Bridge Slope and Curvature



Overview

A vertical curve is used to change the profile of a highway to provide a smooth transition between two sloped grades.

Key Takeaways

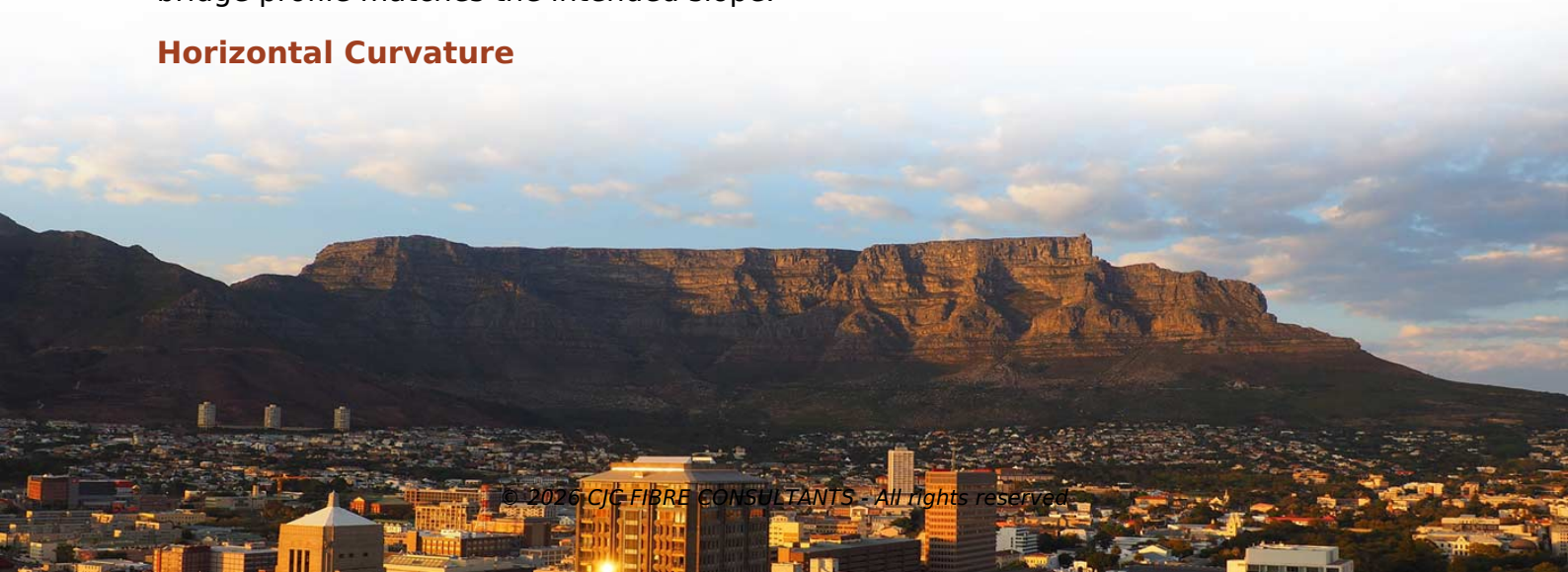
Bridge slope and curvature are critical design elements that ensure smooth transitions, structural stability, and safe traffic flow, involving vertical and horizontal curves, cambering, and adjustments for long spans.

Vertical Slope and Curves

Bridges often incorporate vertical curves to transition smoothly between different grades, providing a comfortable ride and proper drainage. These curves are classified as crest curves (convex) and sag curves (concave), and their design depends on factors such as design speed, slope, friction, sight distance, and drainage requirements. Vertical curves typically extend beyond the bridge length to reduce construction complexity and ensure proper alignment with the roadway profile.

Cambering of girders or prestressed concrete elements is often applied to compensate for expected deflections under dead and live loads, ensuring the final bridge profile matches the intended slope.

Horizontal Curvature



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Horizontal curves are used when a bridge follows a curved alignment in plan, which is common for road bridges to optimize the carriageway layout or for aesthetic purposes in footbridges. The radius of curvature affects the angular change along the bridge and influences the design of beams and deck slabs. For larger radii (over 300 m), a series of straight beams with angular changes at discrete points may be used, while smaller radii may require truly curved girders for structural efficiency and visual appeal.

