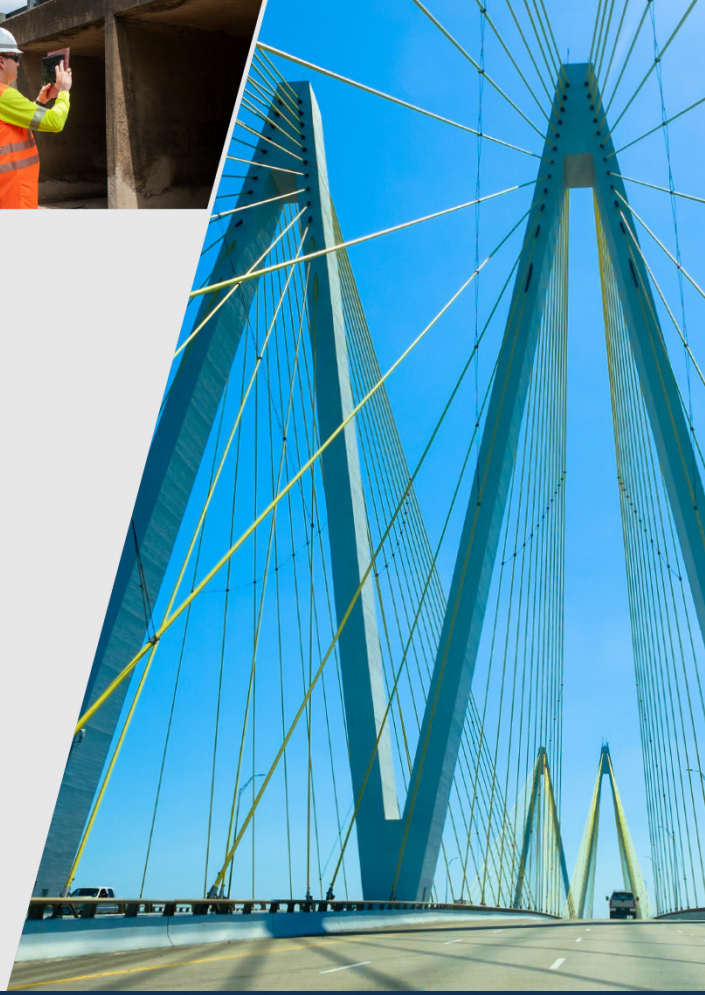
TxDOT Bridge Design Guide – Mar 2022 Release

TxDOT Bridge Division



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Texas Department of Transportation

Bridge Design Guide

Bridge Division

March 2022

Texas Department of Transportation

MEMO

March 23, 2021

To: Directors of Transportation Planning and Development

From: Michael D. Hyzak, P.E.
Bridge Design Section Director, Bridge Division

Subject: TxDOT Bridge Design Guide

The TxDOT *Bridge Design Guide* has been updated and is posted online here: https://ftp.txdot.gov/pub/txdot-info/brg/design/bridge-design-guide.pdf. Please see the Guide Revision History table on page 1-2 for a summary of the revisions.

These documents apply to any bridge designs that are presently at a 30% or earlier design phase. These documents also apply to Design-Build contracts not already executed. Usage for projects beyond these stages of development are at the discretion of the District Engineer.

An upcoming webinar on Friday April 29th will describe revisions to this document, as well as other recent bridge design documents for TxDOT staff and consultant partners. A separate invitation to this webinar will release shortly. For any questions related to these documents, please contact me at 512-416-2184 or michael.hyzak@txdot.gov.

