

# *Analysis of Current Situation and Enhancement Strategies of Seismic Resistance of Rural Buildings*

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**Keywords:** Rural buildings; seismic resistance capability; evaluation methods; promotion of seismic technology

**Abstract:** This paper comprehensively evaluates the current situation of seismic resistance of rural buildings and proposes optimization suggestions for the existing problems, including establishing a system for promoting seismic technology, strengthening standardized management of seismic resistance capabilities, and formulating policy measures to promote the enhancement of seismic resistance capabilities. These measures will help improve the resilience of rural buildings in earthquake disasters, safeguarding the lives and property of the people. With the acceleration of urbanization and the increasing frequency of earthquakes in many areas, the seismic issues of rural buildings are becoming increasingly prominent. Solving this problem has important practical significance and profound social impact. Therefore, strengthening research and enhancement of the seismic resistance capabilities of rural buildings is of great strategic significance for promoting integrated urban-rural development and enhancing national disaster prevention and relief capabilities.

## 1. Introduction

Earthquakes are common natural disasters that cause serious loss of life and property to human society. Due to being located in earthquake-prone areas, enhancing the seismic resistance of buildings has always been an important topic for national development. Rural buildings are one of the most vulnerable parts of seismic disasters in China, and improving their seismic resistance is of great significance for reducing the losses caused by earthquakes. The seismic resistance of rural buildings is directly related to the safety of rural residents' lives and property. However, due to the limited economic conditions in many rural areas, the quality of buildings varies, and their seismic resistance is relatively weak. Once encountering earthquake disasters, serious casualties and property losses often occur. Therefore, strengthening the seismic resistance of rural buildings and improving disaster prevention and response capabilities have become one of the urgent problems to be solved. This paper aims to analyze the current situation of seismic resistance of rural buildings and propose corresponding enhancement strategies, aiming to provide reference and guidance for rural construction and earthquake disaster prevention work.

## **2. Current Situation of Seismic Resistance of Rural Buildings**

### **2.1 Existing Methods for Seismic Resistance Assessment**

The assessment of seismic resistance of rural buildings is an important part of ensuring building safety. Currently, there are mainly two methods for assessing the seismic resistance of rural buildings: quantitative assessment and qualitative assessment. Quantitative assessment is usually based on the mechanical properties of the building structure and the interaction of seismic forces, calculating the seismic performance parameters of the building structure to assess its seismic resistance. Qualitative assessment focuses more on the overall condition of the building structure and possible seismic vulnerabilities, judging the seismic resistance level of the building through observation and analysis of the building structure's appearance, materials, and structural connections. However, existing assessment methods have certain limitations in practical application, such as insufficient consideration of factors such as building structure materials and construction quality, as well as inadequate comprehensive analysis of regional factors such as seismic wave characteristics and building foundation conditions. Therefore, further research can explore how to comprehensively consider these factors to improve the accuracy and comprehensiveness of seismic resistance assessment of rural buildings<sup>[1]</sup>.

### **2.2 Seismic Design Standards and Current Policies for Rural Buildings**

The seismic design standards and current policies for seismic resistance of rural buildings are important bases for ensuring building safety. China's seismic design standards for rural buildings are mainly formulated by relevant regulations such as the "Code for Seismic Design of Buildings." These standards specify the seismic requirements that rural buildings should meet in the design, construction, and acceptance processes to ensure that the buildings have certain seismic resistance when earthquakes occur. Local governments also formulate corresponding seismic policies and measures to strengthen the management and supervision of the seismic resistance of rural buildings based on the local geological and seismic activity conditions. However, the current problem is that some local governments have inadequate implementation of seismic policies, resulting in a low level of seismic design for some rural buildings. Therefore, it is necessary to further improve seismic design standards and policies, strengthen the monitoring and assessment of the seismic resistance of rural buildings, and enhance the seismic resistance of rural buildings in earthquake disasters to ensure the safety of people's lives and property<sup>[2]</sup>.

