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Reconstruction of Abandoned Apartment on Ahmad Yani Street, Cirebon City

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ABSTRACT
Apartments can serve as an efficient vertical housing solution amid limited urban land. However, not all apartment projects are completed as planned, such as the 12-storey apartment building on Ahmad Yani Street, Cirebon City, which was abandoned midway through the Reconstruction project and required structural redesign for re-functionality. This research aims to redesign the structure using the latest planning standards, namely SNI 2847:2019 (Structural Concrete Requirements), SNI 1726:2019 (Earthquake Resilience Planning), and SNI 1727:2020 (Minimum Building Load). The methods include literature studies, primary and secondary data collection, structural modeling using ETABS software, and analysis and redesign of key elements such as slabs, beams, and columns. The calculation results show that the redesigned structural elements meet all technical criteria and safety requirements. The slab thickness of 200 mm meets the minimum limit based on slab and beam rigidity. The beam and column dimensions are sufficient to withstand gravitational and lateral loads. The total factored load (DL + LL + earthquake) was calculated and used as the basis for designing the structural elements and foundations. With a design approach that complies with the latest regulations and technology, the previously unused apartment building can now be revitalized into safe, decent housing that supports Cirebon City's spatial development.
Keyword: Apartment, Structural redesign, SRPMK, SNI 2847:2019, ETABS, earthquake.

INTRODUCTION

Cirebon City has experienced significant growth in recent years (Firman, 2019; Hudalah et al., 2020). This is reflected in the rampant construction of new hotels, shopping centers, and restaurants, which has made Cirebon increasingly transform into a modern city (Setyono & Suryanto, 2021). Moreover, progress in transportation infrastructure—such as the Palimanan-Kanci Toll Road, improved train services, and the presence of Kertajati International Airport—has also strengthened accessibility to this city (Soehodo et al., 2019; Prasetyo et al., 2022). In this context, the presence of apartments is expected to integrate harmoniously with the surrounding environment and contribute to the development of urban spatial planning (Yigitcanlar et al., 2020). However, not all apartment development projects achieve completion, with approximately 15–20% of multi-storey residential projects in Indonesia remaining abandoned or suspended due to financial constraints, regulatory changes, or construction failures (Indonesian Real Estate Association, 2023). These abandoned structures represent both economic losses and urban blight, yet they simultaneously offer opportunities for sustainable redevelopment through structural rehabilitation (Bullen & Love, 2017).

Global urbanization has intensified pressure on urban housing systems, with the United Nations projecting that 68% of the world's population will reside in urban areas by 2050 (UN-

Habitat, 2020). This demographic shift necessitates efficient vertical housing solutions, particularly in developing nations where horizontal land expansion is increasingly constrained (Awuah & Abdulai, 2022; Delechat et al., 2024; Gutiérrez & Kahhat, 2022; Sharma & Dehalwar, 2025). In Indonesia, rapid urban growth has resulted in a housing backlog estimated at 12.75 million units as of 2021, with multi-storey apartments representing a critical component of the government's solution strategy (Ministry of Public Works and Housing, 2022).

In general, an apartment is a type of residence that stands independently in a building complex (Chiara, 1980; Yau & Ho, 2017). Units in apartments are usually designed as residences equipped with household amenities such as living rooms, bedrooms, kitchens, and bathrooms (Harris, 1975; Bullen & Love, 2017). Thus, an apartment can be interpreted as a multi-storey building consisting of several complete residential units (Yung & Chan, 2018; Sharifi, 2019). The successful transformation of such buildings requires comprehensive structural assessment and redesign in accordance with contemporary building codes (Fay & Cooperman, 2020; Ferreira et al., 2021).

One important aspect of building structure planning is the consideration of earthquake risk. Indonesia's location on the Pacific Ring of Fire exposes the archipelago to significant seismic hazards, with approximately 129 million people—nearly half the population—living in earthquake-prone zones (National Disaster Management Authority, 2021). For this reason, Indonesia has established technical guidelines through SNI 1726:2019 concerning Procedures for Earthquake Resilience Planning for Buildings and Non-Buildings, as the main reference in designing earthquake-resistant buildings. This regulation represents a substantial update from SNI 1726-2012, incorporating revised seismic hazard maps, updated spectral acceleration parameters, and enhanced requirements for structural irregularity considerations.

