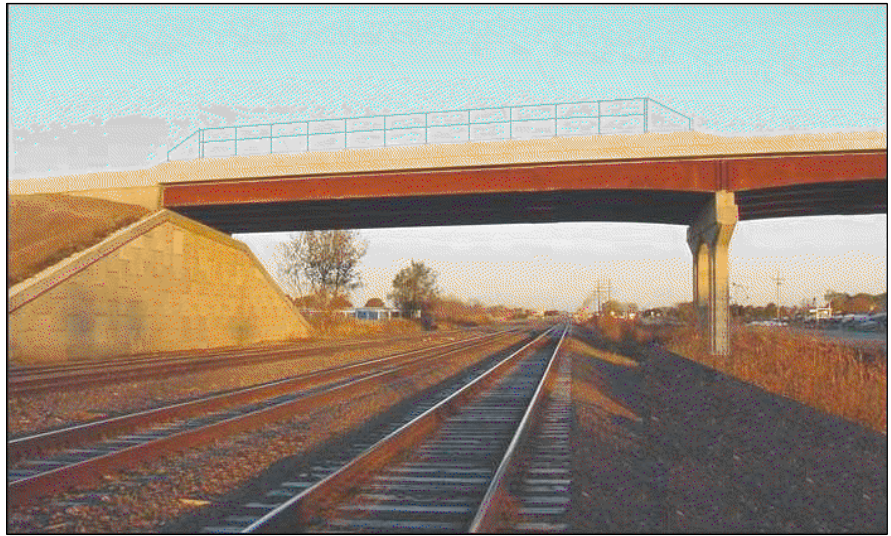




# BNSF RAILWAY - UNION PACIFIC RAILROAD

## GUIDELINES FOR RAILROAD GRADE SEPARATION PROJECTS



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<b>BRIDGE STANDARDS</b> <small>GRADE SEPARATION PROJECT GUIDELINES</small>	
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# 1. INTRODUCTION

## 1.1 Purpose

The purpose of these Guidelines is to inform Applicants, Contractors and other parties concerned with Railroad policies, requirements and standards for the design and construction of Grade Separation Projects. Compliance with these Guidelines is required to achieve uniformity in the preparation of construction documents for Grade Separation Projects and to expedite the review and approval by the Railroad of design and construction submittals.

The purpose of review by the Railroad is solely to insure compliance with the minimum standards of the Railroad dealing with particular areas of concern to rail transportation and not to warrant the general safety of the structure.

## 1.2 Definitions

### **Access Road:**

A road used and controlled by the Railroad for maintenance, inspection and repair.

### **Applicant:**

Any party proposing a grade separation project on Railroad right-of-way or other Railroad operating location, regardless of track being active or out of service.

### **AREMA:**

The current edition of the American Railway Engineering and Maintenance-of-Way Association Manual for Railway Engineering.

### **AASHTO:**

The current edition of the American Association of State Highway and Transportation Officials Standard Specifications for Highway Bridges.

### **C & M Agreement:**

A Construction and Maintenance Agreement that has been negotiated between the Railroad and the Applicant that addresses all the duties and responsibilities of each party regarding the construction of the proposed grade separation and the maintenance requirements after construction of the said structure.

### **Construction Documents:**

Refers to design plans and calculations, project and/or standard specifications, geotechnical report and drainage report.

### **Contractor:**

The individual, partnership, corporation or joint venture and all principals and representatives (including Applicant's subcontractors) with whom the contract is made by the Applicant for the construction of the Grade Separation Project.

### **Crossover:**

A track connection between two adjacent tracks.

### **Construction Window:**

A timeframe in which construction or maintenance can be performed by the Contractor with the required presence of a Flagman.

### **Multiple Main Tracks:**

Two or more parallel or adjacent main tracks.

### **Engineer-of-Record:**

The Professional Engineer that develops the criteria and concept for the project and is responsible for the preparation of the Plans and Specifications. The Engineer-of-Record shall be registered in the state of the project location. The Engineer-of-Record may be the Applicant's in-house staff or a consultant retained by the Applicant. The Contractor shall not employ the Engineer-of-Record as the Contractor's Engineer-of-Record or as a Specialty Engineer, with the exception of design build projects.

**Flagman:**

A qualified employee of the Railroad providing protection from Railroad operations per Railroad requirements.

**Guidelines:**

Refers to the information contained in this document or referenced in AREMA or AASHTO.

**Grade Separation Project:**

A project that includes an Overhead or Underpass Structure that crosses the Railroad right-of-way or other Railroad operating location regardless of track status being active or out of service.

**Main Track:**

A track extending through yards and between stations that must not be occupied without proper authority.

**Overhead Structure:**

A Roadway and Trail or pedestrian Structure over the Railroad right-of-way.

**Railroad Local Representative:**

The individual designated by the Railroad as the primary point of contact for the project.

**Railroad:**

Refers to the BNSF and/or Union Pacific Railroad.

**Railroad Right-of-Entry Agreement:**

An agreement between the Railroad and an Applicant or a Contractor allowing access to Railroad property.

**Siding:**

A track connected to the main track and used for meeting, storing or passing trains.

**Single Track:**

A main track where trains operate in both directions.

**Timetable:**

A Railroad publication with instructions on train, engine or equipment movement. It also contains other essential Railroad information.

**Trail:**

A pathway impacting Railroad right-of-way or other Railroad operating locations regardless of track status being active or out of service. This includes pedestrian, bicycle, approved motorized recreational equipment and equestrian uses.

**Underpass Structure:**

A Railroad Structure over a Roadway and/or Trail.

**Yard:**

A system of tracks, other than main tracks and sidings, used for making up trains, storing cars and other purposes.

**Yard Limits:**

A portion of main track designated by "yard limit" signs and included in the timetable special instructions or a track bulletin.

1.3 Guidelines and References

These Guidelines are provided for reference only and are subject to revision without notice. These Guidelines cannot be taken as authority to construct. Railroad approval of construction documents, execution of a C & M Agreement and Railroad Right-of-Entry Agreement (if applicable) are required prior to beginning construction.

These Guidelines supplement the current (AREMA) Manual for Railway Engineering, AASHTO and State Railroad Regulatory Body requirements. Where these Guidelines and the documents referenced in the preceding sentence differ, these Guidelines will govern.