CC: Federal Highway Administration
Bridge Design Consultants
District Design Engineers
District Bridge Engineers
District Bridge Coordinators
Bridge Division

March 23, 2022 Memo Information

- Documents apply to any bridge designs that are:
  - presently at a 30% or earlier design phase
  - Design-Build contracts not already executed
  - Usage for projects beyond these stages of development are at the discretion of the District Engineer
- Most design contracts have this contractual verbiage:

1.1. Design Criteria. The Engineer shall prepare all work in accordance with the latest version of applicable State's procedures, specifications, manuals, guidelines, standard drawings, and standard specifications or previously approved special provisions and special specifications, which include: the *PS&E Preparation Manual*, *Bridge Design Manual – LRFD*, *Geotechnical Manual*, *Roadway Design Manual*, *Hydraulic Design Manual*, the *Texas Manual on Uniform Traffic Control Devices* (TMUTCD), *Standard Specifications for Construction and Maintenance of Highways, Streets and Bridges, (latest Edition)*, and other State approved manuals.

High Level Review of TxDOT BDG

- Purpose
  - Acts as a companion document to the policy document *TxDOT Bridge Design Manual - LRFD*
  - Serves as a resource for engineers designing bridges for TxDOT
  - Provides guidelines specific to TxDOT policies, details, and design assumptions
- Please recognize this is a “guide”, not “policy”
- We welcome questions and feedback

High Level Review of Changes (in Manual Notice)

- High Level Summary of Significant Changes
  - Revised to mirror the updated BDM with adoption of LRFD 9th Edition
  - Added table of contents
  - Chapter 1 was updated to include a list of references
  - Chapter 3, Section 1 updated beam guidance and added vertical clearance guidance
  - Chapter 3, Sections 8 and 9 updated with additional geometric information
  - Chapter 4, Section 5 updated inverted tee guidance
  - Chapter 5, Section 1 added additional bridge widening guidance
  - Chapter 5, Section 5 added joint guidance
  - Chapter 6, Section 2 added additional FAQ

Chapter 1: About this Guide Updates

- Consolidated references & Update links

References

Bracketed <references> reference relevant sections of the *AASHTO LRFD Bridge Design Specifications*, edition specified in the TxDOT *Bridge Design Manual - LRFD*.

Links to External documents:

- *Bent (Pier) Protection Guide*. Texas Department of Transportation. https://ftp.txdot.gov/pub/txdot-info/brg/design/bent-pier-protection-guide.pdf
- *Bridge Design Manual-LRFD*. Texas Department of Transportation. http://onlinemanuals.txdot.gov/txdotmanuals/lrf/lrf.pdf
- *Bridge Detailing Guide*. Texas Department of Transportation. http://ftp.dot.state.tx.us/pub/txdot-info/brg/design/bridge-detailing-guide.pdf
- *BridgeLink PGSuper Design Guide*. Texas Department of Transportation. ftp://ftp.dot.state.tx.us/pub/txdot-info/isd/txdotapps/support/design_guidelines_pgsuper.pdf
- *Guidelines to Design for Constructability and Fabrication (G12.1-2020)*. American Association of State Highway and Transportation Officials, and National Steel Bridge Alliance. https://www.aisc.org/globalassets/nsba/aashto-nsba-collab-docs/nsbagdc-4.pdf
- *Preferred Practices for Steel Bridge Design, Fabrication, and Erection*. Texas Department of Transportation, and Texas Steel Quality Council. https://ftp.txdot.gov/pub/txdot-info/library/pubs/bus/bridge/steel_bridge.pdf
- *Roadway Design Manual*. Texas Department of Transportation. http://onlinemanuals.txdot.gov/txdotmanuals/rdw/rdw.pdf

Links to websites:

- Bridge Publications website. Texas Department of Transportation. https://www.txdot.gov/inside-txdot/forms-publications/consultants-contractors/publications/bridge.html#design

  Contains:

  - Live Load Deflection Spreadsheets
  - Quality Assurance/Quality Control Guide
  - Recommended beams spacings and span lengths
- Bridge Standards website. Texas Department of Transportation. http://www.dot.state.tx.us/insdtdot/orgchart/cmd/cserve/standard/bridge-e.htm
- Engineering Software website. Texas Department of Transportation. https://www.txdot.gov/business/resources/engineering-software.html
- Extended Span Precast Girders. Texas Department of Transportation. https://www.txdot.gov/inside-txdot/division/bridge/girders.html

