



# Railroad Requirements

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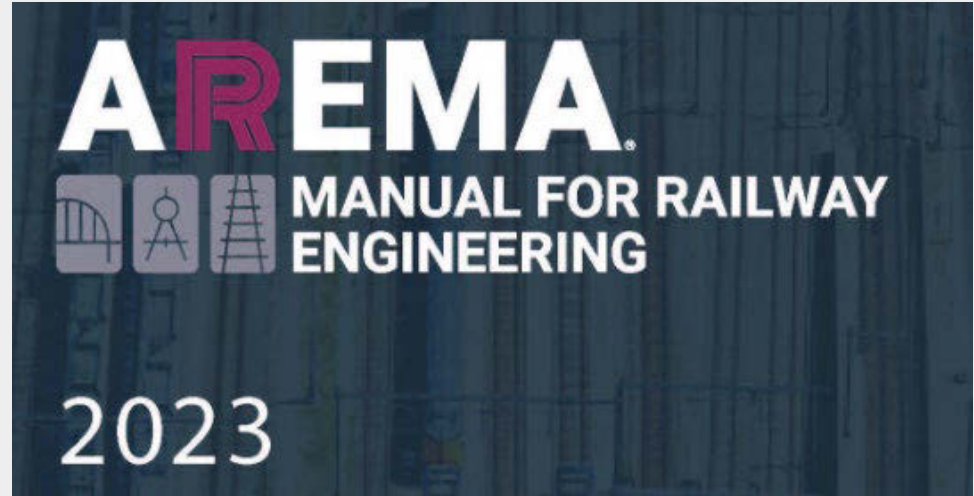
January 25, 2024



- TxDOT Project Development Resources
- AREMA Manual for Railway Engineering
- Rail Company Specific Guidelines
  
- Two types of railroad bridges
  - Overpasses (Overhead Structures)
    - Highway bridges
  - Underpasses
    - Railway bridges



- AREMA = American Railway Engineering and Maintenance-of-Way Association
  - [AREMA Home](#)
- Manual for Railway Engineering
  - Current Edition: 2023
  - Released: Each April - Annual Publication
  - Chapter 7 - Timber Structures
  - Chapter 8 - Concrete Structures and Foundations
  - Chapter 15 - Steel Structures
  - Chapter 28 - Clearances





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## Railroad - highway crossing information

- [Rail-Highway Operations Manual](#)
- [Railroad Design Guidelines](#)
- [Construction and Maintenance Agreements](#)
- [Plans, Specifications and Estimates Requirements on Projects with Railroads](#)
- [Sample Right-of-Entry Agreements](#)
- [Railroad Crossing Information Management](#)



- Rail Division and Bridge Division collaboratively
- Rail Division:
  - [Railroad Design Guidelines \(txdot.gov\)](#)
- District Rail Coordinators Essential

The screenshot shows the TxDOT website page for "Railroad design guidelines". The page header includes the TxDOT logo and navigation links: "Discover Texas", "Data and maps", "Do business", "Explore projects", "Stay safe", and "About". The breadcrumb trail is "Home / Business / Project development resources / Railroad - highway crossing information". The main heading is "Railroad design guidelines". Below the heading, there is a paragraph stating: "TxDOT routinely enters into construction and maintenance agreements with railroad companies. Below are railroad design and construction guidelines, including noted exceptions from TxDOT." Another paragraph follows: "It is recommended that contractors verify with individual railroad companies that these guidelines are the most current for the proposed work." The page is organized into sections: "BNSF Railway – Union Pacific Railroad" and "Kansas City Southern Railway". Each section contains a list of links to specific guidelines. The "BNSF Railway – Union Pacific Railroad" section lists: "2016 Railroad Grade Separation Project Guidelines", "2007 Railroad Grade Separation Project Guidelines (Annotated by TxDOT)", "TxDOT Comments to Appendix/Drawings", "Temporary Shoring Guidelines", "BNSF Preparation of Demolition Plans for Structures Over Railroads Guidelines", "Union Pacific Railroad Demolition Guidelines", "Union Pacific Railroad Technical Resources for Public Projects (Track Work and Shoefly)", "Union Pacific Industrial Track Specifications", and "Union Pacific Utility Installations". The "Kansas City Southern Railway" section lists: "Design and Construction of Railroad Overpasses and Underpasses Guidelines". The "Other design references" section lists: "FHWA Grade Crossing Handbook", "Texas Manual on Uniform Traffic Control Devices", "Traffic Operations Division Standard Sheets", "TxDOT Railroad Crossing Design Guidelines", and "American Railway Engineering and Maintenance-of-Way Association".

Home / Business / Project development resources / Railroad - highway crossing information

## Railroad design guidelines

TxDOT routinely enters into construction and maintenance agreements with railroad companies. Below are railroad design and construction guidelines, including noted exceptions from TxDOT.

It is recommended that contractors verify with individual railroad companies that these guidelines are the most current for the proposed work.

### BNSF Railway – Union Pacific Railroad

- [2016 Railroad Grade Separation Project Guidelines](#)
- [2007 Railroad Grade Separation Project Guidelines \(Annotated by TxDOT\)](#)
- [TxDOT Comments to Appendix/Drawings](#)
- [Temporary Shoring Guidelines](#)
- [BNSF Preparation of Demolition Plans for Structures Over Railroads Guidelines](#)
- [Union Pacific Railroad Demolition Guidelines](#)
- [Union Pacific Railroad Technical Resources for Public Projects \(Track Work and Shoefly\)](#)
- [Union Pacific Industrial Track Specifications](#)
- [Union Pacific Utility Installations](#)

### Kansas City Southern Railway

- [Design and Construction of Railroad Overpasses and Underpasses Guidelines](#)