The AREMA Manual is available from:  
American Railway Engineering and Maintenance-of-Way Association  
10003 Derekwood Lane Suite 210  
Lanham, MD 20706 – 4362  
Phone: (301) 459-3200  
FAX: (301) 459-8077  
[www.arema.org](http://www.arema.org)

The specific Railroad requirements for a Grade Separation Project, as addressed in this document, shall be followed at all locations where the Railroad operates, regardless of track ownership or track status, either active or out of service.

Any items affecting Railroad property not covered in these Guidelines shall be subject to the Railroad's prior review and approval.

All new or modified Overhead Structures or Underpass Structures shall be designed in accordance with the most current policies, requirements and standards of the Railroad. These guidelines do not apply to existing structures.

## **2. AGREEMENTS**

### **2.1 Applicant and Contractor Responsibility**

The Applicant, at its expense, shall be solely responsible for all costs, design, construction, future replacement, maintenance and serviceability of the proposed Grade Separation Project, except as noted otherwise in the C & M Agreement with the Railroad. The Applicant shall develop design plans including, without limitation, all procedures necessary to construct and maintain the proposed Grade Separation Project, which cause no interruption to Railroad operations during and after construction. The Applicant must verify with the Railroad Local Representative for the latest version of these guidelines prior to developing Construction Documents.

The Applicant shall be responsible for obtaining all Federal, State, local and other permits for construction of the Grade Separation Project.

The Applicant and/or the Engineer-of-Record have the ultimate responsibility and liability for the Construction Documents and liability for damages to Railroad property during and after construction of the project.

The Contractor is responsible to comply with the construction documents prepared by the Applicant. The Contractor shall comply with Railroad requirements stated in the C & M Agreement prior to the commencement of any construction. The Contractor shall develop work plans that ensure the track(s) remain open to train traffic per Railroad requirements as stated in the C & M Agreement and meet the requirements of the Railroad Right-of-Entry Agreement (if applicable).

The Applicant is responsible for the security and safety of all people including the general public and trespassers, and the protection of Railroad infrastructure within the limits of the proposed Grade Separation Project. Any damage to Railroad property such as track, signal equipment or structure could result in a train derailment. All damages must be reported immediately to the Railroad Local Representative in charge of the project and to the Railroad Manager of Track Maintenance (MTM).

The Applicant and Contractor are required to meet all safety standards as defined by the Railroad, Federal Railroad Administration (FRA), Division of Occupational Safety and Health Administration (OSHA), Local, State and Federal Governments and the State Railroad Regulatory Body.

### **2.2 Railroad Right-of-Way**

The Railroad right-of-way accommodates existing tracks, drainage systems, multiple utilities, Access Roads and space for future track(s). The proposed Grade Separation Project shall not limit current or future Railroad operating capacity and utility accommodations within the Railroad right-of-way.

### **2.3 Railroad Right-of-Entry Agreement**

The Applicant, Contractor or their representatives must sign the Railroad's Contractor's Right-of-Entry Agreement (if applicable) and/or obtain a valid Right-of-Entry permit from the Railroad and comply with all Railroad requirements when working within the Railroad right-of-way limits. Limits of Railroad right-of-way are to be located by the Applicant and identified on the plans.

### **2.4 C & M Agreement**

Any Overhead Structure or Underpass Structure impacting the Railroad will require the Applicant to execute a C & M Agreement prior to any construction on Railroad right-of-way. The C & M Agreement cannot be signed without the Railroad's prior approval of construction documents. The C & M agreement shall include a funding source, cost

estimate, insurance and indemnification requirements, method of payment, responsibility for design, construction, ownership, maintenance and future replacement.

The Applicant shall own, maintain and replace the proposed Overhead Structure or Underpass Structure at no cost to the Railroad and with no interruption to Railroad operations during construction, maintenance and future replacement of the Structure. The Railroad shall, at its own expense, be responsible for ownership and maintenance of track components only.

The Applicant is responsible for performing the work in accordance with the terms specified in the C & M Agreement. This responsibility includes, without limitation, compliance with all Railroad requirements, Federal, State and Local Laws and applicable county or municipal ordinances and regulations.

## 2.5 Railroad Review of Submittals and Construction Observation

The Applicant will be responsible for all costs associated with the Railroad or its consultant's review of design and construction documents. Prior to any review, the Railroad Local Representative shall receive written notice from the Applicant agreeing to pay all costs associated with review of the submittals and project site observations during design and construction phases of the project. Review expenses shall include all costs for in-house personnel and/or consultants retained by the Railroad. The estimated costs shall not be the upper limit of the costs but will provide a guideline for budgeting purposes. Review cost is a function of the quality of submittals received from the Applicant. Regardless, all actual costs incurred by the Railroad or its consultant during the plan review process and construction monitoring phase of the work shall be fully recoverable from the Applicant.

## 3. SUBMITTALS

### 3.1 Railroad Review Process

All design and construction submittals shall be transmitted to the Railroad Local Representative. The submittal will then be forwarded to the Railroad's Central Engineering department. The Central Engineering department shall have the option of reviewing the project documents in-house or by using an outside consultant. If an outside consultant is used to review the design documents, the Central Engineering department representative will arrange for communication with the Applicant to resolve design issues. During the review process, the Railroad Local Representative shall be the point of contact for resolving outstanding issues.

It should be noted that the Railroad's review and approval of construction documents does not relieve the Applicant and/or Engineer-of-Record from the ultimate responsibility and liability for damages to Railroad property during and after construction of the proposed Grade Separation Project, nor does it relieve the Applicant and the Contractor from their responsibilities, obligations and/or liabilities under the C & M Agreement and the Contractor's Right-of-Entry Agreement (if applicable). Railroad's approval of construction documents will be given with the understanding that Railroad makes no representations or warranty as to the validity, accuracy, legal compliance or completeness of such documents and that any reliance by the Applicant, Engineer-of-Record or Contractor on such documents is at the risk of Applicant, Engineer-of-Record and Contractor.

### 3.2 Contractor Review

The Contractor must review all construction submittals to ensure that the materials and proposed method of construction are compatible with the existing site conditions. The Contractor's work plan must be developed to allow Railroad traffic to remain in service per Railroad requirements and C&M Agreement.