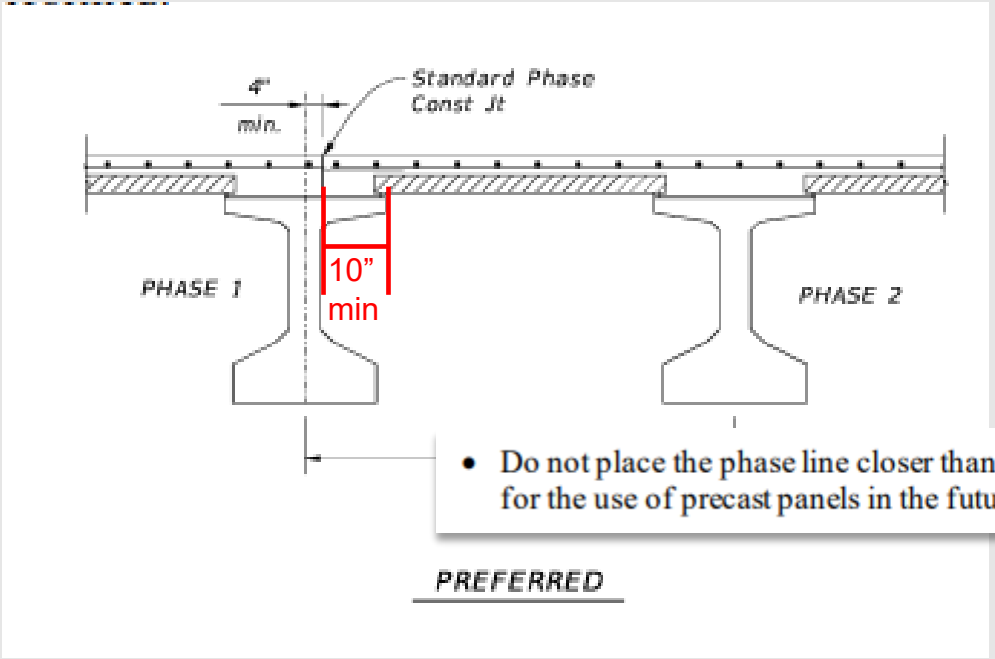
  Contains:

  - Long Span Precast I-Girder Sections
  - Long Span Precast U-Girder Sections Straight and Curved
- Structure Design - Corrosion Protection Guide, Texas Department of Transportation. https://ftp.txdot.gov/pub/txdot-info/brg/design/corrosion-protection-guide.pdf

Chapter 3: Superstructure Updates

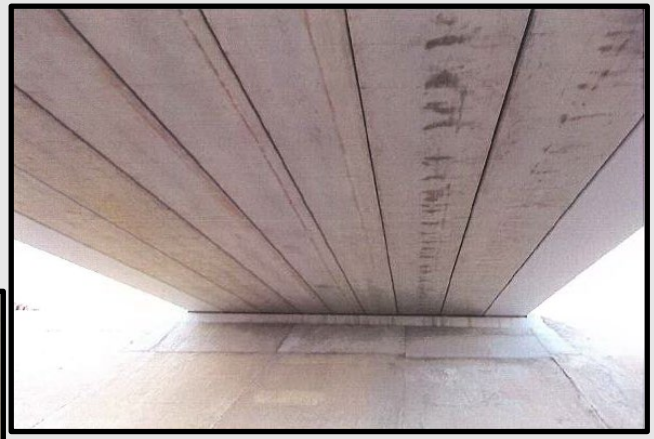
- Section 1: General Recommendations
  - Added section on temporary vertical clearance discussion with respect to height impacts and girder selection
  - Prestressed Concrete Beam and Girder Design
    - Updated concrete strength discussion
      - Limit on cement content, reduces ASR/DEF potential
      - Allows for some flexibility on maximum concrete strengths
      - Designers may request an exception, must provide justification
  - Added guidance on Prestressed Concrete Panels (PCPs) and the design of PCPs