### **2.3 Correlation between Seismic Resistance of Rural Buildings and Regional Characteristics**

The seismic resistance of rural buildings is closely related to regional characteristics, including geological conditions, seismic activity, and architectural styles, all of which can affect the seismic performance of buildings. Geological conditions are one of the important factors affecting the seismic resistance of rural buildings. In areas with good geological conditions, such as solid foundations and stable strata, buildings tend to have stronger seismic resistance. In areas with poor geological conditions, such as areas prone to landslides and mudslides, the seismic resistance of buildings is weaker. Seismic activity is also a key factor affecting the seismic resistance of rural buildings. In areas with frequent earthquakes, the seismic design standards and requirements for buildings are often higher, and the seismic resistance of buildings is correspondingly stronger. In areas with lower seismic activity, the seismic design standards and requirements for buildings are relatively lower, and the seismic resistance of buildings is correspondingly weaker. Architectural style can also affect the seismic resistance of rural buildings. Traditional architectural styles often

have weaker seismic resistance, while modern architectural designs and structures often pay more attention to seismic performance, resulting in relatively stronger seismic resistance. Therefore, when improving the seismic resistance of rural buildings, it is necessary to fully consider regional characteristics and formulate corresponding seismic design and construction standards based on factors such as geological conditions, seismic activity, and architectural styles in different regions to improve the seismic resistance of rural buildings in earthquake disasters<sup>[3]</sup>.

### **3. Problems in Seismic Resistance of Rural Buildings**

#### **3.1 Discrepancy between Current Assessment of Seismic Resistance of Rural Buildings and Actual Seismic Demands**

There is a significant gap between the current assessment of seismic resistance of rural buildings and actual needs, which is undoubtedly a serious hidden danger. Existing seismic assessment methods and standards often fail to comprehensively and deeply reveal the true seismic performance of buildings. These methods do not fully consider the complexity and diversity of regional factors, such as geological conditions, seismic wave characteristics, and building foundation conditions, when evaluating building structures, materials, and construction techniques. This discrepancy results in a large deviation between the assessment results and actual needs. The attention of local governments to the seismic construction of rural buildings needs to be further enhanced. In some areas, the seismic resistance of rural buildings lags significantly behind actual needs, making these buildings likely to be ineffective in resisting seismic forces during earthquakes, leading to serious casualties and property losses. Therefore, it is necessary to face this situation, recognize the gap between the assessment of seismic resistance of rural buildings and actual needs, and analyze its causes in depth. Only through more accurate and comprehensive assessment and increased attention and investment from local governments can this gap be gradually narrowed, ensuring that rural buildings have sufficient seismic resistance in the face of earthquakes and safeguarding the safety of people's lives and property<sup>[4]</sup>.

#### **3.2 Insufficiencies of Local Governments in Seismic Construction of Rural Buildings**

In terms of seismic construction of rural buildings, local governments indeed have many shortcomings in policy formulation and implementation. Some local governments lack sufficient emphasis on the seismic construction of rural buildings, lack long-term planning and continuous investment, resulting in low levels of seismic design and weak seismic resistance of buildings. This short-sighted behavior makes rural buildings appear particularly vulnerable to earthquakes and could lead to unimaginable consequences after earthquake disasters. There are also obvious deficiencies in the formulation and implementation of seismic policies by local governments. Some policies lack foresight and scientificity, failing to fully consider local geological characteristics and seismic activity, resulting in a significant reduction in the effectiveness of policy implementation. These deficiencies in policies make rural buildings lack strong support in seismic resistance and difficult to effectively cope with the challenges brought by earthquakes. There are also obvious omissions in the supervision and supervision of seismic construction by local governments. Some seismic construction projects have quality problems and regulatory loopholes, which, if not resolved in a timely manner, undoubtedly sow the seeds of hidden dangers in the seismic resistance of rural buildings. The shortcomings of local governments in the seismic construction of rural buildings not only affect the seismic resistance of buildings but also increase the losses and impacts after earthquake disasters. Therefore, local governments must face these issues, strengthen attention and investment, improve the level of policy formulation and implementation, and increase supervision

and supervision to effectively enhance the seismic resistance of rural buildings.

