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Research Article

Application of Lintel Beams in the Construction of a Three-Storey Residential House at Manali Hill Housing, Malang

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Abstract
The construction of a three-floor house requires meticulous planning and execution to ensure structural stability. One crucial structural element in this process is the lintel beam, which serves as a load-bearing component above openings such as doors and windows. The primary objective of this study is to analyze the application of lintel beams in residential construction at Manali Hill Housing, Malang. The research methodology involves a combination of literature review and field observations. The findings highlight that the appropriate use of lintel beams significantly enhances a building's resistance to both vertical and lateral loads. Additionally, proper lintel beam installation helps prevent the formation of cracks in areas surrounding openings, thereby improving overall structural integrity. The study also identifies four main types of lintel beams - rollag brick, wooden, steel, and concrete - with reinforced concrete emerging as the most advantageous option for modern construction due to its strength, rigidity, and fire resistance. These results emphasize the importance of integrating well-designed lintel beams in multi-storey house construction to ensure safety, durability, and long-term performance against environmental and structural stresses.

Keywords: Lintel Beam, Structural Engineering, Multi-storey Construction, Residential Structural Design, Load-bearing Components

1. Introduction

Malang Raya, as one of the leading educational hubs in East Java, has experienced rapid growth in higher education institutions, both public and private. The increasing number of incoming students in a city contributes to the growth of the rental housing business (Rahmadyani, 2022). Most university students come from outside the area, while only a few are commuters. Differences in background and individual needs create complexity in providing suitable housing types (Reski & Tampubolon, 2017).

More broadly, the rising number of students in Indonesia directly correlates with the increasing demand for rental housing, such as boarding houses (kost), rented houses, dormitories, and apartments. From the perspective of housing providers, this business offers promising investment opportunities to generate profit (Nurdini, 2009). As the demand for rental housing continues to grow, the construction aspects of buildings become a crucial factor in ensuring the safety and comfort of residents.

In multi-story housing construction, structural stability is a key element that supports the durability of the building. One of the critical structural components in maintaining the strength and stability of a building is the lintel beam. Lintel beams serve to support loads above openings such as doors and windows while also helping to distribute the load evenly to other structural elements.

Therefore, the proper application of lintel beams in rental housing construction needs to be analyzed to ensure the durability and safety of the building for its residents.

Several studies have examined the application of lintel beams in building construction to understand their role in improving structural stability. Agisna et al. (2022) investigated the compliance of subsidized housing structures in Cilegon City with earthquake-resistant housing guidelines. The results showed that 70% of houses did not meet the standards due to the absence of lintel beams and other structural elements, indicating the need for increased awareness and dissemination of technical standards to stakeholders. Meanwhile, Tukan et al. (2021) analyzed the impact of lintel beam usage in two-story buildings using SAP2000 software. The findings revealed that the use of lintel beams increased base shear values and reduced lateral drift, although the percentage improvement was relatively small. Furthermore, Mukti & Aqillah (2023) examined the application of partial lintel beams in reinforced concrete structures at the Auxiliary Building 802 and 803 of Padalarang Station. The study found that the application of lintel beams increased static and dynamic shear forces while reducing structural deformation, lateral drift, and maximum shear force.

Based on previous studies, lintel beam usage has been proven to contribute to structural stability, particularly in resisting lateral loads. However, there is still limited research on the application of lintel beams in multi-story housing intended for students. Therefore, this study aims to analyze the application of lintel beams in the construction of a three-story residential building in Manali Hill Housing, Malang. This analysis is expected to provide further insights into the effectiveness of lintel beams in enhancing the strength and stability of multi-story buildings.

2. Methods

In this study, data were collected from books, journals, scientific articles, and literature reviews that discuss relevant concepts and findings. The research employs a qualitative method with a descriptive approach to analyze the collected data (Sugiyono, 2016). The data were examined by reviewing related journals to identify the most relevant and sufficiently relevant research findings in terms of program implementation, program reporting, program dissemination, program planning, occupational health and safety, as well as operational management and program design.