The main goal of structural planning is to produce a building that is sturdy, safe, comfortable, efficient, and cost-effective. To ensure that the building functions properly within the planned period, the structure must withstand the loads and forces acting during its lifetime of use. The lifecycle performance of structural systems depends critically on adherence to design codes that reflect current understanding of material behavior, load combinations, and seismic response mechanisms.

The specific case examined in this research is a 12-storey apartment building located on Ahmad Yani Street, Cirebon City, which was originally designed in 2015 using SNI 2847-2013 and SNI 1726-2012, subsequently superseded by updated standards. Construction was abandoned at approximately 60% completion, leaving a structurally incomplete building that cannot be occupied without comprehensive redesign. Site investigations revealed incomplete reinforcement detailing, non-compliant concrete strength in certain elements, and structural configurations that do not meet current seismic design category requirements. This situation necessitates complete structural re-evaluation and redesign rather than simple continuation of the original plans.

Previous research on abandoned building reconstruction provides limited guidance for comprehensive structural redesign. Mardiana (2020) analyzed the structure of Sangkan Hotel in Kuningan Regency using SNI 2847-2019, focusing on new construction rather than abandoned structure rehabilitation. Wijaya et al. (2021) investigated seismic performance of existing buildings in Jakarta through retrofitting approaches but did not address structurally incomplete buildings requiring full redesign. Rahman and Susanto (2022) examined SRPMK system applications in high-rise residential buildings, providing valuable insights on moment frame behavior but limiting analysis to greenfield projects. Hartono et al. (2023) studied structural optimization of apartment buildings using ETABS modeling yet focused exclusively on cost minimization rather than code compliance for abandoned structures. These studies collectively reveal a significant research gap: there is insufficient guidance for the complete structural redesign of abandoned multi-storey residential buildings to meet current Indonesian building codes, particularly for structures in high seismic zones requiring SRPMK systems.

The urgency of this research stems from multiple converging factors. First, the abandoned apartment represents significant economic value—approximately IDR 75 billion in invested capital—that remains unrealized while the building deteriorates. Second, Cirebon City's 2019–2039 Spatial Plan designates the Ahmad Yani corridor as a priority development zone for vertical housing, making the successful completion of this project strategically important for urban planning objectives. Third, the building's location in Seismic Design Category D presents life-safety risks if improperly designed, making rigorous structural analysis essential. Fourth, the transition from SNI 2847-2013/SNI 1726-2012 to SNI 2847-2019/SNI 1726-2019 introduces substantive technical changes that must be incorporated into any contemporary redesign effort.

The novelty of this research lies in its comprehensive approach to abandoned building reconstruction within the framework of updated Indonesian building codes. Unlike previous studies that address either seismic design of new buildings or retrofitting of completed structures, this research develops a systematic methodology for the complete structural redesign of an abandoned 12-storey apartment building, incorporating: (1) transition from obsolete design codes (SNI 2847-2013, SNI 1726-2012) to current standards (SNI 2847-2019, SNI 1726-2019, SNI 1727-2020); (2) application of SRPMK system requirements specific to Seismic Design Category D conditions; (3) integration of ETABS-based structural analysis with practical construction constraints of partially completed buildings; and (4) development of complete structural documentation including reinforcement detailing for slabs, beams, columns, and foundations that addresses both gravity and seismic load combinations.

This research focuses on the structural design of an apartment building using reinforced concrete structures that comply with SNI 1726:2019 and the Special Moment Resisting Frame System (SRPMK). The study aims to produce a complete apartment building plan, including load analysis, structural analysis, and structural drawings, by evaluating structural responses such as vibration forces, shear periods, minimum seismic forces, displacements, and inter-story drift. Specific objectives include: (1) analyzing gravity and seismic loads according to SNI 1727-2020 and SNI 1726:2019; (2) modeling the 12-storey structure using ETABS to evaluate dynamic characteristics including fundamental periods, mode shapes, and response spectrum analysis; (3) designing slab, beam, column, and foundation elements to satisfy strength, serviceability, and ductility requirements of SNI 2847-2019; (4) verifying compliance with inter-story drift limitations, strong column–weak beam provisions, and detailing requirements for SRPMK systems; and (5) producing complete construction documentation including 2D floor plans, elevations, sections, and 3D structural models.