### 3.3 Applicant and/or Engineer-of-Record Review

The Applicant and/or Engineer-of-Record must review and approve each construction submittal for compliance with the construction documents, AREMA and/or AASHTO, and these Guidelines before forwarding the submittal to the Railroad for review and approval.

### 3.4 Submittal Schedule

The Applicant shall schedule submittals per [Tables 3-1](#) or [3-2](#) to ensure adequate time for review. The Applicant shall not expect a lesser time for review than that indicated in the tables nor shall the Railroad be responsible for delayed design and construction. Partial, incomplete or inadequate submittals will be rejected, thus delaying the approval. Revised submittals will follow the same procedure as the initial submittal until all issues are resolved. At the 100% submittal, prior to submission to the Railroad, all design plans and calculations, project specifications/Special Provisions, the geotechnical report and the drainage report must be signed and stamped by a registered Professional Engineer familiar with the Railroad requirements and licensed in the State where the project is located.

#### 3.4.1 Design Submittals

The Applicant or their representative shall submit all applicable design submittals as shown in [Table 3-1](#) or [3-2](#) to the Railroad for review and approval following their own internal review and approval of the submittal. Design plans shall be submitted in 11"x17" hard copy format as well as electronic .pdf format. See [Plan No. 711100, sheets 2 and 3](#) and also [Plan No. 711200, sheet 1](#) for additional information regarding items to be included in the Design Plans.

#### 3.4.2 Design Calculations

Design calculations shall be provided for all structures, except Overhead Structures, to be constructed as part of the project. Design Calculations shall be clear, readable and easy to follow. Computer program generated output or

data sheet calculations shall be accompanied by input data information and sample calculations to verify the accuracy of the computer output.

### 3.4.3 Geotechnical Report

A geotechnical report shall be provided covering all bridges and retaining walls. The preliminary geotechnical report shall include enough information to support foundation design calculations and backfill design requirements. The final geotechnical report shall have recommendations consistent with those used in the final structural design.

### 3.4.4 Drainage Report

A drainage report is required if the Grade Separation Project necessitates changes in existing drainage patterns or increases in drainage flow on Railroad right-of-way. See Section 4.5.2 and 4.5.3 for hydraulic criteria to be used.

### 3.4.5 Units

All controlling dimensions, elevations, design criteria, assumptions and material stresses shall be expressed in English units. Dual units with English units in parenthesis are acceptable for projects that require the use of Metric units per Federal, State and/or Local government requirements.

## 3.5 Construction Submittals

The Applicant or their representative shall submit all applicable construction submittals defined in Tables 3-1 or 3-2 to the Railroad for review and approval following their own internal review and approval of the submittal. The Engineer-of-Record's review comments must be submitted to the Railroad along with the construction submittal.

**Table 3-1, Overhead Structures**

Phase		Type of Submittals	Format	Railroad Review Time
Design	A	Concept (Plans and Site Pictures)	4 hard copies and .pdf	4 weeks
	B	30% (Applicant response, Design Plans, Project Specifications, Drainage Report, Shoofly Design, Construction Phasing Plans)	4 hard copies and .pdf	4 weeks
	C	100% (Applicant response, Design Plans, Project Specifications, Drainage Report, Shoofly Design, Construction Phasing Plans)	4 hard copies and .pdf	4 weeks
Construction	Shoring Falsework Demolition Erection Erosion Control Construction Phasing Plans	4 hard copies and .pdf	4 weeks	

All .pdf files shall be submitted on Compact Disc (CD) and may also be transmitted electronically via e-mail or through an internet ftp site

A. The Concept Submittal shall, at a minimum, include the following:

1. Plan, Elevation and Typical Section of proposed grade separation.
2. Photo log with pictures of the proposed project location. Site pictures shall be in all controlling directions including, but not limited to, North, East, South and West. The plan view should show a reference location and direction for each picture.

Four (4) sets of the concept submittal shall be transmitted to the Railroad Local Representative. Allow four (4) weeks for in-house review by the Railroad's Local Representative and Local Operating Unit from the time the submittal is received.

B. The 30% Submittal shall, at a minimum, include the following:

1. Applicant response to Railroad review comments on the concept submittal. The 30% submittal shall reflect concept review comments.
2. Design Plans showing a Plan View, Elevation View, Typical Section and Railroad Profile Grade Diagram. See [Plan No. 711100, sheet 2](#) for additional details. Plans to include general notes per [Plan No. 711100, sheet 3](#) and to indicate structure design criteria and construction methods.
3. Project Specifications and/or Special Provisions, including Railroad coordination requirements.
4. Drainage Report, if drainage is affected (See [Section 3.4.4](#)).
5. Shoofly Design. Bridge general plan shall show the location of the shoofly and indicate the footprint of the structure in relation to centerline of shoofly and existing track(s). See [Section 4.1.1](#).
6. Construction Phasing Plans. Construction Phasing Plans must show all required phasing, construction procedures, controlling dimensions and elevations. See [Section 4.1](#).

Note: Fiber optic cables may be presently buried on the Railroad right-of-way or such installations may be scheduled. The presence of such facilities shall be considered in the project design and appropriate measures for the installation and protection of the fiber optic cables shall be addressed in the plans and contract documents.

Four (4) sets of the 30% submittal shall be transmitted to the Railroad Local Representative. Allow four (4) weeks for in-house review by the Railroad's Central Engineering department from the time plans are received. All review comments shall be returned to the Railroad Local Representative for handling with the Applicant.

C. The 100% Submittal shall, at a minimum, include the following:

1. Applicant response to Railroad review comments on the 30% submittal. The 100% submittal shall reflect 30% review comments.
2. Design Plans showing Plan View, Elevation View, Typical Section and Railroad Profile Grade Diagram. See [Plan No. 711100, sheet 2](#) for additional details. Plans to include general notes per [Plan No. 711100, sheet 3](#) and to indicate structure design criteria and construction methods.
3. Project Specifications and/or Special Provisions, including Railroad coordination requirements.
4. Drainage Report, if drainage is affected (See [Section 3.4.4](#)).
5. Shoofly Design. Bridge general plan shall show the location of the shoofly and indicate the footprint of the structure in relation to centerline of shoofly and existing track(s). See [Section 4.1.1](#).
6. Construction Phasing Plans. Construction Phasing Plans must show all required phasing, construction procedures, controlling dimensions and elevations. See [Section 4.1](#).