### Other design references

- [FHWA Grade Crossing Handbook](#)
- [Texas Manual on Uniform Traffic Control Devices](#)
- [Traffic Operations Division Standard Sheets](#)
- [TxDOT Railroad Crossing Design Guidelines](#)
- [American Railway Engineering and Maintenance-of-Way Association](#)



- Bridge Project Development Manual (2023)
  - [Bridge Project Development Manual \(BPD\) \(txdot.gov\)](https://www.txdot.gov/bridge/development-manual/)
  - Chapter 2 Section 5 – Railroad Grade Separation (RGS) Program
  - Chapter 3 Section 3 – Agreements -> “Railroad”
  - Chapter 4 Bridge Plan Review Processes
    - Section 1 Preliminary Bridge Layout Review  
Railroad Overpasses/Underpasses  
Submit PBLR to BRG, Railroad Exhibit A to Rail Division
    - Section 2 Bridge PS&E Review
  - Tables for Plan Development Timeline
    - Overpasses Can be Long Depending on Case
    - Underpasses Much Longer

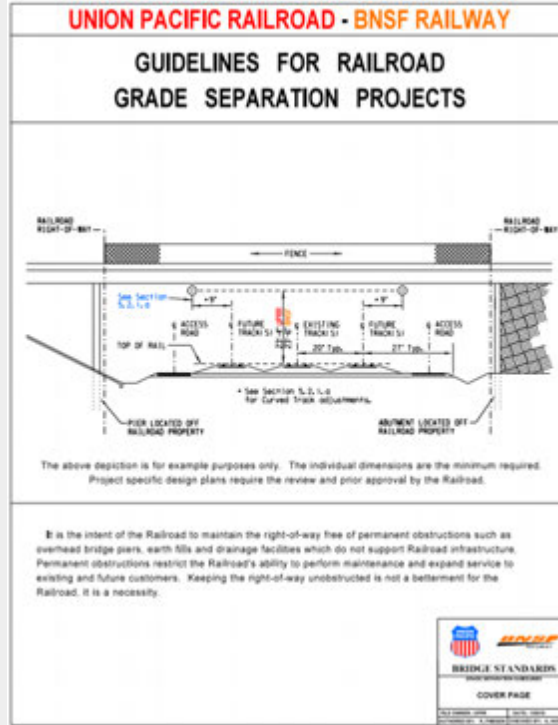


- Exhibit A Design
  - Guidelines on projects with Overpasses
  - Guidelines on projects with Underpasses
- PS&E Design
  - Match Exhibit A
  - Railroad Scope of Work Sheet
  - Railroad Requirements Sheets

# Company Specific Guidelines



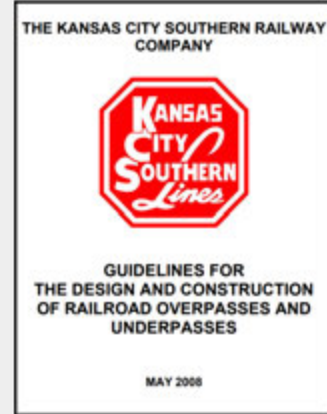
- UPRR BNSF Joint Guidelines (2016)
- KCS RR Guidelines
  - KCS acquisition by Canadian Pacific Railway (CPKC)
  - Guidelines go beyond AREMA and have very specific requirements
  - Deviations can be onerous



## Guidelines for Design and Construction of Industry Tracks

August 1, 2017

KANSAS CITY SOUTHERN







- Guidelines for Temporary Shoring
  - [bnsf-up-shoring-guide.pdf](#)
  - Updated 12/7/2021
  - Requirements beyond what is in AREMA
  - Highly recommend a pre-approved temporary shoring design for areas under live load influence in project plans prior to letting
  - Temporary shoring (vertical) ideally is limited in height and may require substantive types
    - Sheet piles
    - Soldier piles/lagging
    - Tie backs
    - All above may not be applicable due to location and height limits and drilled shaft wall is the only option





## ■ UP: Project Specifications

Home > Customers > Industrial Development > Operations

## Union Pacific Engineering Project Specifications

- > Technical Specifications for Industrial Tracks
- > Track Design Guidelines for Third Party Public Projects
- > White Paper - Coordinating with Union Pacific in Alt. Delivery Projects
- > Guidelines for Temporary Shoring 
- > Joint BNSF Railway and UPRR Guidelines for Railroad Grade Separation Projects 



## ■ UP: Public Projects

### Track Design Guidelines for Third Party Public Projects

These documents are provided by Union Pacific to assist 3rd party public projects in the design of track construction plans in accordance with Union Pacific design standards and requirements. Excludes rail customer projects except when the 3rd party public project results in modification to a rail customer/industry track. For guidelines pertaining to the design of a new industry connection, please click [Here](#).

Documents hosted on this page will be revised periodically. It is the responsibility of the User to update his/her copy with the most current information.

If you have questions concerning these guidelines and standards or if you would like to acquire a full set of standard drawings, please contact the appropriate [Manager-Industry and Public Projects](#).

#### Plan Preparation Documents

> [Public Project Guidelines](#) 📄

> [Shoofly Schematic Example](#)

> [Public Project Checklist](#) 📄  
02/23/2022

> [Public Project Geotech Requirements](#) 📄

> [Public Project Quantity Summary](#)

> [UPRR CAD Configuration Files](#)  
12/18/2023

#### Shop Drawing/ Material Verification

> [Shop Drawing/ Material Verification Instructions](#)

> [Shop Drawing Submittal Tracking Sheet](#)

#### Track Standard Drawings

> [UPRR Engineering - Track Standards](#)



## ■ Engineering - Track Standards (up.com)

### Technical Specifications for Design and Construction of Track and Other Rail Related Infrastructure

**i** These conditions, specifications and guidelines are provided by Union Pacific to assist in the design and construction of track and other rail related infrastructure. This information will be revised periodically. It is the responsibility of the user to obtain the most current information. Union Pacific makes no representations or warranties as to the validity, accuracy, legal compliance or completeness of this information and any reliance by user on this information is at the risk of the user.

