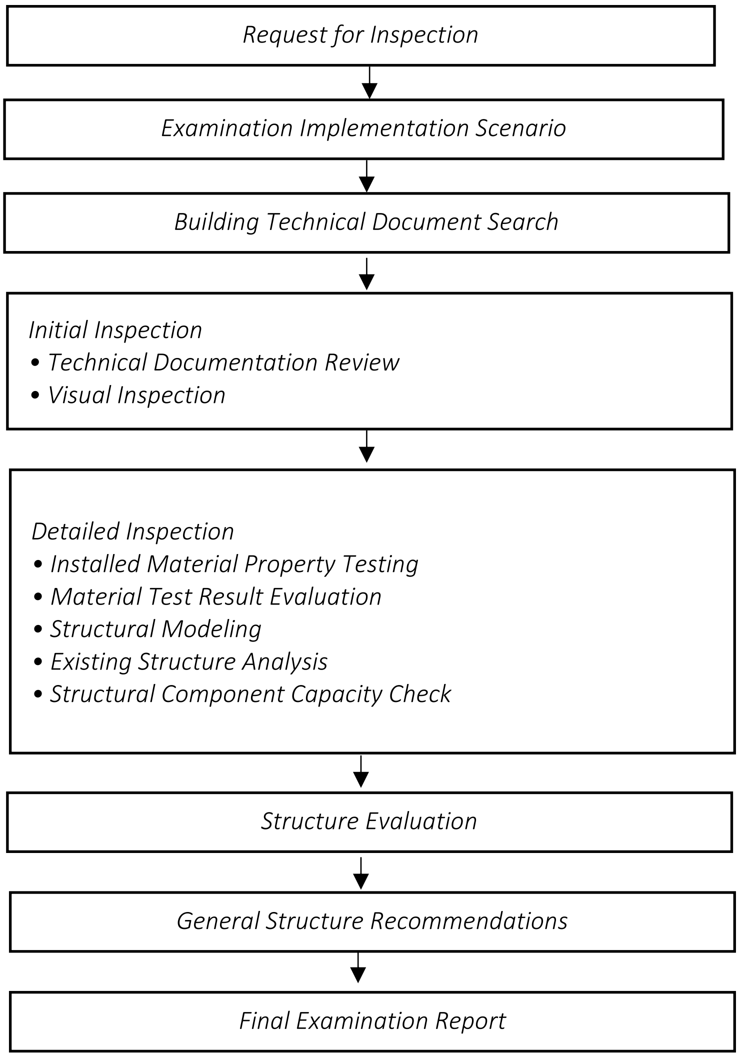
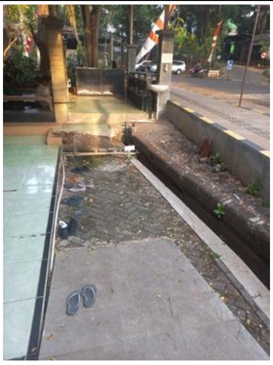


Diagram. 1 Building inspection procedures

National Building Safety Standards: For the construction of high-rise buildings, especially shopping centers, permitting procedures must always be adhered to, especially those related to fire safety. The Indonesian National Standards for Building Safety (SNI/SK SNI) regulates the National Building Safety Standards, including methods, specifications, and other guidelines in Indonesia. The procedures for installing fire alarm detection systems for fire prevention in buildings and homes are regulated in SNI: 03-3985-1995.[14]

3.1 Situation and Conditions of Al-Faritsi Mosque

		The Al-Faritsi Mosque building of the Faculty of Engineering (FT) seen from the front.
		The area inside the Al-Faritsi FT Mosque with the presence of electric poles is very uncomfortable and disturbing.
		At several points around the Al-Faritsi FT Mosque there are infiltration wells/rainwater harvesters. The condition of the pipes is disturbing.
		The roof and roof tiles need maintenance so that they can function optimally as protection for the building. Lightning protection is not yet available.