Four (4) sets of the 100% submittal shall be transmitted to the Railroad Local Representative. The submittal will then be forwarded to the Railroad's Central Engineering department. Allow four (4) weeks for review. Following final review and resolution of any outstanding issues, and upon receipt of four (4) sets of final signed and stamped Construction Documents, the Railroad Local Representative will issue a letter of project acceptance.

**Table 3-2, Underpass Structures**

Phase		Type of Submittals	Format	Railroad Review Time
Design	A	<b>Concept</b> (Plans and Site Pictures)	4 hard copies and .pdf	4 weeks
	B	<b>30%</b> (Applicant response, Type Selection Report, Design Plan, Shoofly, Construction phasing)	4 hard copies and .pdf	4 weeks
	C	<b>60%</b> (Applicant response, Design Plans and Calculations, Geotechnical Report, Project Specifications and/or Special Provisions, Drainage Report and Plan, Shoofly Design, Construction phasing)	4 hard copies and .pdf	6 weeks
	D	<b>100%</b> (Applicant response, Design Plans and Calculations, Geotechnical Report, Project Specifications and/or Special Provisions, Drainage Report and Plan, Shoofly Design, Construction phasing)	4 hard copies Microstation and .pdf	4 weeks
<b>Construction</b>	Shoring Falsework Demolition Erection Erosion Control Shop Drawings Bearing shop drawings and material certifications Concrete Mix Design Structural Steel, Rebar and Strand Certifications 28 day Cylinder Test of Concrete Strength Waterproofing Material Certification Test reports for fracture critical members Foundation Construction Reports (eg.: pile driving records, caisson drilling and/or crosshole sonic log testing for drilled shafts.)		4 hard copies and .pdf	4 weeks

Microstation files shall be compatible with UPRR and BNSF. Microstation and .pdf files shall be submitted on Compact Disc (CD) and may also be transmitted electronically via e-mail or through an internet ftp site.

A. The Concept Submittal shall, at a minimum, include the following:

1. Plan, Elevation and Typical Section of proposed grade separation.
2. Photo log with pictures of the proposed project location. Site pictures shall be in all controlling directions including, but not limited to, North, East, South and West. The plan view should show a reference location and direction for each picture.

Four (4) sets of the concept submittal shall be transmitted to the Railroad Local Representative. Allow four (4) weeks for in-house review by the Railroad's Local Representative and Local Operating Unit from the time the submittal is received.

B. The 30% Submittal shall, at a minimum, include the following:

1. Applicant response to Railroad review comments on the concept submittal. The 30% submittal shall reflect concept review comments.
2. Structure Type Selection Report.

3. Design Plans showing a Plan View, Elevation View, Typical Section and Railroad Profile Grade Diagram. See [Plan No. 711200, sheet 1](#) for additional details. Plans to include general notes to indicate structure design criteria, construction methods, and material compliance specifications.
4. Shoofly Design. Bridge general plan shall show the location of the shoofly and indicate the footprint of the structure in relation to centerline of shoofly. See [Section 4.1.1](#).
5. Construction Phasing Plans. Construction Phasing Plans must show all required phasing, construction procedures, controlling dimensions and elevations. See [Section 4.1](#).

Note: Fiber optic cables may be presently buried on the Railroad right-of-way or such installations may be scheduled. The presence of such facilities shall be considered in the project design and appropriate measures for the installation and protection of the fiber optic cables shall be addressed in the plans and contract documents.

Four (4) sets of the 30% submittal shall be transmitted to the Railroad Local Representative. Allow four (4) weeks for in-house review by the Railroad's Central Engineering department from the time plans are received. All review comments shall be returned to the Railroad Local Representative for handling with the Applicant.

C. The 60% Submittal shall, at a minimum, include the following:

1. Applicant response to Railroad review comments on the 30% submittal. The 60% submittal shall reflect 30% review comments.
2. Design Plans and calculations including superstructure and substructure details, bearing details, deck and waterproofing details, miscellaneous bridge details, and a complete set of structural calculations (See [Section 3.4.2](#)).
3. Geotechnical Reports/recommendations (See [Section 3.4.3](#)).
4. Project Specifications and/or Special Provisions, including Railroad coordination requirements.
5. Drainage Report, if drainage is affected (See [Section 3.4.4](#)).
6. Shoofly Design plans and alignment data.
7. Detailed Construction Phasing Plans.

Four (4) sets of the 60% submittal shall be transmitted to the Railroad Local Representative. Allow six (6) weeks for in-house reviews by the Railroad's Central Engineering department from the time plans are received. All review comments shall be returned to the Railroad Local Representative for handling with the Applicant.

D. The 100% Submittal shall, at a minimum, include the following:

1. Applicant response to Railroad review comments on the 60% submittal.
2. Revisions to plans and calculations as dictated by review of the 60% submittal.
3. Geotechnical Reports (See [Section 3.4.3](#)).
4. Project Specifications and/or Special Provisions, including Railroad coordination requirements.
5. Drainage Report, if drainage is affected (See [Section 3.4.4](#)).
6. Shoofly Design plans and alignment data.
7. Detailed Construction Phasing Plans.

Four (4) sets of the 100% submittal shall be transmitted to the Railroad Local Representative. The submittal will then be forwarded to the Railroad's Central Engineering department. Allow four (4) weeks for review. Following final review and resolution of any outstanding issues and upon receipt of four (4) sets of final signed and stamped Construction Documents, the Railroad Local Representative will issue a letter of project acceptance.



### 3.6 As Built Submittals

The owner or their representative is required to submit As Built documents for all Underpass Structures to the Railroad at the completion of the bridge structure prior to closing the project. The following is a list of these documents:

**Table 3-3, As Built Submittals**

ITEM	As Built	SETS REQD.	NOTES	Format
1	Design Plans and Construction Documents	4	Final plans only	Microstation, .pdf and half size hard copies
2	Shop Plans			
3	Pile driving Records			.pdf and hard copies

Microstation files shall be compatible with UPRR and BNSF. Microstation and .pdf files shall be submitted on Compact Disc (CD) and may also be transmitted electronically via e-mail or through an internet ftp site.

As Built Submittals shall be transmitted to the Railroad Local Representative within eight weeks after completion of the bridge structure, who will forward them to the Railroad Central Engineering department.