Search Track Standards:

- ▶ What's New - Standards Revision
- ▶ Ballast, Roadbed Sections and Geometry
- ▶ Concrete, Wood and Steel Ties and Panels
- ▶ Frogs and Frog Components
- ▶ Guard Rails
- ▶ Joint Bars, Transition Rails, Bolts & Accessories
- ▶ Misc. and Crossing Diamonds
- ▶ Rail Sections
- ▶ Road Crossings
- ▶ Roadway Signs and Track Marking
- ▶ Switches and Switch Components
- ▶ Tie Plates, Fasteners and Accessories
- ▶ Turnouts and Turnout Components

[All Standard Files \(.zip format\)](#)  
[Track Maintenance Field Handbook](#)

▶ External Design Documents (For Third Party Work)

# Railroad Bridge Types: Overpasses



- AASHTO LRFD 9<sup>th</sup> Edition Specifications
- TxDOT Design Policy
  - Bridge Design Manual
  - Bridge Detailing Manual
- AREMA Specifications && RR Guidelines
  - Vertical Clearance
    - 23'-0" (Industry Requirement Higher)
    - Existing Vertical Clearance Must Be Maintained When Widening Structures
  - Horizontal Clearance
    - Crash Walls
  - Minimum Temporary Construction Clearances
- Railroad Required Protective Fencing





- Ideally Use TxGirders (cost effective and familiar)
  - RR ROW usually 100 ft or more
  - Likely looking at Tx46/Tx54 and above to span RR ROW
  - Skews will be more challenging
- Steel Plate Girders or Spliced Concrete Girders for Longer Spans
- Long Approaches / Increased Grades Result From 23'-4" Min Vertical Clearance
- No Deck Drains, Utility, Joints inside RR ROW

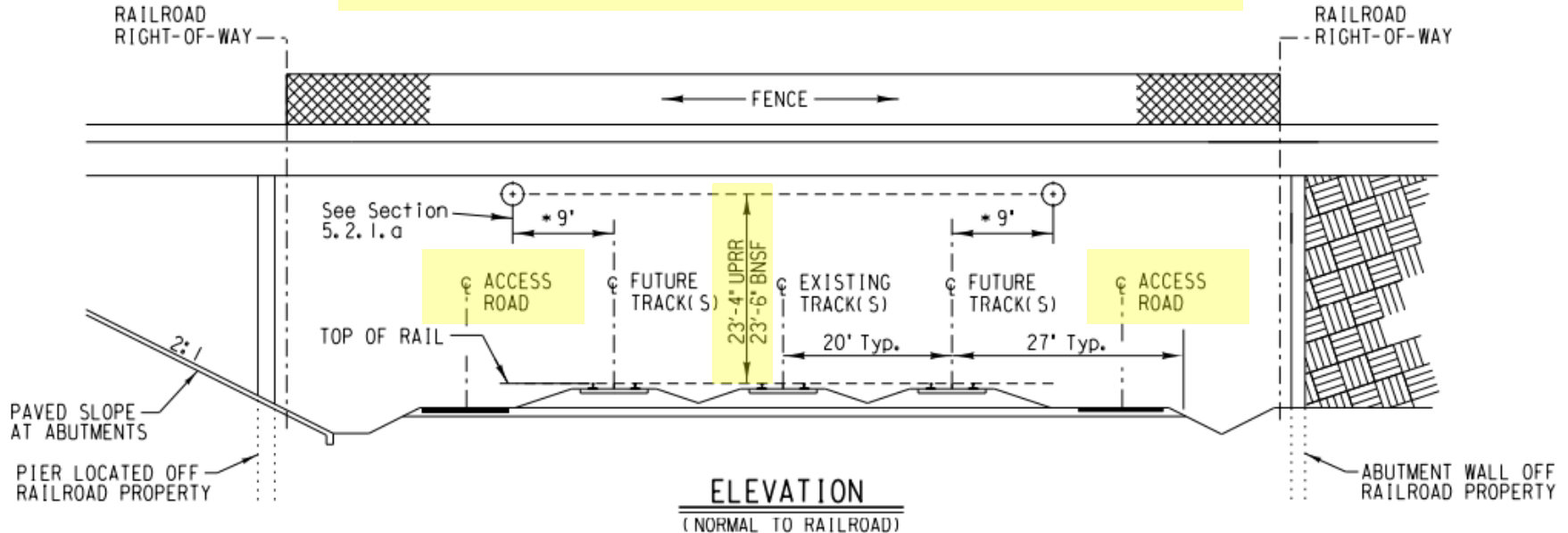




# UPRR-BNSF Grade Separation Guidelines - Overpasses



Overhead bridges shall be designed to completely span the Railroad Right-Of-Way.  
Piers shall be located outside Railroad Right-of-Way.