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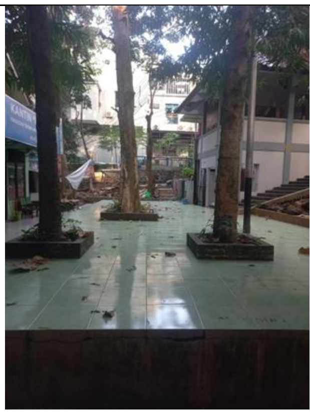
		The condition of the roof gutter joints that need to be repaired so that they do not cause leaks in the future.
		The condition of the men's ablution area is poorly maintained and needs to be repaired immediately. The walls are damp due to water seepage and are not waterproof.
		Large tree roots can cause damage to the ground, floors and stairs of the mosque.
		The condition of the ceramic floor tiles in the mosque is damaged, the stairs are not safe enough, stair tracks are needed to make

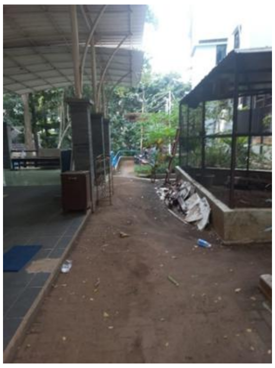
		it easy and comfortable.
		There are unused items piled up around the side of the mosque. The condition around the water tank is mossy and poorly maintained.
		Some of the furniture in the mosque was affected by termites and some items were damaged.
		A garden that is not optimized, should be arranged and planted with trees to increase aesthetics and oxygen.

Fig. 1 Situation and Conditions of Conditions of Al-Faritsi Mosque

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3.2 Masterplan Design Approach

Architectural design encompasses all aspects related to building planning and construction, from site selection and design concepts to material selection, engineering planning systems, and other necessary elements. Architectural design addresses not only the aesthetics and beauty of a building, but also its functionality and user comfort. Design must understand the needs and desires of the users, and consider factors such as climate, environment, and site conditions to create a building structure that meets its intended purpose.[15]

Building quality refers to a building's condition that ensures its function is suitable for its intended purpose or concept. A building's quality system is determined by its design criteria and process. Design criteria are the requirements necessary for a quality design that represent the needs, goals, concepts, and ideas determined at the beginning of the design process.

1. Functional Design Criteria

These criteria relate to the function of a building. These criteria are described by the pattern of activities that occur in a building, resulting in a relationship between the necessary spaces/components.

2. Technical Design Criteria

These are criteria that must be met after the functional criteria have been identified. Technical design criteria are the requirements that must be met when planning a building based on its intended functions. Technical design criteria relate to the comfort and safety of building users and are closely related to the scale, dimensions, aesthetics, layout, and shape of the building or space. Activity patterns in office buildings can be distinguished based on the flow pattern of user activities, namely: Visitor activity patterns, management activity patterns, service activity patterns, and activity/goods flow patterns. The structure of state buildings must meet safety requirements and the provisions of laws and standards for building construction, as evidenced by a structural analysis in accordance with regulations. General technical specifications for state building structures.[16]

The selection of environmentally friendly materials (porous/permeable materials) and compliance with green building principles refers to Minister of Public Works and Housing Regulation Number 2 of 2015 concerning Green Buildings and Minister of Public Works and Housing Regulation Number 9 of 2021 concerning Guidelines for Sustainable Construction Implementation.[17]