The scope of this research includes the preparation of 2D and 3D building drawings as well as detailed designs of floor slabs, beams, columns, and foundations. Theoretically, this research contributes to deepening understanding of earthquake-resistant high-rise building analysis and planning, particularly regarding the influence of seismic load analysis on structural dimensions and the practical application of SRPMK system requirements in buildings transitioning between design code generations. Practically, this study serves as a comprehensive reference for structural engineers, architects, and construction professionals involved in applying earthquake load analysis to abandoned or incomplete multi-storey building projects, providing a validated methodology that balances code compliance, structural safety, and economic feasibility in urban redevelopment contexts.

METHOD

This research employed a mixed-methods approach that combined quantitative structural analysis with qualitative observational data collection to comprehensively address the reconstruction of the abandoned apartment building. The quantitative and qualitative methods used were as follows: quantitative methods involved studying existing literature for thesis preparation, while qualitative methods involved collecting data from the research objects for thesis preparation.

The research design began with the collection and study of literature related to planning. The data used in this study included site data such as land area, building area, and building function; building drawing data; literature from books and other media (e.g., internet) for the literature review; SNI 2847:2019 (Structural Requirements for Buildings); SNI 1727:2020 (Minimum Design Loads and Related Criteria for Buildings and Other Structures); SNI 1726:2019 (Procedures for Earthquake Resilience Planning for Buildings and Non-Buildings); and conclusions and recommendations derived from the research results.

Data collection methods included literature review and observation. The literature method entailed collecting, studying, and identifying relevant sources from books and the internet on building planning, which informed the analysis and design. The observation method involved conducting direct surveys at the site to assess field conditions and inform research decisions.

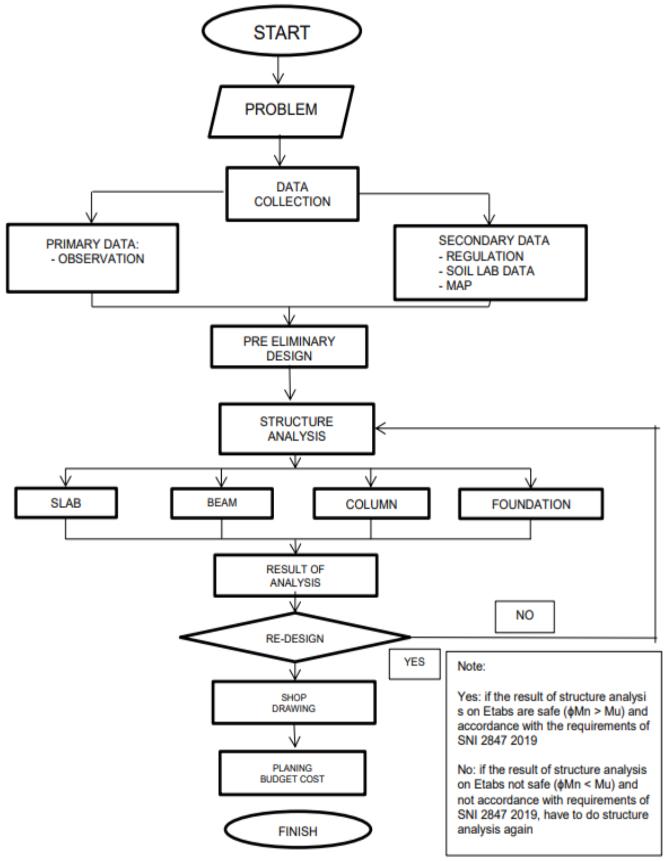

Figure 1. Flowchart

The location in the research of the apartment building on Jend. Ahmad Yani street, Pegambiran, Cirebon City, West Java