## 4. GENERAL REQUIREMENTS FOR GRADE SEPARATION PROJECTS

The recommendations provided within this Section are intended for all Grade Separation Projects impacting the Railroad. All Grade Separation Projects shall be designed in accordance with the requirements in this section and the specific requirements of all applicable sections within these Guidelines.

### 4.1 Railroad Operational Requirements

It is essential that the proposed construction be performed without interference to Railroad operations. The most effective method for reducing interference to Railroad operations for construction of Grade Separation Projects is to use an Overhead Structure and avoid an Underpass Structure. The Railroad recommends the use of an Overhead Structure, which can be designed and constructed without interruption to Railroad operations. If an Underpass Structure is required, the project must temporarily reroute train traffic around the construction site by utilizing a shoofly track subject to local operating review and approval. Shoofly track(s) shall be designed per [Section 4.1.1](#).

Construction activities that impact Railroad operations must be coordinated with the Railroad. The proposed staging and phasing must be reviewed and approved by the Railroad at the concept stage and re-reviewed during development of detailed plans. Special Provisions must include Railroad coordination to improve Contractor understanding of Railroad requirements prior to letting of the proposed Grade Separation project.

Grade separation structures may require an inside guard rail per Railroad standards.

#### 4.1.1 Shoofly Track(s)

Shoofly track shall be designed for maximum authorized timetable speed for freight and/or passenger trains, per Railroad track standards and operating requirements. Other restrictions specific to the individual Railroad may apply. Applicant needs to verify this with Railroad's Central Engineering department. The proposed shoofly must be designed to account for track settlement. Construction staging shall be designed to keep the Railroad tracks fully operational at all times except for pre-approved construction windows during cut over operations. The Applicant must schedule track related submittals per [Table 3-1 or 3-2](#) for Railroad review and approval.

#### 4.1.2 Track Spacing and Shifting

Existing track spacing will be maintained unless otherwise required by the Railroad. Future track shifting and direction of shifting must be verified at the preliminary stage of the feasibility study for the proposed Grade Separation Project. Due to safety and operational needs, existing track spacing may need to be increased to meet current safety standards. The Railroad requires a minimum spacing of 20 feet between freight tracks and 25 feet between freight and commuter tracks.

#### 4.1.3 Future Track(s)

A fundamental part of any feasibility study is to verify the need, requirement and location of future main, siding and/or spur tracks. The Railroad has the right to reserve the Railroad right-of-way for future expansion per [Section 2.2](#). In many cases the Railroad may have specific plans for additional tracks for all critical, major and other service routes. In other cases a transit agency may have long range plans to use part of or the entire corridor for future transit or commuter rail service. Should additional tracks be a possibility, they should be included in the design process. Space is to be provided for one or more future tracks as required for long range planning or other operating requirements. Where provisions are made for more than two tracks, space is to be provided for an Access Road on both sides of the tracks.

All structures located within critical, major and other service routes that require additional track(s) shall be designed to accommodate future track expansion. Future freight track shall be located a minimum of 20 feet from the centerline of the nearest existing track. Future commuter track shall be located a minimum of 25 feet from the centerline of nearest existing or future freight track.

#### 4.1.4 Access Road

Access Road requirements and location should be verified at the concept stage of the proposed Grade Separation Project. Access Roads provide maintenance and emergency access to the Railroad local operating units. Access Road, Access Road bridge or Access Road turnaround with a minimum of 50' radius is to be provided as designated by the local Railroad Operating Department. Grade Separation design should include adequate access to existing Railroad facilities along and/or within its right-of-way.

Minimum Access Road width shall be 10 feet and the centerline of the Access Road shall be located a minimum of 20 feet from centerline of nearest existing or future track.

#### 4.2 Grade Separation Structure Type

The Railroad discourages Underpass Structures due to safety concerns, possible interruption to Railroad operations, cost, and limitation of future replacement and maintenance. In general, the least complicated method for a grade separation is to use an Overhead Structure. Economy alone shall not be the governing factor in determining structure type. The analysis of Cost-Benefit ratio shall be fully considered before the structure type is finalized. Cost-Benefit ratio must include all costs associated with interruption to Railroad operations during construction of the proposed structure and/or future replacement structure in addition to future maintenance and other applicable costs.

#### 4.3 Structure Separation

All non-freight Railroad structures, with the exception of Access Road structures running adjacent to existing or proposed Railroad structures, shall be outside the Railroad right-of-way limits or as far away as practical. Clear horizontal separation between structures shall never be less than 25 feet, measured perpendicular from proposed structure(s) to existing or future Railroad structure(s).

Vertical and horizontal structure separations shall be subject to the Railroad's existing, proposed or future structure type, size, location and other site constraints.

#### 4.4 Construction

Railroad's review and approval of construction submittals defined in [Table 3-1](#) or [3-2](#) are required. The Applicant and its Contractor are responsible to comply with construction documents approved by the Railroad and must execute a work plan that enables the track(s) to remain open to train traffic per Railroad requirements. The Engineer-of-Record and the Applicant shall evaluate the quality of materials furnished and work performed by the Contractor. All field inspection reports, quality control reports and final As Built plans shall be submitted to the Railroad. The project site shall be inspected by the Railroad at the Applicant's expense during construction and toward the end of construction for final acceptance before the Contractor demobilizes.

The review of construction submittals and observation of the construction site shall neither relieve the Applicant, Engineer-of-Record nor the Contractor from the ultimate responsibility and liability for the construction on or damages to Railroad property during and after construction of the project.

#### 4.4.1 Construction Clearances

Temporary horizontal and vertical construction clearances shall be shown on the plans for all Grade Separation Projects impacting the Railroad. Every effort must be made to design for greater clearances. Greater clearances may be required for special cases to satisfy local operating conditions such as required sight distance for signals. Reduced temporary construction clearances, which are less than construction clearances defined in [Section 4.4.1.1](#) and [4.4.1.2](#), will require special review and approval by the Railroad.

##### 4.4.1.1 Temporary Vertical Construction Clearances

A minimum temporary vertical construction clearance of 21 feet measured above top of high rail for all tracks shall be provided. The 21 foot temporary vertical clearance shall not be violated due to deflection of formwork. Greater temporary vertical clearances may be required. The temporary vertical clearances are subject to Railroad local operating unit requirements.