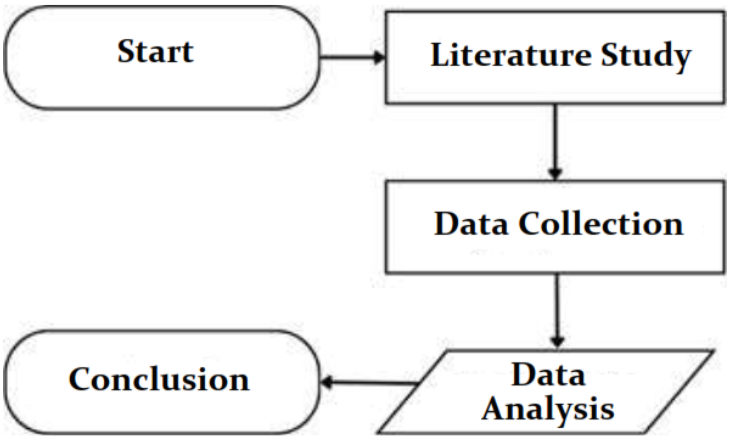


Figure 1. Research Flow Chart

3. Results and Discussion

A lintel beam is a beam positioned above windows, doors, or large wall openings. Its primary function is to act as a support that distributes the load from above the frame, preventing the weight from being directly transferred to the frame itself (Rahayu, 2023).

By installing a lintel beam, the risk of breakage or bending is reduced, even during an earthquake. Additionally, it helps prevent cracks at the corners of openings. The minimum diameter for the main reinforcement, beam rings, and columns in lintel beams is 10mm, while the stirrups must have a minimum diameter of 6mm with a spacing of 15cm (center to center) or 8mm with a spacing of 20cm. The standard size of a lintel beam is 15x15 cm (NAHP, 2022).

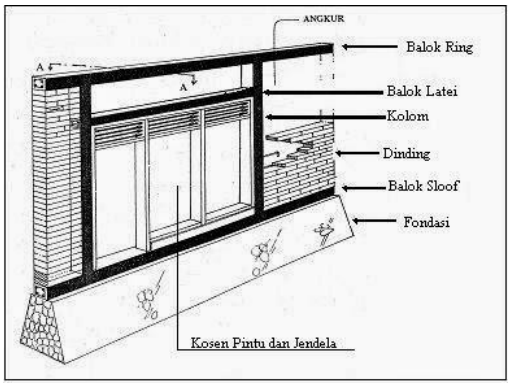


Figure 2. Lintel Beam
Source: KMS Group

3.1. Types of Lintel Beams

Based on our literature review, lintel beams can be classified into several types based on their construction materials, including (Rembulan, 2022):

3.1.1. Rollag Brick Lintel

A rollag brick lintel consists of bricks laid vertically. The installation of rollag bricks must adhere to specific requirements, including a minimum thickness of 30 cm. This ensures the structural strength of the rollag brick lintel and enhances its load-bearing capacity.

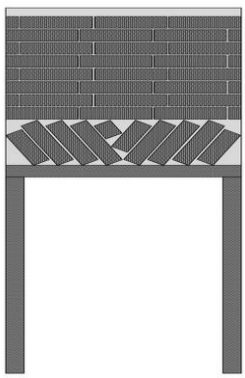


Figure 3. Rollag Brick Arrangement

3.1.2. Wooden Lintel

Wooden lintel beams are commonly used due to the availability of wood as a material. However, the main disadvantages of wooden lintels are their high cost, lower durability, and susceptibility to fire. As a result, wooden lintels are becoming less popular in modern construction.

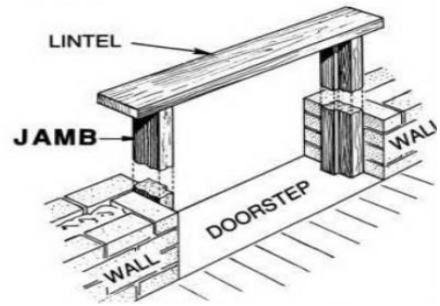


Figure 4. Wooden Lintel Beam

3.1.3. Steel Lintel

Steel lintels are used when the supported load is heavy and the openings are large. These lintels are made from rolled steel sections or channel beams. They can be installed as a single section or in combinations, depending on structural requirements.