- Section 2: Superstructure Phasing Guidance

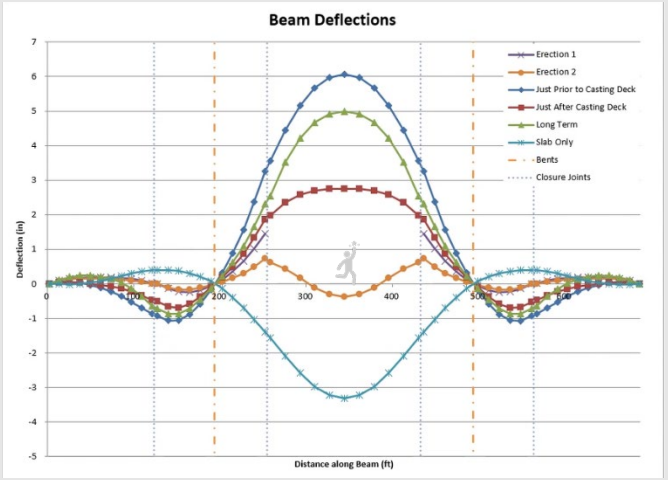


- Do not place the phase line closer than 10 inches from the beam edge, to allow for the use of precast panels in the future phase.

- Slab and Decked Slab Beams (8) and Box Beams (9)
  - Updated to be consistent with each other.
    - Bearing pads and bearing seats
    - Overhangs
    - Girder orientation
    - Beam framing discussion



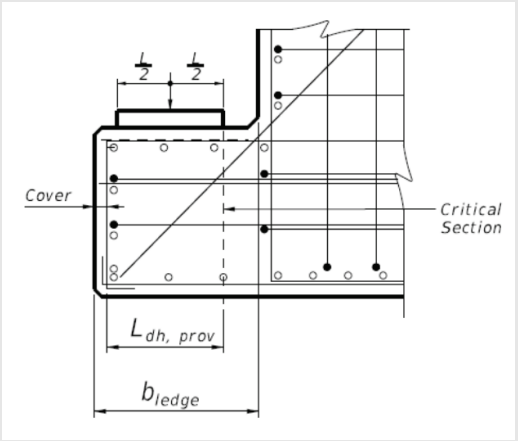
- Section 11: Splice Precast Concrete
  - Added



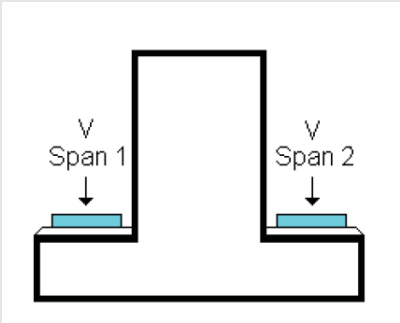
Design Criteria

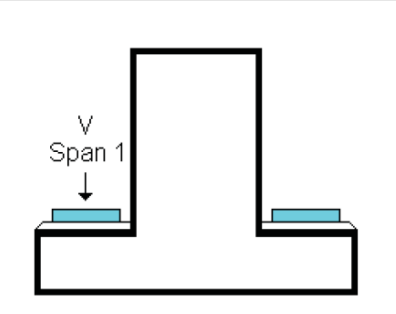
A calculated positive (upward) camber is desired after application of all permanent (dead) loads for segments resisting positive flexural moment. This may not be possible for all roadway geometries.

