

Function of seismic bracing for bridge structures in Bhutan



Overview

BRACE Bhutan: HomeOur aim is to develop resilience and research capacity within Bhutan to cope with earthquakes and their cascading effects on the environm.

Key Takeaways

Seismic bracing in Bhutanese bridges enhances structural stability, reduces vibration, and prevents collapse during earthquakes, particularly in timber and traditional bridge designs.

Purpose of Seismic Bracing

Seismic bracing is designed to strengthen bridges against earthquake-induced forces, ensuring that the structure can withstand lateral and vertical shaking without catastrophic failure. In Bhutan, which lies in seismic zones IV and V, bridges are particularly vulnerable due to the combination of high seismicity and traditional construction methods that often rely on timber and cantilevered designs without modern reinforcement standards. Bracing helps to distribute seismic loads, limit excessive movement, and maintain the integrity of joints and bearings under dynamic conditions.

Application in Timber Bridges



Traditional Bhutanese timber bridges, such as the Punakha Bazam, are constructed with cantilevers and horizontal beams supported on abutments. These bridges are prone to vibration and structural weaknesses during earthquakes due to the flexibility of timber and the absence of nails or standardized codes. Seismic bracing in these bridges typically involves reinforced joints, suitable bearings, and additional lateral supports to improve load transfer and reduce the risk of collapse.

Dynamic testing has shown that timber bridges have fundamental frequencies between 5 Hz and 11 Hz, indicating susceptibility to seismic excitation, which bracing can mitigate.

Benefits of Seismic Bracing

Enhanced Structural Stability: Bracing prevents excessive lateral displacement and torsion during seismic events. **Vibration Control:** Reduces oscillations caused by both earthquakes and vehicular loads, improving serviceability. **Load Redistribution:** Transfers seismic forces to stronger structural elements, protecting weaker components.

Preservation of Heritage Structures: Allows traditional bridges to remain functional while meeting modern safety standards.

Cost-

Effective Retrofitting: Bracing can be added to existing bridges without complete reconstruction, improving resilience efficiently. **Integration with Bhutanese Seismic Resilience Strategies**The BRACE project in Bhutan emphasizes combining engineering solutions with historical and environmental knowledge to develop earthquake-resilient infrastructure. Seismic bracing is a key component of this approach, ensuring that bridges can withstand earthquakes while maintaining cultural and environmental considerations.

By implementing bracing and retrofitting techniques, Bhutan can reduce disaster risk and enhance the longevity of critical transportation networks. In summary, seismic bracing in Bhutanese bridges functions to protect lives, preserve infrastructure, and maintain connectivity in a seismically active region, particularly for traditional timber bridges that require reinforcement to meet modern safety standards.

Article Content

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Our aim is to develop resilience and research capacity within Bhutan to cope with earthquakes and their cascading effects on the environment, infrastructure, business, and society.

Comparative Study on Traditional Timber Bridges of Bhutan with

All the Bhutanese timber bridges are cantilever bridges with 3 to 4 cantilever beams placed depending on the span length of the bridge. Moreover, bearings are not provided for making the bridges spring

Building Bhutanese Resilience Against Cataclysmic Events (BRACE)

By merging new research in these fields with close consultation with in-country policymakers and engineers, our long-term aim is to develop a sustainable framework for improving Bhutanese

Comparative Study on Traditional Timber Bridges of Bhutan with

Timber bridges in Bhutan face vulnerabilities to seismic loading, requiring improved design and retrofitting techniques. Punakha Bazam, a historical bridge, has undergone minor retrofitting but

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However, allowing the plastic deformation of structural components means allowing damage and residual displacement of structural components, which has a great impact on the post

Comparative Study on Traditional Timber Bridges of Bhutan with

Key takeaways AI The paper examines traditional timber bridges in Bhutan, focusing on their seismic performance and methodologies for enhancement. Timber bridges in Bhutan face vulnerabilities to

Bridge Engineering Reference Manual | PDF | Bridge | Truss

This document provides guidelines for bridge engineering in Bhutan. It covers topics such as preliminary data collection, site selection, surveys, subsoil investigation, bridge classification, selection of bridge

List of bridges in Bhutan

Bridges of this type were very common in mountainous region of India, Nepal and Tibet with an average span of 20 metres (66 ft), but those from Bhutan have the particularity of being more elaborate with

Seismic Retrofitting of Structures by Steel Bracings

Abstract Seismic retrofitting is the modification of existing structures so as to improve the system behaviour or its components repair/strengthening up to the performance it is expected.

Progress Report on the Present Conditions and Technical

The paper introduces a technical cooperation project on bridge maintenance management in Bhutan. The project is performed under the “Technical Cooperation” program funded by JICA. As

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