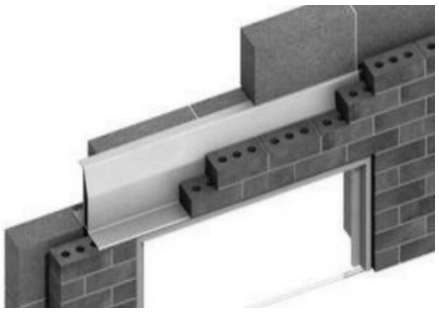


Figure 5. Steel Lintel Beam

3.1.4. Concrete Lintel Beam

Concrete lintel beams are the most commonly used type today. Reinforced concrete lintels offer advantages in strength, rigidity, fire resistance, cost-effectiveness, and ease of installation. Concrete lintels are divided into two types (Setiawan, 2016):

1. Precast concrete lintels, which are pre-manufactured and ready for installation.
2. Conventional concrete lintels, which are cast on-site along with the walls.

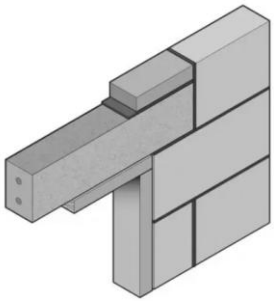


Figure 6. Reinforced Concrete Lintel Beam

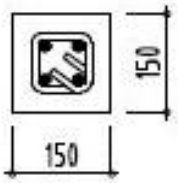
3.2. Construction Process of Lintel Beams

The construction of concrete lintel beams follows similar steps to general structural beam construction, with the primary difference being their dimensions. The construction process includes:

3.2.1. Reinforcement Preparation

The reinforcement is prepared according to the working drawings, using a minimum main reinforcement diameter of Ø10mm and stirrups with a minimum diameter of Ø6mm, spaced 15cm apart (NAHP PU 2022).

Table 1. Specifications of Concrete Lintel Beams

Beam Code: Lintel	BL Support
	
Dimension	150 x 150 mm
Top Reinforcement	2Ø8
Middle Reinforcement	
Bottom Reinforcement	2Ø8
Stirrups	Ø6-150
Notes	Located above each frame

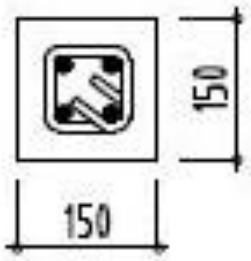


Figure 7. Concrete Lintel Beam Design

The design of concrete lintel beams that are in accordance with the regulations is continued to make molds or formwork of the desired size.

3.2.2. Formwork Preparation

The formwork is built to accommodate a lintel beam with a height of 15 cm, a width of 15 cm, and a length adjusted to the width of the door or window frame, with an additional 30 cm extension on both sides.

Figure 8. Concrete Lintel Beam Formwork

3.2.3. Concrete Casting

The concrete used should be a minimum of K-175 grade, with a mix ratio of 1 part cement, 2 parts sand, and 3 parts gravel. The concrete is then poured into the prepared formwork.

Figure 9. Concrete Casting Process for Lintel Beams

3.2.4. Finishing

Once the concrete has fully cured and hardened, the formwork is removed to reveal the completed lintel beam.

Figure 10. Finished Lintel Beam

3.3. Key Factors to Consider When Constructing Lintel Beams

3.3.1. Lintel Beam Length

The standard lintel beam length should be equal to the width of the door or window frame, with an additional extension of approximately 20 cm on both sides. For example, if a door frame has a total width of 70 cm, an additional 20 cm should be added on each side, making the total length of the lintel beam 110 cm.

3.3.2. Providing Anchors for Frames

It is essential to install anchors on door and window frames when placing lintel beams. This ensures that the building structure remains stable. Anchors help secure the frames to the walls. Without proper anchoring, the frames may become unstable, causing doors and windows to rotate or leading to cracks in the walls.

3.3.3. Installing Concrete Dook with Anchors Under the Frame

This installation prevents groundwater from seeping into the frame. If door and window frames are frequently exposed to moisture, they are at risk of rotting. Additionally, the use of concrete dook helps prevent termite infestations from the ground.

4. Conclusion

The use of lintel beams is essential for maintaining wall stability and preventing cracks around door and window frames. While rollag brick lintels are the most cost-effective, reinforced concrete lintels offer superior strength, durability, and fire resistance. Proper selection of lintel beam materials should consider structural load requirements, ensuring they effectively distribute weight and prevent localized stress. Installing anchors correctly is crucial to maintaining the stability of door and window frames. Additionally, using high-quality materials and meeting minimum concrete strength standards will enhance durability. To prevent moisture infiltration and wood rot, waterproofing measures, such as concrete dook installation, should also be implemented. These considerations will optimize the performance and longevity of lintel beams in construction.

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