Trapezoidal bridge structure



Overview

Trapezoidal sections A dimensionally accurate trapezoidal section forms a closed cross-section with the deck which makes surface treatment easy. High accur.

Key Takeaways

Trapezoidal bridges, often implemented as box girder bridges, use trapezoidal cross-sections to enhance torsional rigidity, cost-effectiveness, and structural efficiency.

Overview

A trapezoidal bridge typically refers to a box girder bridge where the cross-section of the girder is trapezoidal rather than rectangular. Box girders are hollow, channel-shaped beams with top and bottom flanges and vertical webs, forming a closed section that provides high torsional stiffness and strength under bending loads. The trapezoidal shape allows one flange to remain in compression and the other in tension, optimizing the structural performance.

Structural Advantages

Torsional Rigidity: Trapezoidal box girders offer superior torsional stiffness, making them ideal for curved bridges or high-speed traffic routes where torsional effects are significant. Shear and Bending Efficiency: The inclined webs of trapezoidal sections reduce shear forces compared to rectangular sections, improving load distribution and structural economy.

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Cost-

Effectiveness: Studies show trapezoidal sections are generally more economical than rectangular ones due to reduced material usage and optimized geometry. Aesthetic and Functional Benefits: The smooth, sleek shape of trapezoidal girders enhances visual appeal and allows space within the box for utilities like electrical conduits or pipelines.

Design Considerations

Web Inclination: Webs may be inclined up to 1: 4 relative to the bottom flange to balance structural efficiency and stability. Flange Thickness: The top and bottom flanges should not be less than 1/30 of the clear span between webs to ensure adequate strength. Prestressing: Trapezoidal box girders are often prestressed to improve load-carrying capacity and reduce deflection.

Single vs.

Multi-

Cell: For spans exceeding 50 meters, a single trapezoidal box girder is often more economical, while multi-cell designs may be used for wider bridges.

Applications

Trapezoidal bridges are widely used in highway and railway bridges, especially where curved alignments or long spans are involved. They are also suitable for orthotropic steel decks, where trapezoidal stiffeners enhance fatigue resistance and reduce material costs. Comparison with Rectangular Box GirdersDeflection: Trapezoidal sections may exhibit slightly higher central deflection (around 7.

6% more) than rectangular sections, but this is offset by reduced shear forces and material savings. Transverse Stresses: Rectangular sections may perform better in transverse stress distribution, but longitudinal stresses are similar in both shapes. Overall Efficiency: Trapezoidal sections are generally preferred for long-span bridges due to their economy, torsional rigidity, and structural efficiency.

In summary, trapezoidal bridges combine structural efficiency, aesthetic appeal, and cost-effectiveness, making them a popular choice in modern bridge engineering, particularly for prestressed concrete and steel box girder designs.

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Article Content

Trapezoidal sections

A dimensionally accurate trapezoidal section forms a closed cross-section with the deck which makes surface treatment easy. High accuracy level means also easier and less welding at the engineering

Trapezoidal sections

Using trapezoidal sections in superstructure bridge design, especially in the orthotropic deck, improves overall bridge economy by enabling structures to be

Design Guidelines for Steel Trapezoidal Box Girder Systems

PDF file

Bridge Geometry Manual - FHWA West Virginia Division

Bridge Geometry Manual Publication No. FHWA-HIF-22-034 Infrastructure O ffice of Bridges and Structures

Comprehensive Design Guidelines for Trapezoidal Steel

Detailed overview of trapezoidal steel box girder bridge design, including geometry, bracing, span ranges, curvature, dimensions, and construction considerations for

Box Girder Bridges | Types, Components, Specification

What is Box girder bridges? Girders are the large section beams above which the slab (deck) rests. They are generally adopted for the bridges. The Box Girder are hollow channel-shaped beams

Orthotropic Bridge Design

The one used by METTLER TOLEDO consists of a deck reinforced by closed ribs with a trapezoidal shape. A proven design that is widely used in bridge construction, it was chosen to replace the

Guide for Orthotropic Steel Deck Level 1 Design

The bridge was constructed in the mid-1960s and was the first long-span orthotropic bridge to be constructed in the United States. The bridge has known serviceability and deck performance issues

The Complete Guide to Steel Structure Box Girder Bridges

A steel structure box girder bridge is a type of bridge that uses box-shaped, hollow girders made of structural steel as its main load-carrying elements. The girder typically consists of two horizontal

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Box girder bridge

The (non-modular) box girder bridge was a popular choice during the roadbuilding expansion of the 1960s, especially in the West, and many new bridge projects

Stability Optimization of Trapezoidal Frame with Rigid Members and ...

Stability has been an important subject in the design of a portal frame structure. Conventional stability analysis of the portal frame is normally conducted assuming that all the joints

Frame bridges

Frame bridges are often the most economical solution for smaller spans. Orthogonal and trapezoidal frames are particularly suitable for grade separations (flyovers, underpasses – modest structures in

Trapezoidal Box Girder Bridge Bracing: Results from Field Monitoring ...

Trapezoidal box girders are being used more frequently, particularly in urban interchanges, based on the aesthetics and substantial torsional stiffness of the completed bridge.

Bridge Basics

Bridge Basics Because of the wide range of structural possibilities, this Spotter''s Guide shows only the most common fixed (non-movable) bridge types. Other types are listed in the Bridge

Orthotropic Bridge Design

Orthotropic Bridge Design Orthotropic is a term used to describe an orthogonal-aniso t ropic structure. This type of structure exhibits different mechanical properties along different perpendicular axes.

Distortion analysis of horizontally curved trapezoidal box girder bridges

As it is shown, none of the previous authors has proposed a completely refined formulation for composite trapezoidal box girder bridges curved in plan. Therefore, the aim of this

Bridge Geometry Manual

Bridge Geometry Manual Publication No. FHWA-HIF-22-034 Infrastructure O ffice of Bridges and Structures

Box girder bridge

A box girder bridge, or box section bridge, is a bridge in which the main beams comprise girders in the shape of a hollow box. The box girder normally

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Truss Design and Member Configurations | PDF

Trusses are structures composed of connected members that form triangular units. The document discusses different types of truss configurations, including triangular trusses and trapezoidal trusses.

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EU project coordination: Parque das Nações, Lisbon, Portugal

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