Figure 2. Research Location

RESULTS AND DISCUSSION

Building Structure Data

1. **Building Specification**
   a. Building Function : apartment
   b. Structure Type : Reinforced Concrete Structure
   c. Number of Floors : 12 Floors
   d. Building Height : 28.5 m
      1) Base : 2 m
      2) 1st Floor: 4 m
      3) 2nd Floor : 4 m
      4) 3rd Floor : 4 m
      5) 4th Floor : 4 m
      6) 5th Floor : 4 m
      7) 6th Floor : 4 m
      8) 7th Floor : 4 m
      9) 8th Floor : 4 m
      10) 9th Floor : 4 m
      11) 10th Floor : 4 m
      12) 11th Floor : 4 m
      13) 12th Floor : 4 m
      14) Roof Flooring : 3 m
   e. Building Area: 7336 m2
      1) 1st Floor : 820 m2
      2) 2nd Floor : 543 m2
      3) 3rd Floor : 543 m2
      4) 4th Floor : 543 m2
      5) 5th Floor : 543 m2
      6) 6th Floor : 543 m2
      7) 7th Floor : 543 m2
      8) 8th Floor : 543 m2
      9) 9th Floor : 543 m2
      10) 10th Floor : 543 m2
      11) 11th Floor : 543 m2
      12) 12th Floor : 543 m2
      13) Roof Flooring :543 m2
   f. Location : Ahmad Yani street, Cirebon City
   g. Soil Type : Medium Soil
2. **Material Specification**
   a. Concrete Quality

The quality of the concrete used in the structural elements of this building is designed with the intention of compressive strength characteristics as follows:

1) Floor Plates : f'c = 30 Mpa
2) beam : f'c = 30 Mpa
3) Column : f;c = 30 Mpa
4) Foundation : f'c = 30 Mpa

b. Quality of Reinforcement Steel

1) Longitudinal : 420 Mpa
2) Transversal : 420 Mpa

Structure Reinforcement

1. Slab

The plate repeating is designed based on the size of the plate panel and the direction of loading. Each panel is tested for feasibility based on the direction of the base and field, both on the top and bottom sides of the plate. The repetition used is D13-150 mm for ordinary floors and D10-150 mm for roof plates, which are installed in all directions (X and Y) in the focus zone as well as the field.

For different plate sizes such as 3×2 m, 4×2 m, 5×2 m, 3×6.2 m, up to 5×8 m, the repetition pattern remains uniform. All focus points and fields are ensured to meet the set repeating conditions, with the results of the analysis showing that all elements are "OK" and have met the technical requirements of planning.

Roof slabs are designed using a smaller diameter rebar called D10, because the load received is lighter than ordinary floor slabs. The fixed reinforcement distance setting is maintained at 150 mm.

2. Beam

The planning of the beam elements follows the dimensions of the cross-sectional varies, ranging from 800×400 mm to 425×300 mm. All beams are tested against force and geometry, bending capacity, shear, and torsi—and are all declared qualified ("OK").

a. Longitudinal reinforcement is installed in the position of the upper pear, the lower pear, as well as in the upper and lower fields. Generally used D25 reinforcement for main strength and D13 for center distribution.
b. Transverse reinforcement or stingers are installed with spacing varying between 80 mm to 150 mm depending on the position and type of beam.

Example:

a. On 800×400 mm beams, 4D25 is used on the upper and lower focuses, as well as 4D13 on the middle.
b. Shears in the pedestal and field are installed with D13 each at a distance of 150 mm.

Each beam dimension has been designed according to the needs of the moment and the latitude force arising from the structural workload.

3. Column

The column dimensions vary from 900×900 mm to 750×750 mm, with a relatively equal number of longitudinal reinforcement of 20 D32 bars, indicating the large load borne by the main columns.

a. Transverse reinforcement (*sengkang*) is installed transversely on both strong and weak axes, both in the pedestal and field area.
b. The pedestal stakes are generally installed with 100 mm distance, while in the field with 150 mm distance, using D13 or D16 rods, depending on the needs of the structure and the dimensions of the column.

Example:

a. For columns measuring 900×900 mm, transverse reinforcement uses 6D13-100 on the pedestal and 4D13-150 on the field.
b. On the 850×850 mm column, 4D16-100 is used in the spotlight and 2D16-150 in the field.