## CONSTRUCTION NOTES:

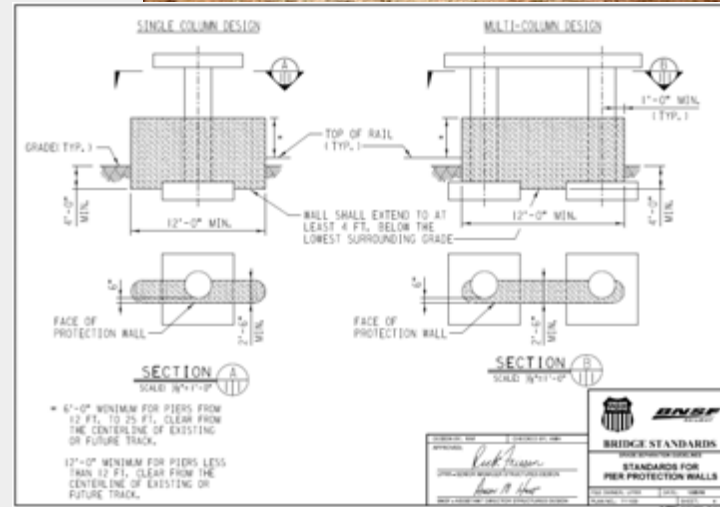
1. Any shoring system that impact the Railroad operations and/or supports Railroad embankment shall be designed and constructed per the Railroad temporary Shoring requirements.
2. All demolition within the Railroad right-of-way and/or demolition that may impact the Railroad tracks or operations shall comply with the Railroad demolition requirements.
3. Erection over the Railroad right-of-way shall be designed to cause no interruption to all Railroad operations.
4. The elevation of the existing top-of-rail profile shall be verified before beginning construction. All discrepancies shall be brought to the attention of the Railroad prior to construction.
5. The proposed grade separation project shall not change the quantity and/or characteristics of the flow in the Railroad ditches and/or drainage structures.
6. The contractor must submit a proposed method of erosion and sediment control and have the method approved by the Railroad prior to beginning any grading on the project site.
7. For Railroad coordination please refer to the Railroad's Coordination Requirements as part of the Specifications or Special Provisions of the project.
8. Temporary Construction Clearances, including falsework clearances, shall comply with Figure 1.
9. All permanent clearances shall be verified before project closeout.



# Railroad Crashwalls (Overpasses)



- Horizontal Clearance > 25 ft
  - No Crash Wall Required
- $25 \text{ ft} \geq \text{Horizontal Clearance} \geq 12 \text{ ft}$ 
  - 6 ft Crash Wall
- $12 \text{ ft} > \text{Horizontal Clearance} > 9 \text{ ft}$ 
  - 12 ft Crash Wall
- Not interference with drainage



# Fencing for Railroad Overpasses



- Protect Railroad Personnel Below from Falling Debris
- Height Above Bridge Deck
  - 8'-0" Curved Top\* (working drawing coming)
  - 10'-0" Straight Top
  - TxDOT CLF-RO (8 ft Above Rail Straight)
- Attaches to Bridge Rail
- Greater of Limits of RR ROW or 25'-0" beyond CL Track
- Chain Link Fencing
  - May Be Color Vinyl Coated after Galvanizing

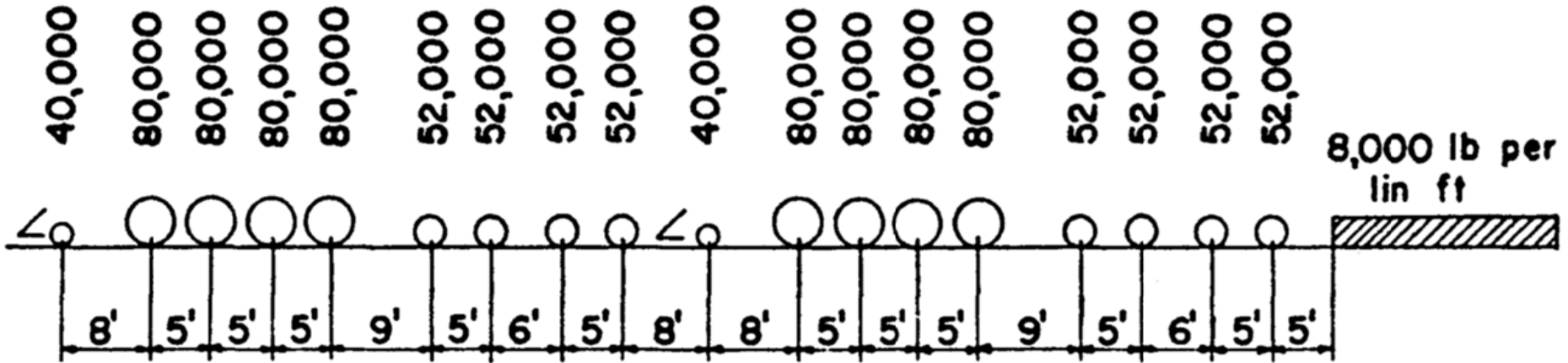


# Railroad Underpasses





- Heavy Live Load
- Substantive Braking/Traction Loads
- Fatigue/Deflection are Important Limit States
- Many provisions are ASD or LFD...LRFD limited





- Simple Spans with ballast deck allowed only
- 15 deg max skew for concrete superstructure, 30 deg max skew for steel superstructure
- Live Load Distribution
  - Use worse case track location for number of beams per track
  - Maximum track spacing 13'
- Seismic Design
  - AREMA, Ch. 9