### **3.3 Disproportion between Seismic Technological Level and Modernization of Rural Buildings**

The disproportion between the seismic technological level and modernization of rural buildings has become a major problem that urgently needs to be solved in current seismic construction. In many rural areas, although the scale of buildings continues to expand, the application of seismic technology is clearly insufficient due to technological backwardness and lack of funds. The design and construction of these areas often use traditional methods and materials, lacking scientific seismic design and reinforcement measures, resulting in the seismic performance of buildings far from reaching modern standards. Some rural areas are slow to act in updating seismic technology, failing to timely introduce advanced seismic technology and equipment, leading to a serious disconnect between the seismic resistance of buildings and the modernization process. This mismatch brings great safety hazards. In the event of an earthquake disaster, these buildings with lower technological levels often cannot resist the impact of seismic forces, leading to collapse and damage, causing serious casualties and property losses. The reasons for this disproportion are not only limited by technology and funds but also related to ineffective policy implementation, lack of supervision, and weak seismic awareness. Therefore, it is necessary to face the disproportion between the seismic technological level and modernization of rural buildings, deeply analyze its causes and effects, and take effective measures to solve it to ensure that the seismic resistance of rural buildings is synchronously improved with the modernization process, safeguarding the safety of people's lives and property.

## **4. Optimization of Seismic Resistance of Rural Buildings**

### **4.1 Establishing a Sound System for Promoting Seismic Resistance Technology of Rural Buildings**

The promotion of seismic resistance technology of rural buildings is key to improving their seismic resistance. To establish a sound promotion system, it is necessary to strengthen research and development of seismic resistance technology, promote continuous innovation and progress in seismic resistance technology. Through the study of advanced seismic technologies such as isolation, damping, and seismic support, the seismic performance of rural buildings can be improved, and losses caused by earthquake disasters can be reduced. It is necessary to strengthen the publicity and promotion of seismic resistance technology, enhance the public's understanding and awareness of seismic resistance technology. This can be achieved by organizing lectures, exhibitions, and other activities to popularize the importance and application value of seismic resistance technology, enhancing public confidence and support for seismic resistance technology. It is also necessary to establish a sound system for training in seismic resistance technology, improve the seismic resistance technology level of rural building practitioners. This can be done by conducting training courses, technical exchange meetings, and other activities to impart knowledge and skills in seismic resistance technology to rural building practitioners, enhancing their ability to cope with earthquake disasters. It is necessary to strengthen the supervision and management of seismic resistance technology to ensure the expected effect of its application. This can be achieved by establishing a seismic resistance technology evaluation mechanism to regularly test and evaluate the seismic performance of rural buildings, promptly identify and solve problems, and improve the application effect of seismic resistance technology. By comprehensively promoting the above measures, a sound system for promoting seismic resistance technology of rural buildings can be gradually established, ensuring the safety of people's lives and property<sup>[5]</sup>.

## **4.2 Strengthening Standardized Management of Seismic Resistance of Rural Buildings**

Strengthening standardized management of seismic resistance of rural buildings is an effective way to improve their seismic resistance. It is necessary to establish a sound evaluation standard system for seismic resistance, clarify the index system and evaluation methods for evaluating the seismic resistance of rural buildings. This includes standardized evaluation indicators for building structures, materials, construction techniques, as well as standardized evaluation methods for seismic fortification levels and seismic performance, establishing a standardized evaluation system can scientifically and objectively evaluate the seismic resistance of rural buildings, providing a scientific basis for seismic construction. It is also necessary to strengthen the standardized management of seismic resistance technology, standardize the application and promotion of seismic resistance technology. This can be achieved by formulating relevant seismic technology standards and specifications to clarify the design requirements, construction specifications, and acceptance standards of seismic resistance technology, ensuring the quality and effectiveness of seismic resistance technology. It is necessary to establish a sound system for standardized supervision of seismic resistance, strengthen the supervision and management of seismic construction. This can be achieved by establishing a seismic resistance monitoring and testing institution to regularly test and evaluate the seismic resistance of rural buildings, promptly identify and solve problems, and improve the effectiveness of standardized management of seismic resistance. It is also necessary to promote the standardized management of seismic resistance, enhance the understanding and attention of society to the standardized management of seismic resistance. This can be achieved by conducting publicity activities, releasing promotional materials, etc., to popularize the importance and significance of standardized management of seismic resistance, enhancing the support and participation of society in the standardized management of seismic resistance. By comprehensively promoting the above measures, the standardized management of seismic resistance of rural buildings can be strengthened, improving the seismic resistance of rural buildings.