##### 4.4.1.2 Temporary Horizontal Construction Clearances

A minimum temporary horizontal construction clearance of 15 feet for BNSF and 12 feet for Union Pacific, measured perpendicular from the centerline of the nearest track, to all physical obstructions including but not limited to formwork, stockpiled materials, parked equipment, bracing or other construction supports, shall be provided. Temporary horizontal construction clearance shall provide sufficient space for drainage ditches parallel to the standard roadbed section or provide an alternative system that maintains positive drainage.

#### 4.4.2 Shoring

All temporary shoring systems that impact Railroad operations and/or support the Railroad embankment shall be designed and constructed per Railroad Guidelines for Temporary Shoring.

#### 4.4.3 Demolition

All demolition within the Railroad right-of-way, which will impact Railroad tracks or operations, shall comply with Railroad demolition requirements.

#### 4.4.4 Erection

Erection over the Railroad right-of-way shall be designed to cause no interruption to Railroad operations. Erection plans shall be developed such that they enable the track(s) to remain open to train traffic per Railroad requirements.

#### 4.4.5 Falsework

Falsework clearance shall comply with minimum construction clearances per [Section 4.4.1](#). The design of all structural members for falsework shall comply with AREMA as well as Railroad requirements.

#### 4.4.6 Vegetation

Vegetation to be planted on or immediately adjacent to Railroad right-of-way shall not become a fire hazard to track-carrying structures and/or an obstruction to inspection and maintenance of the structures.

#### 4.5 Drainage

Railroad corridors are constructed with a drainage system designed to keep runoff away from the tracks and ballast. The drainage system includes the parallel ditches along the embankments as well as the bridges, culverts, siphons and other structures that convey runoff beneath the tracks or serve as water-equalizing structures. Maintaining the integrity of the Railroad drainage system is extremely important. The proposed construction shall safely pass high flows and not inhibit low flows or alter the path of the existing drainage system.

When changes in the drainage system are contemplated by new or replacement construction, or because of drainage problems, the system shall be modified as required to accommodate current-condition runoff including any changes that have occurred in the drainage pattern. The size of the proposed drainage system must conform to the Railroad Hydraulic Criteria described in [Section 4.5.2](#) and [4.5.3](#).

A complete hydrologic and hydraulic study is required whenever new or additional drainage is added to the Railroad right-of-way, or when a drainage structure is scheduled to be added, removed, modified or replaced. The Drainage Report must be in compliance with the requirements described in these Guidelines.

#### 4.5.1 Erosion and Sediment Control

General plans for construction within the Railroad right-of-way shall indicate the proposed methods of erosion and sediment control. They must specifically provide means to prevent sediment accumulation in the ditches and culverts, to prevent fouling the track ballast and sub-ballast, and to allow free flow of runoff in the drainage systems during and after construction.

Corrective and/or mitigative construction due to the fouling of Railroad ballast, sub-ballast, ditches, culverts or drainage systems will be at the Applicant's expense. It is the Applicant's responsibility to document the condition of the site before and after construction.

Existing track ditches shall be maintained open at all times throughout the construction period. After the construction is complete, all erosion and sediment control devices must be removed, all sediment deposits removed, and the entire project area restored to the pre-construction condition.

The Applicant and/or Contractor are responsible for securing the required permits from Local, State and Federal entities. The Applicant and/or Contractor shall furnish the Railroad all copies of the Storm Water Pollution Prevention Plan (SWPPP) and approved permits, if required. Further, these documents shall be available on-site during all construction activities. Approval of the erosion and sediment control plan does not relieve the Applicant and/or Engineer-of-Record and Contractor of the ultimate responsibility and liability for compliance with erosion and sediment control requirements.

#### 4.5.2 Hydraulic Criteria for Bridge and Culvert Openings

1. Replacement openings shall be sized for two high water events designated "low chord" and "subgrade."
2. Provide the Energy Grade Line (EGL), water surface elevation and velocity flow for both the existing and proposed hydraulic opening.
3. For subdivisions and for any lines in urban areas, regardless of classification, the low chord event is the 50-year flood and the subgrade event is the 100-year flood.
4. For industrial leads and for customer-owned trackage, the low chord event is the 25-year flood and the subgrade event is the 50-year flood, unless the proposed structure is immediately adjacent to a main line bridge(s). Then, the low chord event and subgrade event shall be as stated above in item 3.
5. If the structure is in a FEMA designated floodplain the water surface elevation for a 100-year event shall be determined regardless of line classification.
6. For all cases, the opening will be sized so that the water surface for a "low chord" event will rise no higher than the crown of the culvert or the low chord of the bridge.
7. For all cases, the opening will be sized so that the energy grade line for a subgrade event will not rise above the adjacent subgrade elevation. The subgrade elevation is defined as 2'-3" below base of rail elevation.

- Both the Railroad criteria and local flood flow criteria shall be evaluated and the more conservative of the two shall be adopted in sizing the replacement.

#### 4.5.3 Hydraulic Criteria for Drainage Systems Parallel to Railroad Tracks

- Culverts and bridges must be designed in accordance with Railroad standard hydraulic criteria described in [Section 4.5.2](#).
- The 100-year event criteria (EGL no higher than top of subgrade) is to be applied for parallel ditches, open channels, and encroachments, as well as bridges and culverts. Sufficient lateral and vertical clearance must be provided to accommodate construction of the standard flat-bottom railroad ditch or a ditch based upon the EGL for a 100 year event; whichever produces the larger ditch. Anything less than this standard is an exception and must be supported by hydrology and hydraulics.
- In cases where the Railroad's standard hydraulic criteria is not applicable due to topography of the track bed and surrounding ground, the Railroad standard flat-bottom drainage ditch (trapezoidal, 10 ft bottom width, a minimum of 2:1 side slopes, with flowline elevation a minimum of 3 ft below the subgrade elevation) must be incorporated.
- Where acquisition of adequate right-of-way is a limiting factor, or site characteristics justify smaller drainage systems, a request for variance with sufficient supporting documents must be submitted to the Railroad for consideration.
- The applicant must provide hydraulic data (EGL and water surface elevations and velocities) for both existing and proposed conditions.
- Consideration shall be given to the effects of localized contraction scour and mitigation, and if deemed necessary, shall be shown on the design plans.