- Section 5: Inverted Tee Reinforced Concrete Caps
  - Concrete Class F, H, or K should be used for higher concrete strength
  - Consider limiting size of aggregate in Material Notes
  - Ledge width provides sufficient development length



- Section 5: Inverted Tee Reinforced Concrete Caps
  - Limitations to construction sequence
    - Unbalanced dead load during construction could control torsional force in cap and on cap to column connection.
  - Longitudinal reinforcing check
    - Beam loads are applied at the bottom of the section





Chapter 4: Substructure Updates

- Section 5: Inverted Tee Reinforced Concrete Caps
  - For larger skewed caps, align hanger and ledge reinforcement to cap skew rather than flared stirrups at the cap ends.
  - Align hanger and ledge reinforcement to cap skew when simpler detailing can be achieved.

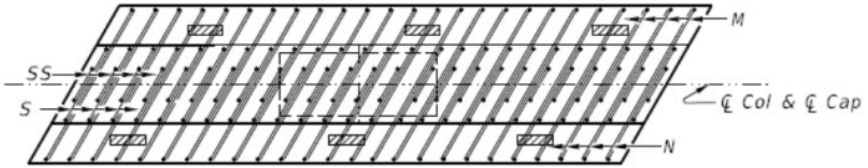


Figure 4-4: Skewed Reinforcing

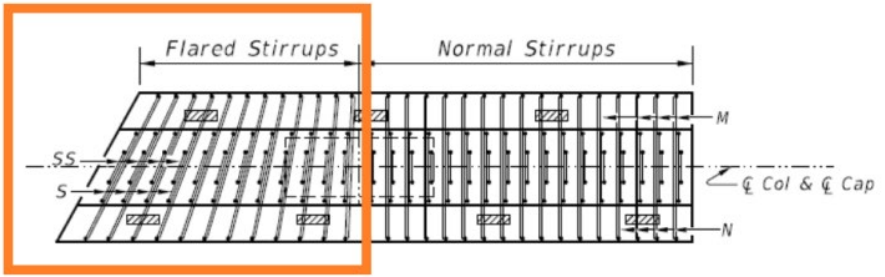
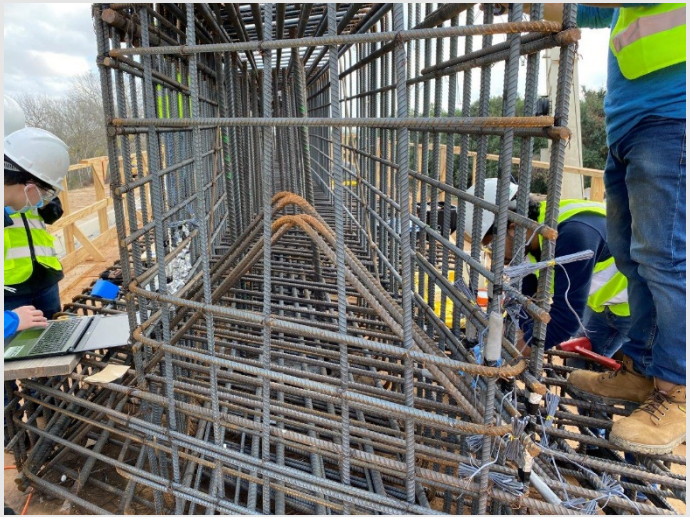


