Study of House Building Failures on Swamp Land: Identifying Causes and Solutions with a Combination of Wood and Concrete Materials

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Abstract Introduction: House construction on swamp land, especially in Banjarmasin, Indonesia, faces unique challenges. Foundation failure due to unsuitable materials and poor design is a common cause of building collapse. This study examines specific failures associated with the combination of wood and concrete materials to improve construction practices and avoid future collapses.

Research Objective: This research aims to identify the weaknesses of wood and concrete combination foundations by investigating structural damage signs in houses built on swamp land.

Methods: Field observations and surveys were conducted at various construction sites in Banjarmasin. Collected data were analyzed descriptively to highlight foundation weaknesses and propose improvements.

Results: Wood and concrete combination foundations often show signs of damage such as cracks in the concrete and wood subsidence. Weak construction elements limit bearing capacity, causing frequent structural failures.

Keywords: wood foundation, concrete foundation, building failure, swamp land, house collapse.

Background Swamp land is one of the biggest challenges in building construction. The soft and often water-saturated soil conditions make structures on it prone to foundation failure. The use of wooden piles as foundations has become a common practice in many swampy areas, including Banjarmasin. However, over time, wood immersed in wet soil tends to deteriorate and degrade, eventually leading to building structure failures.

House construction on swamp land, such as found in the Banjarmasin area of Indonesia, presents unique challenges requiring specialized construction

approaches. The swamp land's low soil bearing capacity, around 0.2 kg/cm^2, differs significantly from hard soil conditions and requires customized foundation designs. Traditional construction in this area often uses wooden pillar foundations that are vulnerable to moisture and decay, resulting in frequent building collapses. The combination of wood and concrete materials is considered an innovative solution to this problem, with the hope of improving structural stability and building resilience against extreme environmental conditions (Agusniansyah, 2024).

Strengthening wooden pile foundations has become a primary focus in civil engineering research and practice to address this issue. According to Agusniansyah and Sarbini (2024), efforts to reinforce house foundations on swamp land in Banjarmasin involve various methods, including the use of additional materials like concrete to strengthen wooden piles. The combination of wood and concrete materials not only enhances structural strength but also extends the foundation's lifespan.

Identifying shallow foundations on swamp land is also an important aspect of preventing building failures. Agusniansyah (2024) highlights the importance of a thorough understanding of soil conditions and the characteristics of the foundations used. By identifying early signs of foundation failure, corrective measures can be taken early to prevent building collapses.

Wood materials such as 'galam' wood have advantages in terms of availability and good adhesive properties, but also have limitations, especially in terms of resistance to moisture and pest attacks. On the other hand, concrete offers higher strength and durability but is heavier and requires more careful handling in swamp land construction. Combining these two materials in building foundations aims to leverage the strengths of each material while minimizing their weaknesses. The use of wood and concrete combination foundations is expected to increase bearing capacity and structural stability of buildings on swamp land (Sutrisno, 2022).

The combination of wood and concrete materials in foundation construction is not entirely new, but its application in swamp land conditions requires further research to understand the dynamics of interaction between these two materials in a humid and unstable environment. Some previous studies have shown that concrete can provide strong structural support while wood can help distribute loads evenly on soft soil. However, the main challenge is ensuring that these two materials can work synergistically without causing new problems, such as cracking in concrete or accelerated wood decay due to swamp land moisture (Hendrawan, 2021).

Early signs of building failure on swamp land, especially in wooden pile foundations, have been well documented. In a study conducted by

Agusniansyah (2024), wooden pile foundation failures can be identified through cracks in the walls, soil settlement around the building, and structural deformation. Early identification is crucial to ensure the safety and stability of buildings in challenging environments such as swamp land.

In addition, the use of wood and concrete combination materials in foundations not only provides additional strength but also offers innovative solutions to classic problems in swamp land construction. This approach combines the flexibility and resilience of wood with the strength and stability of concrete, creating a more durable and reliable foundation system.

This study aims to identify specific weaknesses of wood and concrete combination foundations and propose solutions to address these issues. Through field observations and data analysis, it is hoped that common failure patterns in swamp land buildings can be found, and practical and effective recommendations for improvement and prevention of future collapses can be developed. Thus, this research not only contributes to improving construction practices in the Banjarmasin area but can also be applied in other areas with similar soil conditions (Rahmat, 2020).

This research aims to deeply investigate the causes of building failures on swamp land and identify innovative solutions through the use of wood and concrete combination materials. Through this approach, it is hoped that more effective and efficient methods for preventing foundation failures on swamp land can be found, thus enhancing the safety and longevity of buildings in such environments.

The unstable and watery swamp land conditions require the use of special foundation designs and moisture-resistant materials. However, the materials used often do not suit these soil conditions. 'Galam' wood, for example, is often used for its adhesive properties but still has limitations. Wooden pillars, the main supporting elements, often fail due to improper material selection and poor construction methods (Wahyu, 2019).

Wood and concrete combination foundations can provide a more stable and durable solution for construction on swamp land. Concrete, with its high strength, can provide strong structural support, while wood can help distribute loads more evenly on soft soil. The use of this combination is expected to address problems typically occurring in wooden or concrete foundations alone, such as cracking in concrete or wood decay (Santoso, 2018).