Fig. 2 Situation

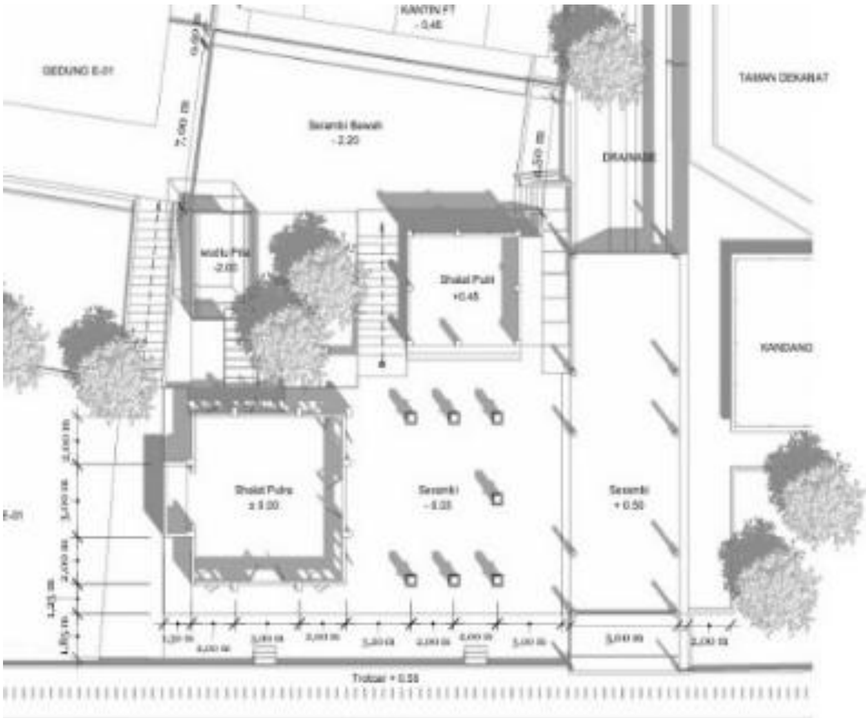

Fig. 3 Siteplan

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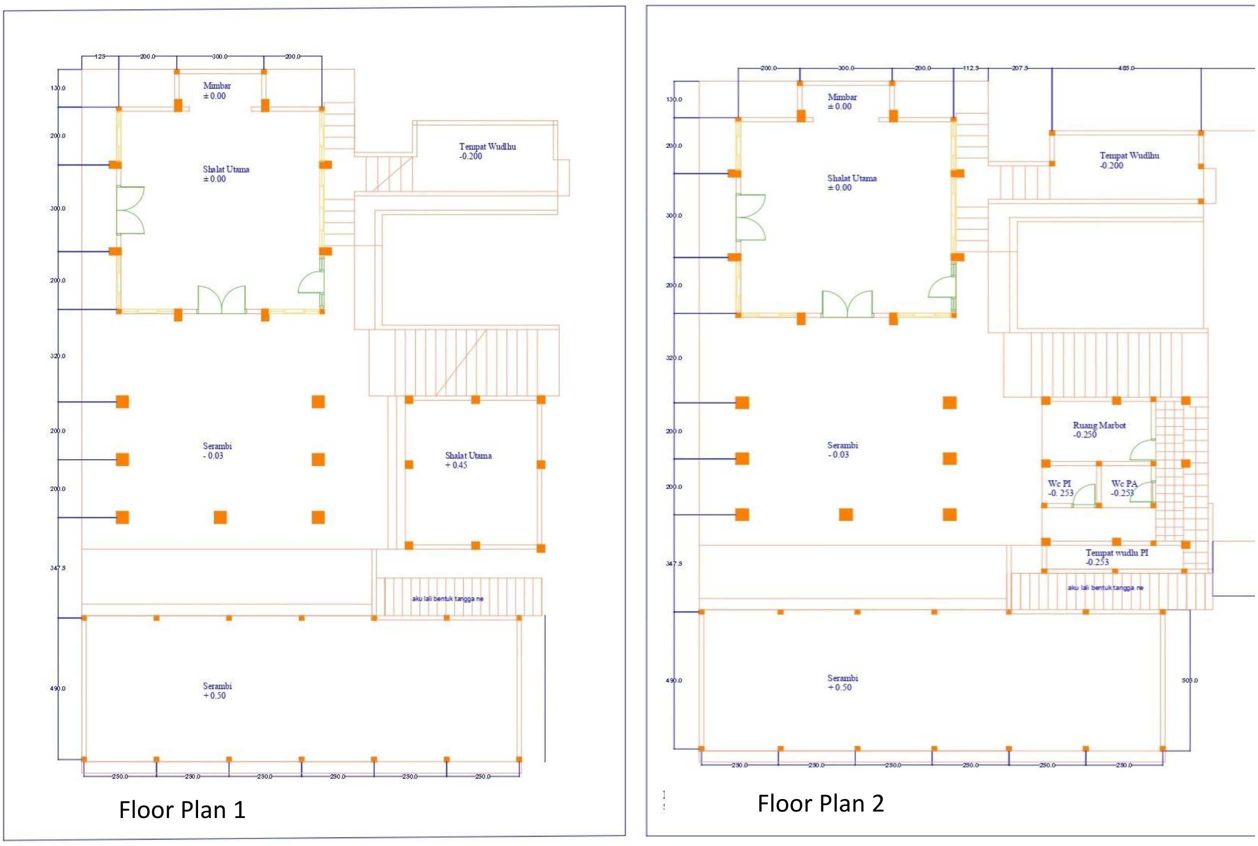