## 6.9.1 Acceptable Superstructure Types

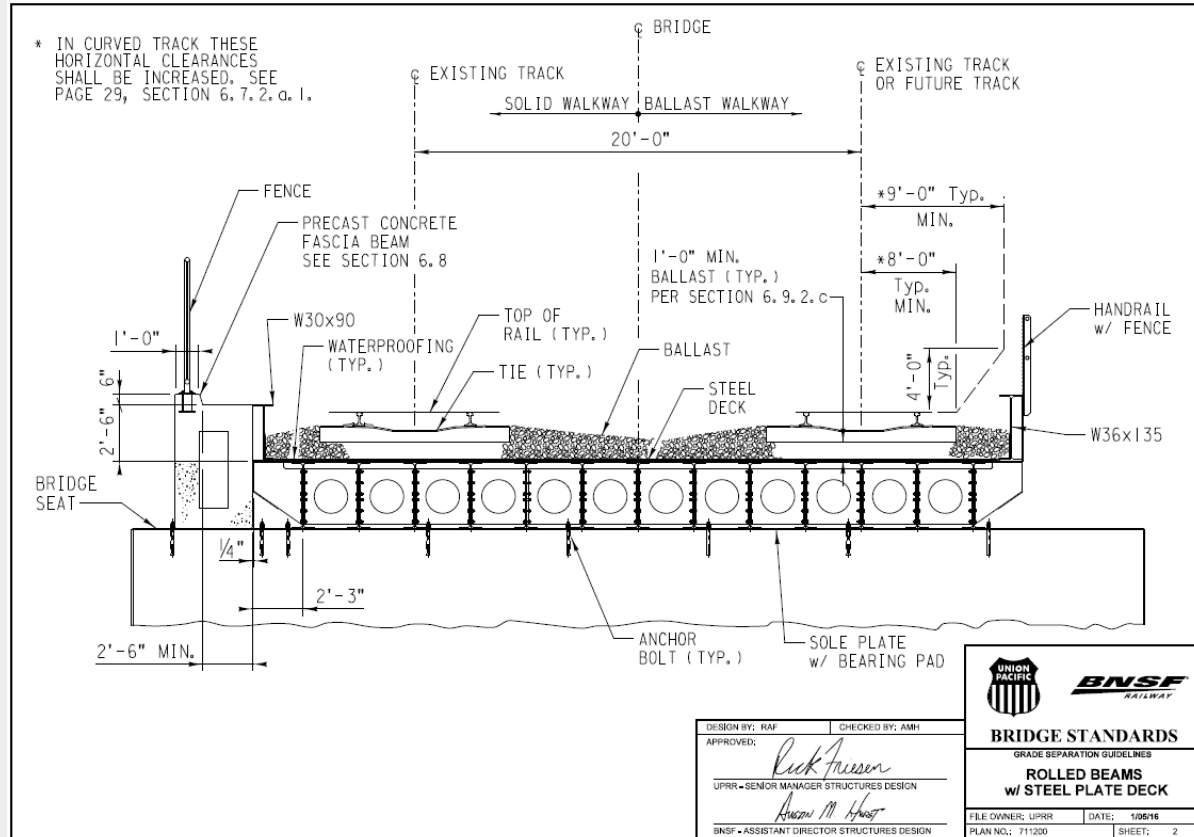
- a. The following is a list of Underpass Structure types that are acceptable to the Railroad and listed in the order of preference. The Railroad's preferred superstructure type is the highest listed feasible alternative unless a detailed type selection report provides justifications that a lower listed alternative is more beneficial to the Railroad and to the project.
  1. Rolled Beams with Steel Plate Deck. There shall be at least five beams per track.
  2. Steel Plate Girders with Steel Plate Deck. There shall be at least four girders per track.
  3. Rolled Beams with Concrete Deck. There shall be at least five beams per track.
  4. Steel Plate Girders with Concrete Deck. There shall be at least four girders per track.
  5. Railroad Standard Prestressed Precast Concrete Double Cell Box Beams.
  6. Prestressed Precast Concrete Box Beams, single or double cell for span of 50 feet or less.
  7. Prestressed Precast Concrete AASHTO Type Beams, (or similar) with Concrete Deck for spans of 100 feet or less.
  8. Steel Through Plate Girders with Steel Plate Deck will be considered by the Railroad when conditions preclude any other structure type.
- b. Underpass Structures of deck truss or through truss design are discouraged. However, in unusual circumstances, they will be considered by the Railroad if conditions preclude the use of any other type of structure.
- c. Where possible, use of Railroad standard spans are encouraged.

*Source: UPRR/BNSF Guidelines for Railroad Grade Separation Projects*

# Railroad Bridge Types: Underpasses



- TxDOT Design Guidance
  - Sacrificial Beams not preferred
- Access Roads and Access Structures add complexities
- Expect Long/Arduous Development/Coordination