#### 4.6 Fences

Chain link fencing with openings not exceeding 2 inches should be used in most applications. In some locations where the trespassers may cut the chain link fence, a wrought iron picket fence with openings not exceeding 3 inches is required. All architectural fencing shall be reviewed and approved by the Railroad. Architectural fencing shall not allow an opening of more than 2 inches and shall be designed to prevent climbing.

Right-of-way fencing shall be provided along the Railroad right-of-way to safeguard the general public and prevent trespassers from entering the Railroad right-of-way. Fencing may need to continue outside the Railroad right-of-way limits, which will be at the discretion of the Railroad Local Representative. These limits shall be reviewed and approved by the Railroad's Central Engineering department. The right-of-way fence shall conform to details as shown on [Plan No. 711000, sheet 1](#).

For overhead grade separation structural fencing, refer to [Section 5.4.2](#).

#### 4.7 Retaining Walls

Retaining walls shall be designed to withstand lateral earth and water pressures, any live load and dead load surcharge, the self-weight of the wall, temperature and shrinkage effects and earthquake loads.

Retaining walls supporting the Railroad embankment shall be designed in accordance with Railroad requirements and the general design principles specified in AREMA.

Retaining walls that do not support Railroad embankment shall be designed in accordance with Railroad requirements and general design principles specified in AASHTO and shall be located outside the Railroad right-of-way limits.

Barrier rail and fencing for the retaining wall are subject to retaining wall location and Railroad operating requirements. Barrier rail and fencing shall be placed in a manner to safeguard the general public while securing the Railroad right-of-way. Barrier rail and fencing shall be designed per [Section 5.4.1](#) and [5.4.2](#).

#### 4.8 Embankment Surcharge

For all tracks located near a proposed embankment causing the track to be surcharged, the contractor must monitor and record top-of-rail elevations and track alignment. The movement shall be within the limits defined by local Railroad Manager of Track Maintenance (MTM). Displacements exceeding the limits defined by the MTM must be immediately reported to the Railroad. The track shall be adjusted as needed at the expense of the Applicant.

#### 4.9 Utilities

Railroad corridors may have utilities that could impact the design, location or even the feasibility of the proposed Grade Separation Project. During the initial study the Applicant shall identify existing utilities within the Railroad right-of-way and plan for proper relocation, protection and installation requirements.

All new or relocated utilities within the Railroad right-of-way will require Railroads prior review and approval. A Railroad Right-of-Entry Agreement (if applicable), per [Section 2.3](#), is required to survey or abandon existing utilities within the Railroad corridor. The Railroad has no obligation to provide property for relocated utilities that do not comply with Railroad's standard specifications and requirements including, without limitation, AREMA and these Guidelines.

No utility attachments will be permitted on Underpass Structures. Existing or future fiber optic lines shall be placed underground and away from the bridge structure.

The Applicant shall be responsible for the identification, location, protection and relocation of all existing overhead and underground utilities. The design plans for the proposed Grade Separation Project shall included complete information on existing and/or proposed relocation of the said utilities.

Appropriate measures for the installation, protection and relocation of fiber optic cables as well as Railroad signal and communication lines shall be addressed in the plans and contract documents. For Railroad requirements and additional information refer to:

UPRR: [www.uprr.com](http://www.uprr.com)

For UPRR Fiber Optic Engineering, "Call Before You Dig", call 1-800-336-9193

For UPRR Grade Crossing/Signal Hotline, call 1-800-848-8715

Please refer to UPRR web site for utility review and approval process and Application.

BNSF: [www.bnsf.com](http://www.bnsf.com)

For BNSF Fiber Optic Engineering, "Call Before You Dig", call 1-800-533-2891

For BNSF Grade Crossing/Signal Hotline, call 1-800-832-5452

Relocation of utilities or communication lines not owned by the Railroad shall be coordinated with the utility owners. The utility relocation plans must then be submitted to the Railroad utility representative for approval.

#### 4.10 Construction Management Team

For construction of grade separated structures an experienced Construction Management Team will be required during the construction of the bridge structure. Public agencies with qualifying bridge structure staff placed on-site during construction will be acceptable; otherwise an outside team must be obtained. Railroad participation during construction is required as indicated in [Section 4.11](#).

The following are minimum requirements for the Construction Management Team:

- The Applicant is to submit names and qualifications of person(s) to be used in the project and their assigned duties.
- Provide a qualified quality control inspector to be present during fabrication of steel spans and any major prestressed concrete items.
- Provide a list of past projects that each person has actively worked on, including bridge structures (highway or rail), underground facilities and drainage structures.
- Provide a verifiable list of employment including a current resume for each person in the Construction Management Team.
- Minimum personnel for the Construction Management Team for a typical grade separation structure will consist of:
  1. Project Manager – Primary point of contact, with experience in managing construction projects, for the Construction Management Team.
  2. Resident Engineer – The resident Engineer for the project shall be a registered Civil Engineer with minimum 5 years experience in the field of bridge construction work.
  3. Construction Engineer – A Construction Engineer performs complex professional engineering work in the management of major construction projects from design through completion.
  4. Construction Inspector – Construction Inspector shall perform continuous inspection of construction projects for compliance with plans, specifications and contract documents. The inspector shall be familiar with concrete and steel bridge construction and have current certifications in the fields of inspection involved.
- Railroad review and approval of duties, responsibilities, education and experience for each of the above listed members of the Construction Management Team will be required.
- All field members of the Construction Management Team are required to have passed and comply with the FRA and Railroad requirements regarding Railroad track safety, bridge fall protection and/or contractor orientation training.

#### 4.11 Railroad Site Observation During Construction

In addition to the office review of submittals, site observation will be performed by the Railroad at significant points during construction, including but not limited to the following, if applicable:

##### Underpass Structure

1. Pre-construction meeting.
2. Shoring systems that impact the Railroad's operation and/or support the Railroads embankment.
3. Demolition.
4. Falsework.
5. Erection.
6. Acceptance observation of any shoofly before placing it in service.
7. Foundation installation.
8. Reinforcement and concrete placement for main bridge substructure and/or superstructure.
9. Shop observation of fabricated steel spans and/or any major pre-stressed concrete items either by the Railroad or its designated representative.
10. Erection of steel or precast concrete bridge superstructure.
11. Deck installation.
12. Acceptance of waterproofing (prior to placing ballast).