Building Design

The results of the building design were obtained through modeling using AutoCAD software, which produces a detailed technical visualization of the structural and architectural elements of the building.

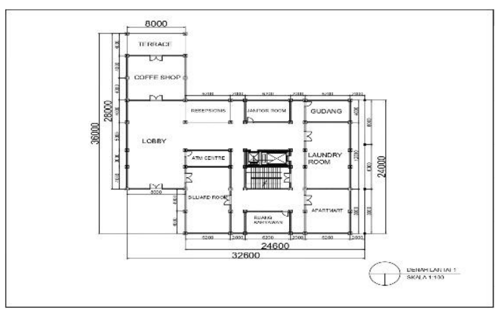

Figure 3. 1st Floor Plan

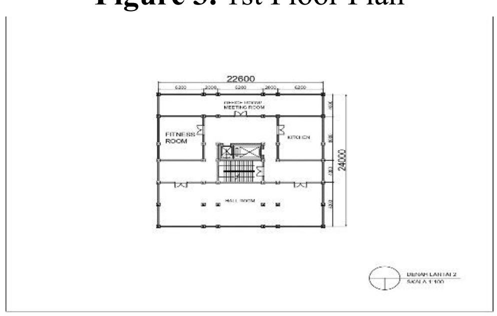

Figure 4. 2nd Floor Plan

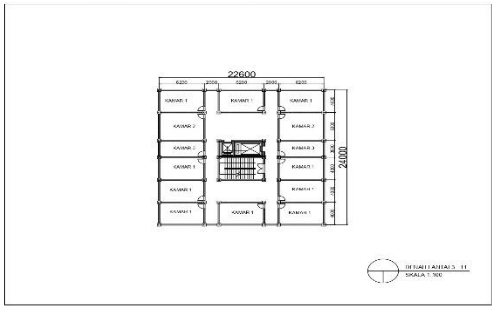

Figure 5. Floor Plan 3-11

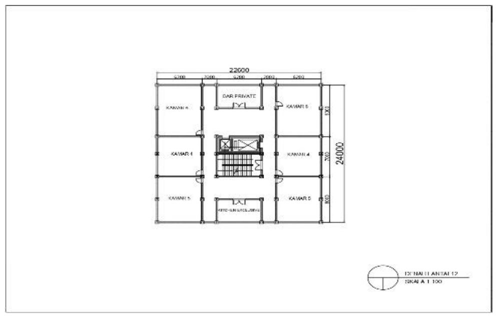

Figure 6. 12th Floor Plan

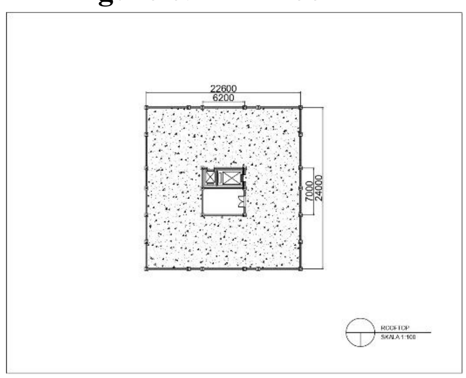

Figure 7. Rooftop

CONCLUSION

This study successfully redesigned a 12-storey abandoned apartment building (28.5 m tall, 12 floors, 30 MPa concrete, 420 MPa steel yield strength, medium soil conditions) into a strong, safe, and efficient vertical residential structure compliant with SNI 2847:2019, SNI 1727:2020, and SNI 1726:2019, employing a Special Moment Resisting Frame System (SRPMK) for Seismic Design Category D. Structural elements—including 200 mm thick slabs, compliant beams and columns, and robust foundations—met all strength, stiffness, and safety requirements under gravity and seismic loads, as verified through ETABS analysis and detailed 2D/3D AutoCAD drawings. Overall, the reconstruction demonstrates the feasibility of rehabilitating abandoned buildings via modern earthquake-resistant planning to enable safe habitation and support Cirebon City's urban development. For future research, investigators could extend this methodology to compare SRPMK performance against alternative systems (e.g., shear walls) in varying seismic categories or incorporate sustainability metrics like lifecycle carbon assessments.

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