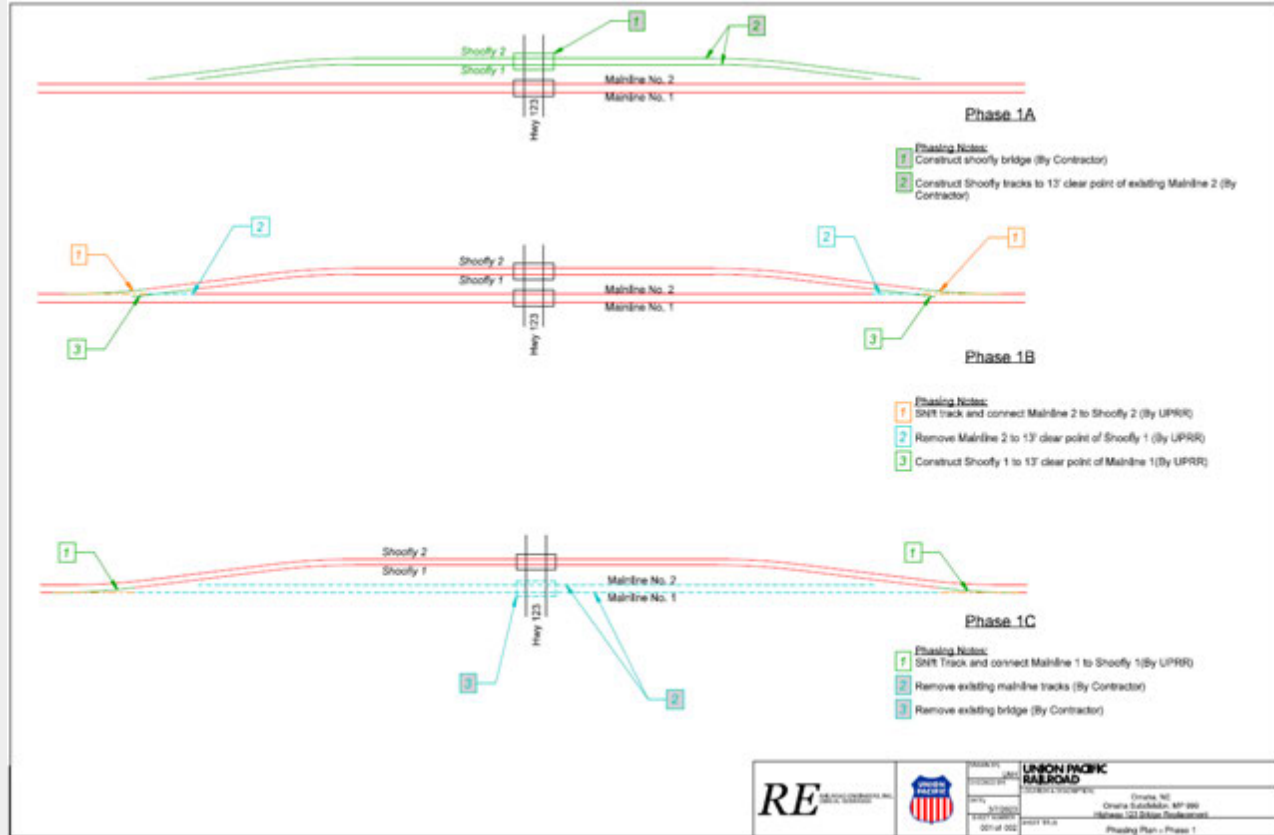




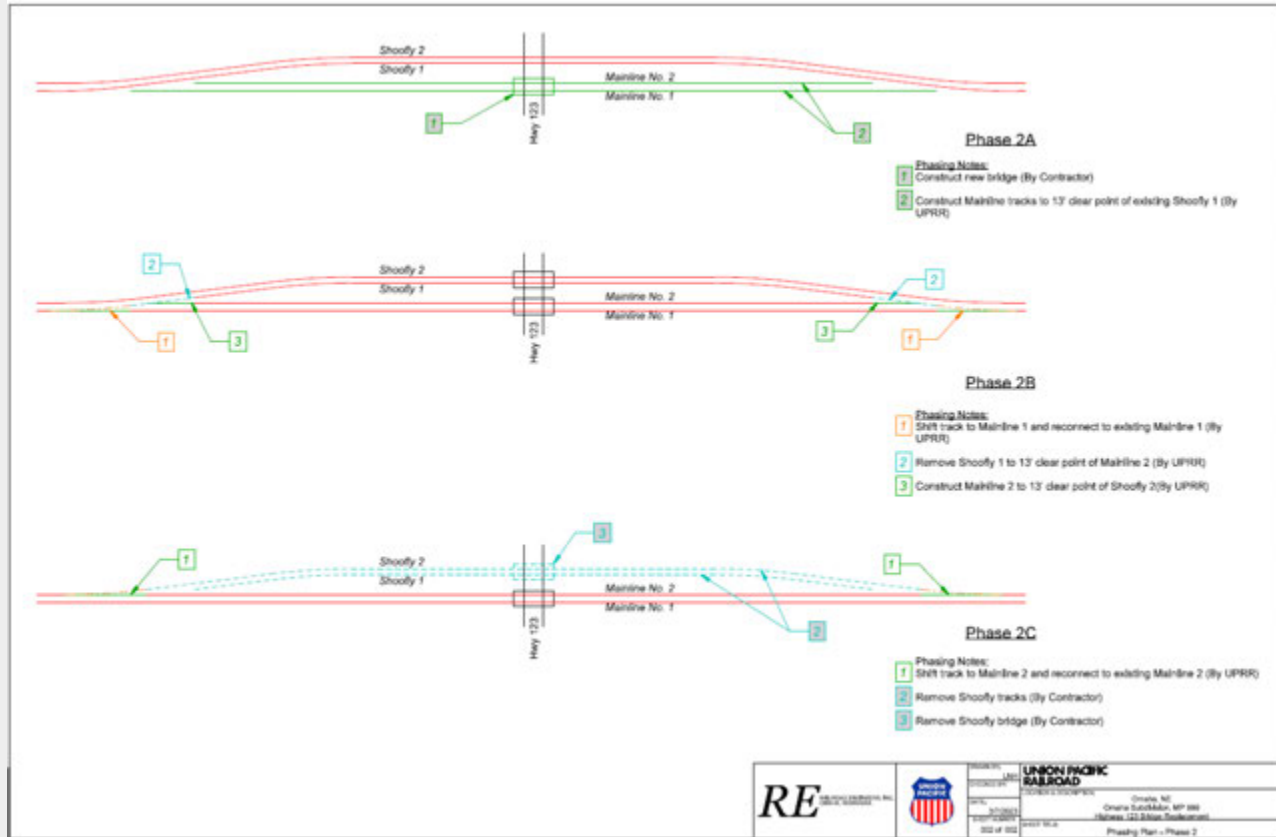
# Example Shoofly Schematic



- UPRR Public Project Website
  - [pdf\\_up\\_shoofly\\_schematic.pdf](#)