Horizontal curves also affect sight distance and traffic safety, and designers often extend curves beyond the bridge to simplify construction. Long Bridges and Earth's CurvatureFor extremely long bridges (typically over 10–15 km), the Earth's curvature becomes significant. Designers must account for horizontal and vertical deviations caused by the planet's curvature, which can affect alignment, load distribution, and structural tolerances.

Geometric corrections, such as adjusting the radius of curvature or vertical profile, are applied to ensure accurate survey data and proper structural behavior over long spans.

Design Considerations

Cambering and Slab Adjustments: Cambering girders or adjusting slab thickness compensates for dead load deflections and ensures the bridge maintains the intended slope. Structural Effects: Curvature and slope influence load distribution, vibration, and support reactions. Roller supports and arch configurations may require special attention to prevent spreading or twisting effects.

Construction Efficiency: Using curved girders simplifies reinforcement placement and formwork, while straight segments with angular connections may be more economical for large-radius curves. In summary, bridge slope and curvature design integrates vertical and horizontal alignment, cambering, and structural adjustments to achieve safe, functional, and aesthetically pleasing bridges, while also considering long-span effects such as the Earth's curvature. Proper planning ensures smooth traffic flow, structural integrity, and efficient construction.

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Article Content

Bridge Geometry Manual

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

Bridge Design Details 2.1 February 2025

A vertical curve is used to change the profile of a highway to provide a smooth transition between two sloped grades. The design of a vertical curve is dependent on the intended design speed for the

BDD Chapter 2 Bridge Layout

A vertical curve is used to change the profile of a highway to provide a smooth transition between two sloped grades. The design of a vertical curve is dependent on the intended design speed for the

4.8.2 Vertical Curves

When vertical curves are located within the limits of a bridge, it is preferred to locate the VPI, VPC, VPT''s in the center of the bridge abutment (s) or bent (s) to simplify construction.

PCI Bridge Manual Chapter 12

The effects of curvature are both structural and geometric. This chapter primarily describes the design of curved bridges. Structures with very sharp curvature (say 300-ft radius) such

Skewed and Curved Steel I-Girder Bridge Fit

Skewed and curved I-girder bridges generally exhibit tor-sional displacements, or twisting, of the individual girders and of the overall bridge cross-section under load, including the loads during

Plan curvature in bridges

Although very many bridges follow a straight alignment from one abutment to the other, some are partly or wholly curved in plan. For road bridges, curvature may

Bridge Alignment Considerations | PDF | Concrete | Bridge

This document discusses bridge alignment considerations, including: 1. Horizontal and vertical curvature, cross-slope, and other alignment aspects must be considered in bridge design.

Design of composite highway briDges curveD in plan

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This new guide describes the two options of using a series of straight girder lengths (chords to a curve) and of using curved girders; it explains that curved girders is generally the favoured option and the

Bridge Manual Part 2

The clearances shown are for new bridges on new roads in accordance with MGL Chapter 160, Section 134A and may be modified by other legal requirements, such as MGL Chapter 634.

Know About IRC:5-2015: Geometric Design Considerations for Safe

Conclusion The geometric design considerations outlined in IRC:5-2015 are fundamental to creating safe, efficient, and durable bridges. By following these guidelines, engineers can ensure that their

Document2

Therefore, it is necessary to transition the longitudinal shoulder slope adjacent to the roadway travel lanes to meet the shoulder slope adjacent to the travel lanes on the bridge.

Design of slope Bridge

The vertical curve is the final profile of the roadway and bridge. Cambering, slab thickenening, or web cutting is how we get the finished grade of the bridge to match the required final

Vertical Alignment

VERTICAL ALIGNMENT Chapter 30 presents Bureau of Local Roads and Streets (BLRS) criteria for the design of vertical alignment elements. This includes vertical curvature and grades for both crest and

Structural Damage Identification Using Mode Shape Slope and Curvature ...

AbstractMode shape–based structural damage detection is an emerging field of research. This study presents a vibration-based damage localization technique using the derivatives of mode

Bridge: Horizontal and Vertical Alignment

Primary Guidance When possible, avoid locating bridges on curved horizontal alignments, since curved bridges are more expensive Cross slopes should be constant across a

Expert Tip: Curvature Effects on A Medium-Span Curved Bridge

You can see the comparison result of the straight beam and the curved beam to visualize the curvature effects for a medium-span curved bridge.

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PDDG Chapter 4

Horizontal sight distance on the inside of a curve is limited by obstructions such as buildings, hedges, wooded areas, walls, abutments, cut slopes, headlights, vertical curvature, or other topographic

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