

# 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

### BRACE Bhutan: Home

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

### Performance of an innovative self-centering buckling restrained brace ...

This paper develops an innovative self-centering buckling restrained brace (SC-BRB), combining a traditional BRB and pre-pressed combination disc springs, for seismic retrofitting of

### Research on the Application of BRBs in Seismic Resistance of Bridge

The use of BRBs as seismic isolation elements in large-span bridges is discussed, and the effects of BRBs, other seismic isolation devices, and their joint application on the seismic

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It considers the temperature-induced expansion in bridge operational conditions and the energy-dissipation performance in earthquake events. The seismic protection performance of the

### Manual for Seismic Resilient Construction and Retrofitting of Rammed ...

Using an actual rammed-earth structure that was built more than a year ago in Bhutan and a simulated rammed-earth block made for laboratory use, the electrical property values were measured by

## STANDARD SLAB AND DECK GIRDER BRIDGES

The manual covers from collection of preliminary data for bridge site selection, detailed survey to selection of type of bridge for a particular location based on various engineering aspects. It also

### A Deep Dive into Types of Bracing in Structural Engineering

Unlike conventional bracing, which targets wind or gravity loads, seismic bracing is purpose-built to handle the unique dynamics of seismic activity. Its goal is clear: minimize structural

### Seismic hazard and risk in Bhutan

We present the first modern seismic hazard and risk assessment in the Bhutan Himalaya. We used a fault-based probabilistic seismic hazard analysis based on fault locations, slip-rates, and

### Enhancing Seismic Performance of Bridges with a Novel ...

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

Displacement-based seismic design of bridge bents retrofitted with ...

PDF | On Jan 16, 2019, Nailiang Xiang and others published Displacement-based seismic design of bridge bents retrofitted with various bracing devices and their seismic fragility assessment under ...

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