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Bridging the Gap: A Review of Traditional Seismic-Resistant Construction Techniques in Srinagar and the Need for Retrofitting Strategies

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Abstract
Traditional construction techniques in Srinagar, particularly Dhajji Dewari and Taq, exhibit remarkable seismic resilience due to their modular and energy-dissipating properties. However, these structures remain vulnerable to high-intensity seismic forces due to material degradation, lack of standardized retrofitting techniques, and evolving urbanization patterns. This review consolidates existing research on the seismic performance of traditional dwellings in Srinagar, highlighting the need for innovative retrofitting strategies. A comparative analysis with modern seismic-resistant designs is conducted to emphasize the strengths and limitations of traditional methods. The study identifies the absence of standardized retrofitting frameworks as a crucial research gap, necessitating collaborative efforts among engineers, policymakers, and conservationists. By integrating traditional knowledge with modern engineering paradigms, a sustainable approach to seismic risk mitigation in heritage-rich regions is proposed.

Keywords: Seismic Performance, Dhajji Dewari, Taq Construction, Retrofitting, Traditional Architecture, Seismic Risk Mitigation

Introduction

The Kashmir Valley, particularly Srinagar, lies in the seismically active Zone V of India's seismic zonation map (IS 1893:2016). Traditional architectural techniques such as Dhajji Dewari and Taq construction have historically demonstrated inherent resilience against seismic forces due to their unique material configurations. However, the vulnerability of these structures to high-intensity earthquakes necessitates a comprehensive assessment of their seismic behavior and potential retrofitting strategies. This review paper synthesizes the existing body of research on traditional construction techniques in Srinagar, identifies research gaps, and evaluates the feasibility of retrofitting solutions for seismic risk mitigation.

Methodology

A systematic review approach is employed to analyze existing studies on the seismic performance of Dhajji Dewari and Taq structures. Data from experimental studies, field surveys, and numerical simulations are consolidated to identify key structural deficiencies. A comparative assessment with modern seismic-resistant structures is conducted to highlight the advantages and limitations of traditional construction techniques. Finally, a critical discussion on the need for standardized retrofitting frameworks is presented, integrating insights from structural engineering, geotechnical analysis, and policy research.

Research Gap Identification

I. Lack of Standardized Retrofitting Protocols Despite the demonstrated resilience of traditional structures, there is no standardized retrofitting methodology tailored to Srinagar's architectural landscape. Existing retrofitting techniques, such as reinforced bands, steel bracings, and fiber-reinforced polymers, have not been

systematically adapted for Dhajji Dewari and Taq structures, creating an urgent need for localized retrofitting solutions.

II. Material Degradation and Structural Weaknesses Traditional materials, including timber and unreinforced masonry, degrade over time due to climatic conditions and poor maintenance. The absence of systematic preservation efforts exacerbates structural vulnerabilities, increasing the risk of failure during seismic events.

III. Socio-Economic and Policy Constraints Retrofitting solutions must consider the socio-economic conditions of Srinagar's residents, many of whom belong to low-income communities. Financial constraints and lack of policy-driven incentives hinder the large-scale implementation of retrofitting strategies.

Comparative Analysis with Modern Seismic-Resistant Techniques

Modern construction techniques, such as reinforced concrete (RC) and steel-frame structures, exhibit superior seismic resistance due to enhanced material properties and engineering precision. However, these methods often overlook cultural and environmental sustainability, making them less viable for heritage conservation. A comparative analysis highlights that while modern structures adhere to stringent seismic codes, traditional dwellings require targeted interventions to maintain their architectural authenticity while improving seismic resilience.

Retrofitting Strategies for Traditional Dwellings

I. Timber Reinforcement and Steel Bracing Strengthening the timber framework of Dhajji Dewari structures with steel bracings can enhance lateral stability, reducing the risk of wall collapses during earthquakes.

II. Use of Fiber-Reinforced Polymers (FRPs) FRP applications on masonry walls can improve the tensile strength of traditional structures without significantly altering their visual or cultural attributes.

III. Seismic Isolation Techniques Introducing base isolation mechanisms in new constructions inspired by traditional techniques can enhance the seismic performance of heritage buildings while preserving their architectural significance.

IV. Community-Based Capacity Building Public awareness programs and policy-driven incentives can encourage homeowners to adopt retrofitting solutions. Government intervention in providing financial assistance for structural upgrades is crucial to ensuring widespread implementation.

Conclusion

This review identifies critical research gaps in the seismic performance and retrofitting of traditional dwellings in Srinagar. While Dhajji Dewari and Taq structures demonstrate intrinsic seismic resilience, their vulnerabilities necessitate innovative and cost-effective retrofitting solutions. Standardizing retrofitting techniques tailored to the local architectural landscape is imperative for ensuring long-term structural safety. Future research should focus on integrating advanced engineering methodologies with traditional construction principles to develop sustainable seismic mitigation strategies. Collaborative efforts among engineers, policymakers, and conservationists are essential to preserving Srinagar's architectural heritage while safeguarding its residents from seismic hazards.

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