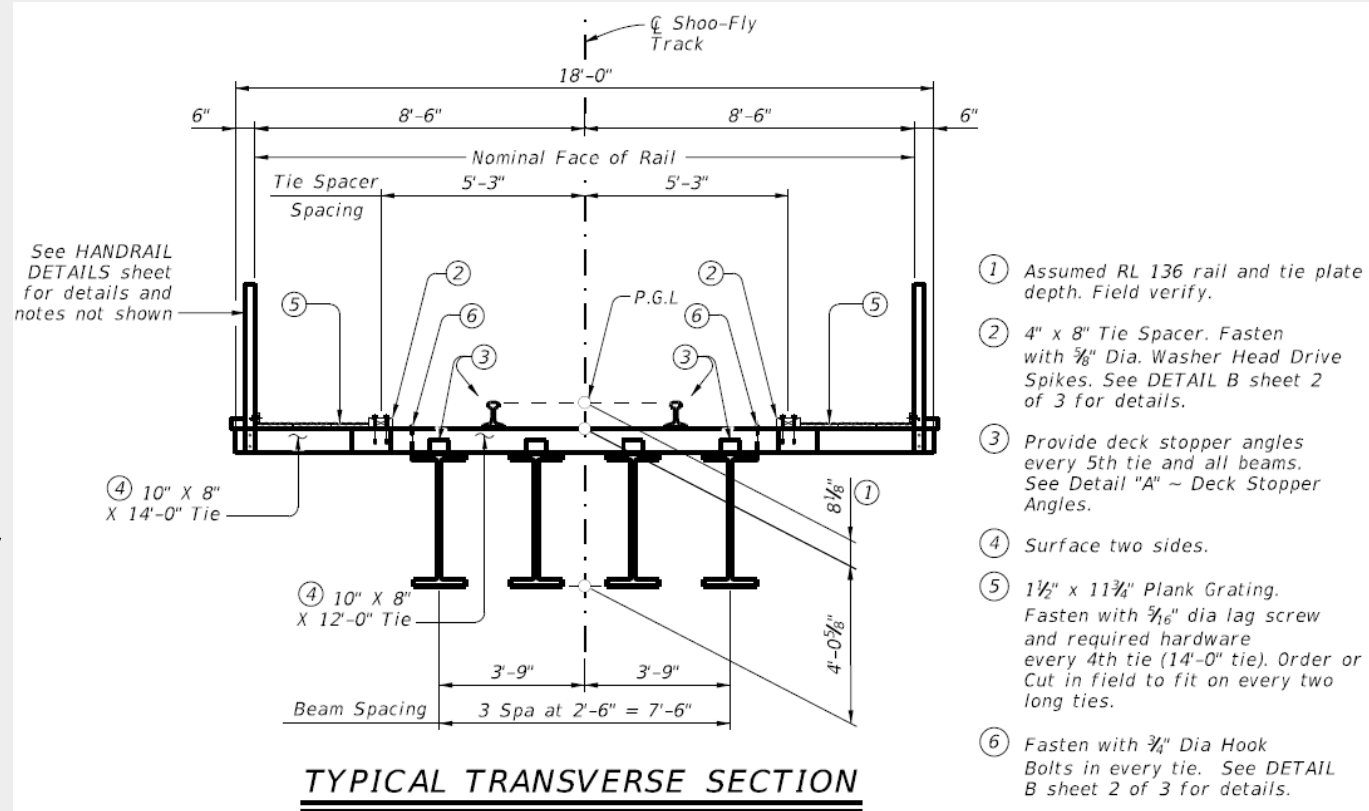


# Example Shoofly Schematic





- Open Deck Design with Steel Girders
  - Can save depth
  - 4'-0" section height for 52 ft span
  - Not preferred by railroad, recently



# Shorter Span Bridges (Approach Spans, Shooflys)

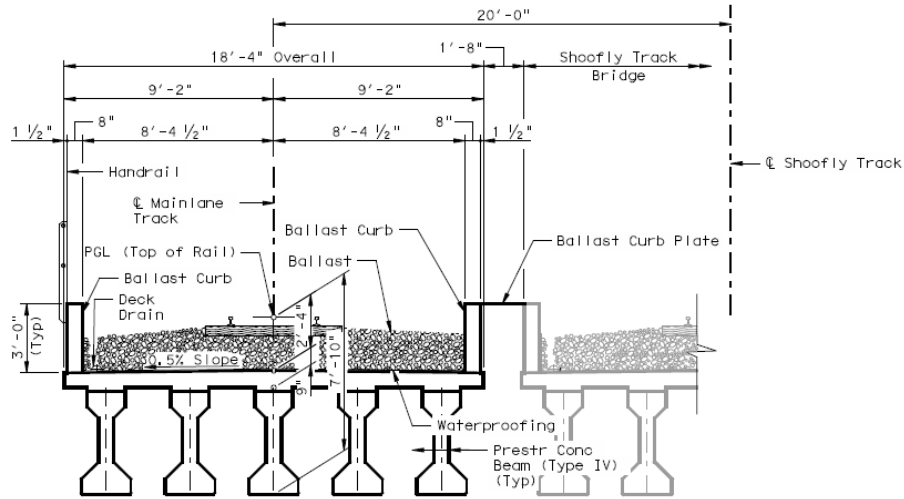


- Prestressed I-Girder Bridges
  - AASHTO Type IV beams, limited to approximately 55 ft
- Steel Girders
  - Rolled shapes up to about 70 ft
  - Plate Girders beyond 70 ft to 150 ft
- RR Minimum Vertical Clearance, TxDOT freight corridors require 18'-6"

16'-6" for steel superstructure with 5 or more beams or 4 or more deck plate girders per track.  
17'-6" for concrete superstructure or steel through plate girders with bolted bottom flanges.

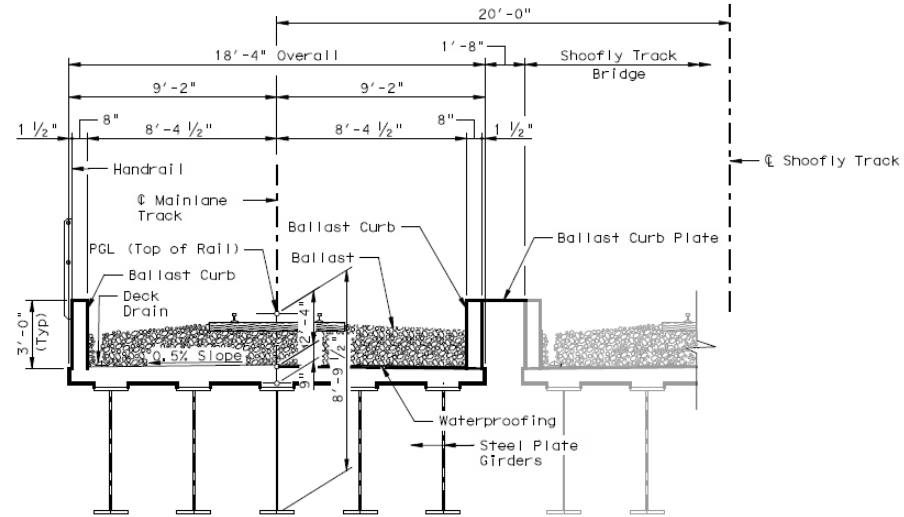


# Deck Girder Bridge – Example Cross-Sections



## TYPICAL SECTION

(SPANS 1, 2 & 5-7)