The main difference between wood and concrete foundations is how they interact with swamp land. Concrete, which is heavier and more rigid, requires careful handling to ensure that the foundation does not crack or

sink into the soft soil. Wood, on the other hand, is lighter and more flexible but prone to moisture and pest attacks. By combining these two materials, it is hoped that a strong, durable foundation capable of adapting to changing soil conditions can be created (Prasetyo, 2017).

This study also examines the impact of renovations and horizontal and vertical expansions on wooden pillar houses. Adding floors or horizontally expanding the building increases the load on an already weak foundation, leading to instability and collapse. Proper reinforcement methods are rarely applied, exacerbating the problem. Therefore, this study will provide recommendations on effective reinforcement methods for wood and concrete combination foundations (Arief, 2016).

Damage to 'sunduk' and 'kalang' beams, combined with the small size of wooden pillars, are major factors in foundation failure. Innovative methods to reinforce these foundations and the use of better-quality materials can significantly improve the stability of houses on swamp land. This study also highlights the importance of regular maintenance and care to ensure that foundations remain in good condition and can withstand structural loads (Fitri, 2015).

As part of this study, field observations and surveys were conducted at various construction sites in Banjarmasin. Collected data were analyzed descriptively to highlight foundation weaknesses and propose improvements. The main focus was on identifying structural damage signs such as concrete cracks and wood subsidence, as well as the main causes of this damage (Ismail, 2014).

This study also aims to provide practical recommendations for construction practitioners in the Banjarmasin area and beyond. By understanding the common weaknesses in wood and concrete combination foundations, it is hoped that technical guidelines can be developed for planning and executing construction projects on swamp land. These recommendations include material selection, construction methods, and foundation reinforcement techniques (Junaidi, 2013).

The results of this study are expected to serve as a reference for other researchers interested in further studying construction on swamp land. With comprehensive data and analysis, this research can form the basis for developing better theories and practices in foundation construction in challenging environments. Additionally, this study is expected to contribute to improving safety and comfort in swamp land housing (Kusuma, 2012).

One of the main focuses of this study is identifying early signs of foundation failure. By understanding early symptoms such as cracks in concrete or wood subsidence, preventive actions can be taken before a total collapse

occurs. Routine monitoring and inspections are essential to ensure that foundations remain in good condition and can withstand structural loads (Lestari, 2011).

This study also evaluates the effectiveness of existing foundation reinforcement methods. Several methods tested include using additional materials, improving wood structures, and concrete reinforcement techniques. The results of this evaluation are expected to provide a clear picture of the most effective and efficient methods for reinforcing foundations on swamp land (Muhammad, 2010).

Finally, this study emphasizes the importance of education and training for construction workers. With adequate knowledge of the challenges and solutions in swamp land construction, it is hoped that workers can apply best practices and avoid mistakes that can cause foundation failure. This education also includes understanding foundation maintenance and care to ensure long-term stability (Nasution, 2009).

Research Methods This research uses both qualitative and quantitative approaches to study foundation failures in swamp land buildings and the effectiveness of using wood and concrete combination materials. Research methods include literature studies, field observations, and laboratory analysis.

Literature Study: Reviewing various previous studies related to swamp land foundations, especially those using wood and concrete combination materials. This step helps understand existing knowledge and identify gaps that need further investigation.

Field Observations: Visiting construction sites and documenting foundation conditions, including signs of damage and structural weakness. Data collected from field observations will be analyzed to identify common failure patterns.

Laboratory Analysis: Testing wood and concrete materials in the laboratory to understand their mechanical properties and interactions under swamp land conditions. This step includes testing the strength and durability of wood and concrete combination materials.

The research also involves interviews with construction experts and workers to gain insights into practical experiences and challenges faced in building foundations on swamp land. These interviews provide valuable qualitative data to complement quantitative data collected through other methods.

Research Results This study finds that wood and concrete combination foundations on swamp land often show signs of damage such as cracks in concrete and wood subsidence. These damages are primarily caused by improper construction methods and unsuitable material selection.

Concrete used in combination foundations often cracks due to poor mixing and curing processes. Additionally, concrete's heavy weight causes it to sink into the soft swamp land, leading to foundation instability.

Wooden piles in combination foundations are often made of low-quality wood, which easily deteriorates and decays in swamp land conditions. This degradation further weakens the foundation, causing structural failures.

Through laboratory tests, it is found that high-quality wood treated with preservatives can significantly improve foundation durability. Using additional materials such as steel reinforcement in concrete also helps increase foundation strength and stability.

Conclusion This study concludes that wood and concrete combination foundations have potential to be an effective solution for building on swamp land, provided that proper materials and construction methods are used. By understanding the common weaknesses and failure patterns, practical recommendations can be developed to improve foundation stability and prevent future collapses.

Recommendations For future construction projects on swamp land, it is recommended to use high-quality wood treated with preservatives and properly mixed and cured concrete. Additionally, regular maintenance and inspections are crucial to ensure long-term foundation stability.

This study also highlights the importance of educating construction workers on best practices for building on swamp land, including understanding material properties and appropriate construction methods. By applying these recommendations, it is hoped that foundation failures on swamp land can be minimized, improving safety and durability of buildings in such environments.