## **4.3 Promoting Policy Measures to Enhance the Seismic Resistance of Rural Buildings**

In the process of promoting the enhancement of seismic resistance of rural buildings, policy measures play a pivotal role. A comprehensive system of seismic construction policies is indispensable. This can not only provide clear policy guidance and goals for the government but also effectively integrate resources from all parties, form a concerted effort. By increasing the investment in seismic construction of rural buildings and implementing targeted subsidy and reward policies, the enthusiasm and creativity of all parties to participate in seismic construction can be effectively stimulated. The establishment of legislation and regulations is also a key link in ensuring the smooth progress of seismic construction. Legislation can clarify the legal status of seismic construction and the responsible subjects, regulate various behaviors in the construction process, ensure that seismic construction is based on laws and regulations, and strengthen supervision and management of seismic construction to timely discover and correct problems in the construction process, ensuring the quality and effectiveness of seismic construction. Promoting research and innovation in seismic technology is an important way to improve the seismic resistance of rural buildings. It is necessary to increase investment in research on seismic technology, establish specialized research institutions, attract and cultivate a group of high-quality seismic technology talents, promote continuous progress and upgrading of seismic technology, and explore more suitable seismic technologies for rural buildings through strengthening the combination of theory and practice, providing strong support for enhancing the seismic resistance of buildings. Strengthening policy publicity and promotion, enhancing the understanding and support of society for seismic construction, is also crucial. This can be achieved by popularizing seismic knowledge to

the general public and relevant departments through various channels and forms, promoting the importance and urgency of seismic construction, and creating a good atmosphere of common concern and participation in seismic construction throughout society. Policy measures play a pivotal role in promoting the enhancement of seismic resistance of rural buildings. It is necessary to continuously improve the policy system, strengthen legislation and supervision, promote technological innovation and publicity, and provide solid policy guarantees for enhancing the seismic resistance of rural buildings.

## 5. Conclusion

This article thoroughly analyzes the current situation of seismic resistance of rural buildings, reveals the existing problems, and proposes practical and feasible optimization strategies. It is found that establishing a sound system for promoting seismic resistance technology, strengthening standardized management, and promoting the implementation of policy measures are crucial for enhancing the seismic resistance of rural buildings. These optimization measures not only help enhance the seismic performance of buildings but also provide strong guarantees for the sustainable development of rural areas. Through the discussion in this article, it provides valuable references for enhancing the seismic resistance of rural buildings and contributes to the protection of people's lives and property. It is hoped that these optimization strategies can be widely applied in practice, laying a solid foundation for building a safer and more stable rural building environment.

## References

- [1] Zhou Y, Ming X, Zhang P, et al. Investigation and Analysis of the Seismic Resistance of Buildings in Hongta District, Yuxi, Yunnan[J]. *Earthquake Research*, 2023, 46(3):446-452.
- [2] Yang Q, Li L, Nie G, et al. Evaluation of the Seismic Resistance of Rural Group Buildings in Southern Guangxi[J]. *World Earthquake Engineering*, 2023, 39(4):116-123.
- [3] Xu W, Yuan K, Li Y, et al. Vibration Table Test Study on the Seismic Performance of Rural Buildings with Sand Cushion Isolation Layer [J]. *Journal of Vibration and Shock*, 2021, 40(18):8.
- [4] Wang R, Yuan K, Dai Y. Study on the Influencing Factors of Seismic Performance of Rural Buildings with Composite Isolation [J]. *Journal of Shihezi University (Natural Science)*, 2020, 38(6):691-698.
- [5] Wan X. Discussion on Seismic Measures of Rural Buildings [J]. *Industrial Construction*, 2021(012):051.