Fig. 4 Floor plan 1 and Floor plan 2

Fig. 5 Building section

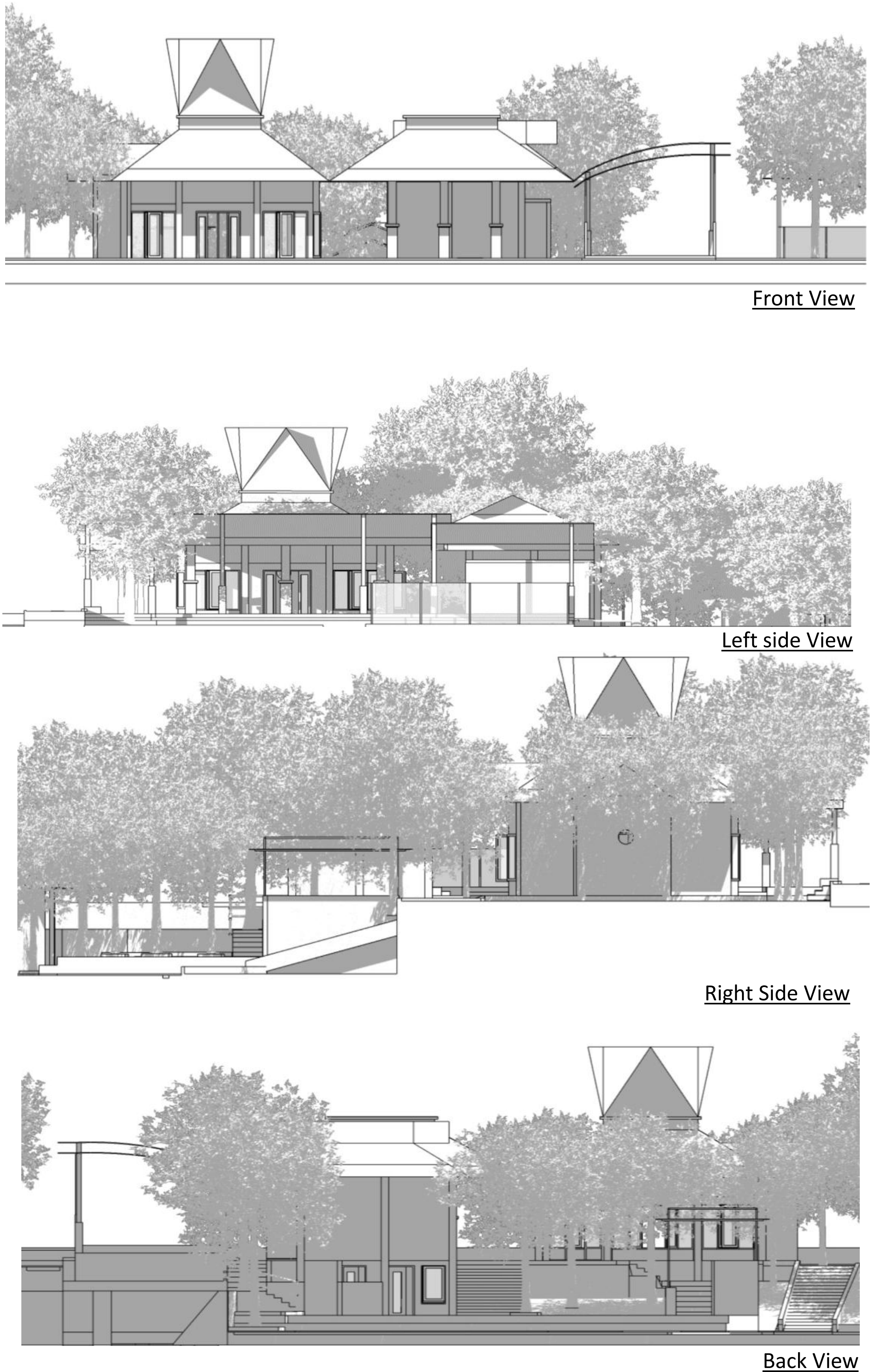

Fig. 6 Four Building Views

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The reinforced concrete structure of the Al-Faritsi Mosque at the Faculty of Engineering, UNNES, is inspected for various reasons. These include the inspection practices, standard references, and reliability assessments[18]. The reasons for the inspections vary widely and fall into six main categories:

1. Questionable structural performance. This is common during the phased construction of a building. In this case, the building owner/manager intends to verify the performance of the existing structure from the previous phase. This reason is also used for buildings that have experienced earthquakes. Before a building can be reused, an inspection is necessary to ensure that the structure's reliability and ability to withstand the resulting loads.

2. Post-fire. Post-fire building inspections determine if unburned parts of the building can be reused or if the building should be demolished.

3. Change of function or additional load. This is done when a building plans to add more floors or convert part or all of the space.

4. Maintenance planning. This is primarily due to the building's age and the need for technical data for maintenance budget proposals.

5. Damage has occurred. Inspections are conducted when a building owner or manager observes a decline in the performance of components or structural systems, such as sagging beams or vibrating floor slabs. This condition has disrupted building users' activities, prompting the owner to consider a comprehensive building inspection.

6. Post-earthquake building inspections are conducted either because the building's performance is questionable or because visible damage is present. These inspections are often conducted using a rapid assessment method, which typically only involves a visual inspection.

The architectural area of a building is the sum of the areas of the floors, measured horizontally in plan to the exterior faces of perimeter walls or to the center line of walls separating buildings. Included are areas occupied by partitions, columns, stairwells, elevator shafts, duck shafts, elevator rooms, pipe spaces, mechanical, and similar spaces having headroom of 6 ft and over.[19]

4. CONCLUSION

The interpretation results are temporary normative results that can be used as a reference for the level of building reliability based on visual observation. If a building is in a very poor condition or has experienced severe damage, such as collapse, a more specific follow-up inspection process will be conducted (full and specific investigation).

Based on the components assessed in the interpretation, the building reliability score of the inspected building falls into the "less reliable" category. The utilities and accessibility components dominate the level of damage/deficiencies across all components. The interpretation results provide several types, techniques, and repair methods to improve the reliability of the inspected building, **The structure needs to be evaluated periodically[20]**. The types of component repairs include:

1. Architectural repairs

The goal is to restore the building's architectural form so that all equipment and fixtures can function again. Actions included in this type are:

a) Patching cracks in walls and plaster.

b) Repairing and replacing doors, windows, and glass.

c) Repairing and tidying electrical cables.

d) Repairing water pipes and drains.

e) Re-plastering walls.

f) Re-arranging roof tiles and corrugated iron.

g) Repairing ceiling frames and ceilings.

h) Repainting.

2. Restoration

This action aims to repair structural elements, including:

a) Injecting cement or epoxy materials into small cracks in load-bearing walls, beams, and columns. Small cracks have a gap between 0.075 and 0.6 cm.

b) Adding reinforcement network to supporting walls, beams, and columns with large cracks, and followed by re-plastering. Large cracks are those with a width greater than 0.6 cm.

c) Dismantling the split wall sections and replacing them with new, stronger walls anchored to the portal.

Wall restoration techniques include:

a) For shallow cracks, fill the cracked area with cement mortar.

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b) For deep cracks, use a chicken wire network on the cracked area.

Restoration techniques for columns and beams include:

a) For moderate cracks, break down and clean the damaged area, then recast it.

b) For severe cracks, columns with reduced strength are re-concreted and wrapped with reinforcement and stirrups, then recast.

3. Strengthening

This action increases the structural strength beyond its original level. Actions included in this category are:

a) Increasing resistance to lateral loads by adding columns and walls.

b) Tying all load-bearing elements together to make the building a unified whole.

c) Eliminating sources of weakness or stress concentrations in certain parts.

d) Preventing brittle failure by installing reinforcement to achieve sufficient ductility to the details.

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