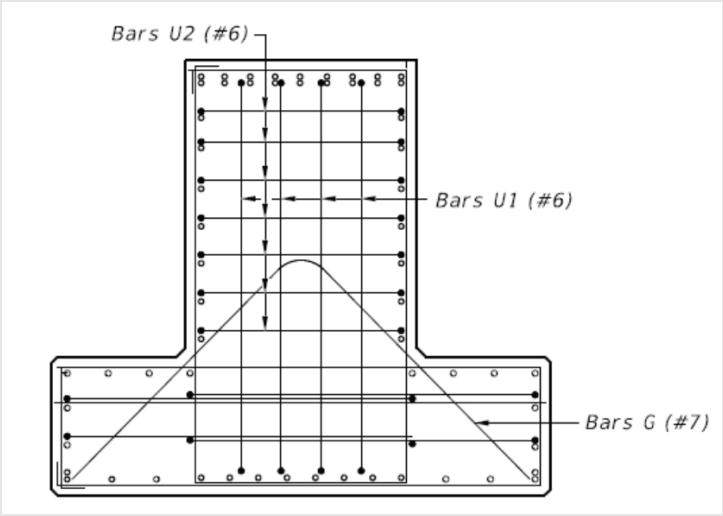
Figure 4-5: Flared Reinforcing

- **Project 0-6905**
  - *Investigation of Performance of Skewed Reinforcing in Inverted-T Bridge Caps*
  - https://library.ctr.utexas.edu/hostedpdfs/uh/0-6905-R1.pdf

Chapter 4: Substructure Updates

- Section 5: Inverted Tee Reinforced Concrete Caps
  - End of cap reinforcing modified based on research.
  - More details in Bridge Detailing Guide





Chapter 5: Other Design Guidance Updates

- Section 1: Bridge Widening Guidance
  - General Recommendations
  - Superstructure Recommendations
  - Substructure Recommendations

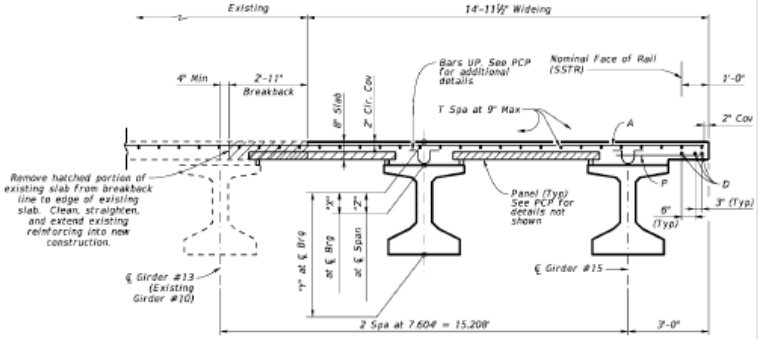


Figure 5-8: Pretensioned Concrete TxGirder Widening with Pretensioned Concrete TxGirder Example

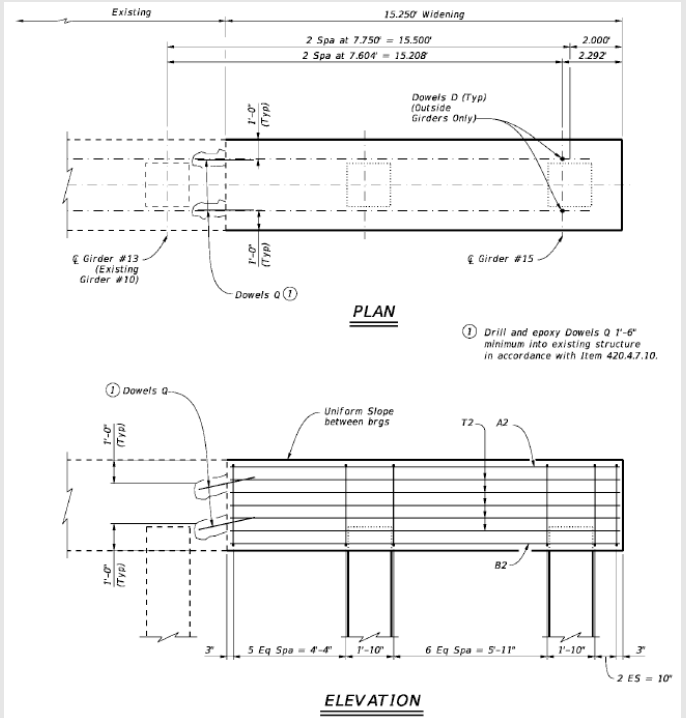
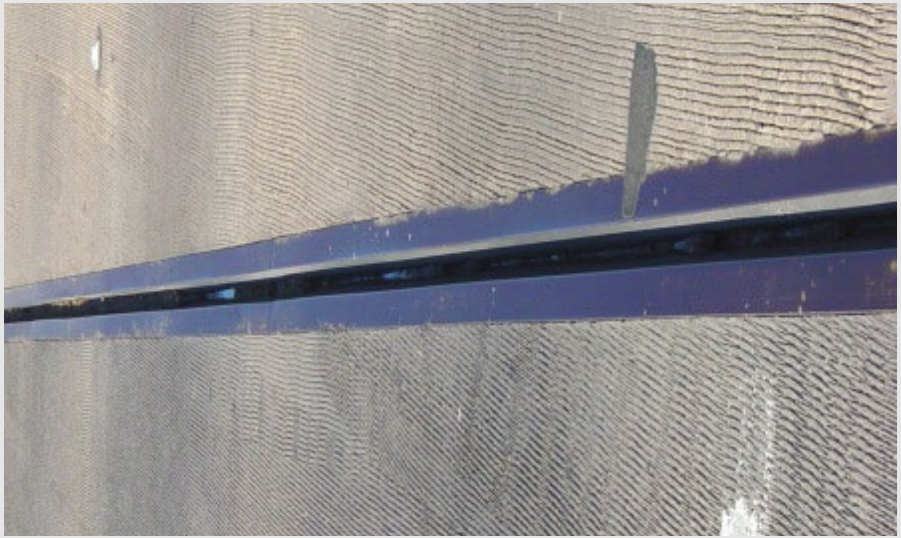