## TYPICAL SECTION

(SPANS 3 & 4)



- Abutments
  - Large with closely spaced supports (usually shafts)
  - More rarely CIP cantilever wall abutment
    - Not recommended
    - Footing footprint
    - Tall shoring
  - If no header bank, integrated into cut retaining wall
- Drilled Shaft Retaining Walls
  - No Soil Nails
- Minimum two pier columns with at least  $0.2H$  thick, solid pier walls preferred at least 4' thick
- Provide CSL and TIP testing for each drill shafts, use casing for track surcharge





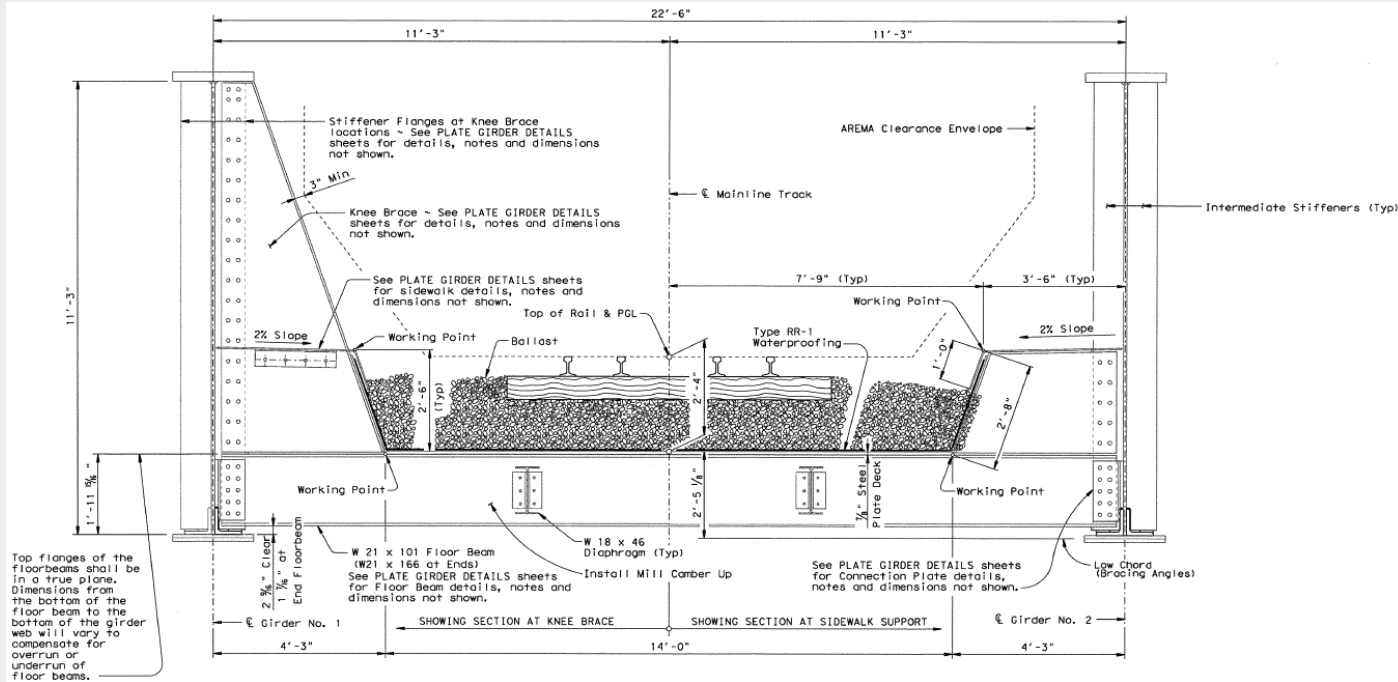
# Through Girder Underpass



- Max Spans 155 feet
- 4'-9" to 5'-2" Approximate Superstructure Depth
- Railroad Desired Vertical Clearance 17'-6" for TPG
- Bolted Built-Up Bottom Flange Required With Less Than 20'-0" Vertical Clearance
- Fracture Critical Design
- High Unit Cost



# Through Girder Cross-Section







- Bearings
  - Elastomeric for Prestressed Beams
  - Elastomeric / Steel Rocker for Steel Beams
  - Steel Masonry Plate for Shoo-Fly Bridges
  - Elastomeric bearings are not acceptable to UPRR recently
- Waterproofing
  - Spray applied waterproofing to bridge deck
  - Deck drainage
- Ballast, Track and Ties
  - Design for 30” Ballast, 13’-0” Min Ballast Pan Width
  - Design Tie 8’-6” Width for Lateral Load Distribution
  - Design Rail is 6” in Height



# Challenges of Getting Specific Cases Approved



- Roll-in Concept
- Open Deck, Except for Temporary Bridges (even that is now an effort)
- Greater Than 30 Degree Skew
- Any Skewed Thru Girder
- Deep Prestressed Box Beams
- Concrete Thru Trough
- Cast-in-Place Box Culverts
- Trusses Considered Only in Very Unusual Cases for Spans Greater Than 160 feet



# Pipes and Culverts Under Railroads



- Railroad Operations Dictate Type and Installation
- Culverts Must Be Designed for AREMA Live Load
  - TxDOT standards do not support!
- Reinforced Concrete Pipe
  - Likely Class V Pipe
  - Requires custom design
- Steel Pipe Preferred by Some





- Use TxDOT Project Development Resources
- Follow Closely Railroad Company Guidelines
- Be Prepared for Railroad Submittal Review Time, Comments and Changes





POC  
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Thank you for your attention!