

Article Overview

A resonance bridge refers to the phenomenon where a bridge structure experiences amplified vibrations due to resonance, which can lead to catastrophic failures, as famously demonstrated by the Tacoma Narrows Bridge collapse in 1940.

What is Resonance?

Resonance occurs when an external force, such as wind or traffic, matches the natural frequency of a structure, causing it to vibrate at increasing amplitudes. This can lead to significant stress on the materials, potentially resulting in structural failure if the vibrations exceed the material's load capacity.

The Tacoma Narrows Bridge Example

The Tacoma Narrows Bridge, completed in 1940, is one of the most notable examples of resonance affecting a bridge. Nicknamed "Galloping Gertie," the bridge exhibited significant oscillations even in moderate winds. On November 7, 1940, a wind gust of about 40 mph triggered a catastrophic failure due to aeroelastic flutter--a specific type of resonance where the wind-induced vibrations interacted with the bridge's natural frequency, leading to violent twisting and eventual collapse .

Mechanisms of Resonance in Bridges

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Mechanical Resonance: This is the general phenomenon where structures respond to external vibrations at their natural frequency, leading to increased oscillation amplitudes. If these vibrations are not dampened, they can cause structural failure .

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Aeroelastic Flutter: In the case of the Tacoma Narrows Bridge, the oscillations were exacerbated by wind vortices that created a feedback loop, amplifying the bridge's natural vibrations until it collapsed .

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Structural Design Considerations: Engineers must account for resonance when designing bridges. This includes incorporating dampers and other mechanisms to mitigate the effects of vibrations and prevent resonance from leading to failure .

Conclusion

Understanding the concept of resonance in bridge engineering is crucial for ensuring the safety and longevity of structures. The Tacoma Narrows Bridge serves as a historical lesson on the importance of considering

Resonance Bridge

resonance in design and the potential consequences of neglecting this phenomenon. By studying such cases, engineers can develop better strategies to prevent similar failures in future bridge designs.

Figure 1: Tacoma Narrows Bridge undergoing significant oscillations due to wind loads near the structure's resonant

When the bridge was re-opened after the dampers were retrofitted to the structure, the

Frequency of vibration is at work when swinging on a swing set or when soldiers march in

Abstract--This article investigates the lateral vibration and resonance of bridges, crucial for transportation network integrity and traffic

Tacoma Narrows Bridge destroyed by resonance

Harmonic resonance occurs when an external force matches a structure's natural frequency, causing catastrophic vibrations--like a

APS Archives When the Tacoma Narrows Bridge over Puget Sound in the state of Washington famously collapsed on November 7,

With the continuous improvement in the operation speed of trains, the impact of train-induced vibration through the

Die Brücke war nach dem besten Stand des damaligen Ingenieurwissen gebaut. Was ging schief? Wissenschaftler des California

If unchecked, the vibration can increase drastically, sending destructive, resonant vibrations traveling through a bridge in the form of

It was a testimony to the power of resonance, and has been used as a classic example in physics and engineering

The case of the Tacoma Narrows bridge is a well-known cautionary tale that's discussed

Resonance may cause violent swaying motions in constructed structures, such as bridges and buildings.

When bridges and buildings begin to vibrate, whether from the wind or traffic or another

Resonance Bridge

Resonance is a physical phenomenon that can cause the catastrophic failure of structures, including bridges, when

The bridge is vibrating at the resonance frequency as the strong wind today, happen at

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