Figure 5-9: Bent Widening Example

Chapter 5: Other Design Guidance Updates

- *New* Section 5: Expansion Joints
  - Originally issued as an attachment to Standard Memo for New and Revised Miscellaneous Bridge Standard Drawings (April 1, 2019)
  - Includes:
    - Geometric constraints
    - Design criteria
      - Thermal expansion
      - Available joints
    - Detailing



Chapter 6: Frequently Asked Questions Updates

- Development length in overhangs.
- Shear in overhangs.
- Longitudinal reinforcing.
- Appendix B Shear vs. <5.7.3.4.2> Shear.

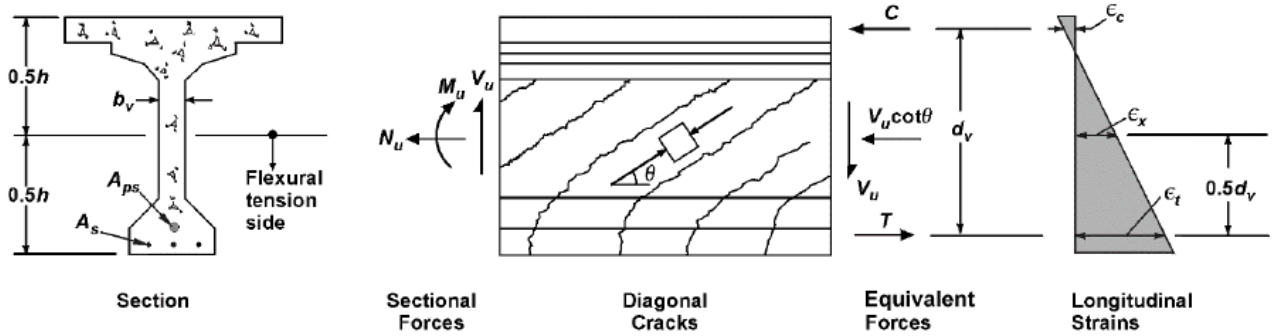


Figure B5.2-1—Illustration of Shear Parameters for Section Containing at Least the Minimum Amount of Transverse Reinforcement, $V_p = 0$

Source: AASHTO LRFD Bridge Design Specification

Questions?

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