13. Final observation and acceptance of the bridge structure.

#### Overhead Structure

1. Shoring systems that impact the Railroad's operation and/or support the Railroads embankment.
2. Demolition within the Railroad's right-of-way.
3. Falsework.
4. Erection over the Railroad's right-of-way.
5. Final observation and acceptance of the Overhead Structure.

Site observations are not limited to the milestone events listed above; rather, site visits to check progress of the work may be performed at any time throughout the construction as deemed necessary by the Railroad.

A construction schedule shall be provided to the Railroad Local Representative for their handling with the Central Engineering department. Inform the Railroad's Local Representative of the anticipated dates when the listed events will occur. This schedule shall be updated as necessary, but at least monthly, so that site visits may be scheduled. Final observation and acceptance of the bridge by the Railroad is required before the contractor leaves the job site.

## 5. OVERHEAD STRUCTURES

### (Roadway Structure Over Railroad)

The preferred Overhead Structure from the standpoint of the Railroad operation is one that will span the entire Railroad right-of-way. The Overhead Structure shall be designed according to Sections 1, 2, 3, 4 and 5 of these Guidelines, AREMA and any applicable sections of AASHTO. The Railroad strongly discourages construction of an Overhead Structure within or in the vicinity of Railroad yard limits.

#### 5.1 Design

The proposed Overhead Structure design plans shall allow the Contractor to execute a work plan that enables the track(s) to remain in service per Railroad requirements.

The Railroad discourages the use of cast-in-place superstructures and every effort shall be made to utilize a structure type that will not require interruption to Railroad operation during construction. Deck drains, future utility installation and expansion or hinge joints for the Overhead Structure over Railroad tracks or inside Railroad right-of-way are not permitted.

##### 5.1.1 Design Plans

Design plans and calculations shall be in accordance with these Guidelines and submitted per [Section 3](#). Compliance with these Guidelines will expedite the review and approval process of submittals for the Grade Separation Project.

#### 5.2 Permanent Clearances

Permanent clearances, as indicated on [Plan No. 711100, sheet 1](#), are minimum clearances. Permanent clearances shall accommodate future tracks, future track raises, Access Roads and drainage ditch improvements. Proposed vertical and horizontal clearances shall be adjusted so that the sight distance to any Railroad signals is not reduced unless signals are to be relocated as part of the proposed Grade Separation Project.

The clear zone, within the permanent clearance envelope, shall be clear of all objects such as trees, sign supports, utility poles and other objects.

Permanent clearance shall be correlated with the methods of construction. This ensures that the temporary construction clearances will not be less than the minimum specified in [Section 4.4.1](#).

##### 5.2.1 Permanent Vertical Clearance

The minimum permanent vertical clearance, per Code of Federal Regulation, shall be 23' - 4" measured from the top of the highest rail to the lowest obstruction under the structure. The 23' - 4" permanent vertical clearance must not be violated due to deflection of the superstructure.

Additional vertical clearance may be required for items beyond those shown in the General Overhead Structure on [Plan No. 711100, sheet 1](#). These items include: correction of sag in the track, construction requirements and future track raise.

The profile of the existing top-of-rail, measured 1000 feet each side of proposed Overhead Structure, shall be shown on the plans. If the profile indicates sag at the proposed bridge location, the vertical clearance from the top of the highest rail to the bridge shall be increased sufficiently to permit raising the track to remove the sag. A note should be added to the profile stating, "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 the commencement of construction.

### 5.2.2 Permanent Horizontal Clearance

Future Track per [Section 4.1.3](#) and Access Road per [Section 4.1.4](#), of these Guidelines must be verified with the Railroad in advance of establishing horizontal clearances. The Railroad requires all piers and abutments to be located outside the Railroad right-of-way limits and to comply with [Section 4.1.3](#) and [4.1.4](#) of these Guidelines. If this is not feasible, all piers and abutments shall be located more than 25 feet measured perpendicular from centerline of nearest existing or future track. Piers within 25 feet, measured perpendicular from centerline of existing or future track, shall be protected per [Section 5.5.2](#) of these guidelines. Absolute minimum horizontal clearance requiring special review and approval by the Railroad, and subject to site conditions, shall be 18 feet measured perpendicular from the centerline of the track to the face of the pier protection wall.

### 5.3 Temporary Clearances

The proposed Overhead Structure shall be designed to satisfy temporary construction clearance requirements per [Section 4.4.1](#) and shown on the plans in accordance with Figure 1 on [Plan No. 711100, sheet 3](#).

### 5.4 Overhead Superstructures

The use of cast-in-place beams is not permitted. The use of stay in place deck forms for falsework between precast concrete beams or steel girders is encouraged.

#### 5.4.1 Barrier Rail

Cast-in-place concrete barrier rail without openings and a minimum height of 30 inches shall be provided on both sides of the superstructure to retain and redirect errant vehicles. The barrier rail shall keep the deck's storm runoff from being deposited onto Railroad right-of-way.

Barrier rail for Overhead Structures, which may be subject to snow removal, shall be a minimum of 42 inches in height with a 4 foot wide shoulder, or 30 inches in height with a 6 foot wide shoulder.

Limits of the barrier rail shall extend to the limits of the Railroad right-of-way or a minimum of 25 feet beyond the centerline of the outermost existing track, future track or Access Road, whichever is greater.

The barrier rail shall be detailed in accordance with [Plan No. 711100, sheet 4](#).

#### 5.4.2 Fence with Barrier Rail

Fence with barrier rail shall be provided on both sides of all Overhead Structures crossing Railroad right-of-way. It shall be designed to prevent climbing and provide positive means of protecting the Railroad facility and the safety of Railroad employees below from objects being thrown by pedestrians or passing motorists.

The limits of the fence with barrier rail shall extend to the limits of the Railroad right-of-way or a minimum of 25 feet beyond the centerline of the outermost existing track, future track or Access Road, whichever is greater. All parallel Overhead Structures that have a gap of 2 feet or more shall be protected with fencing. Structures with a gap of 2 feet or less shall either have the gap covered or be fenced on both sides.

The minimum combined height of a barrier rail with curved fence shall be 8 feet or with a straight fence shall be 10 feet. The barrier rail with fence detail shall be in accordance with [Plan No. 711100, sheet 4](#).

## 5.5 Overhead Substructures

All piers, abutments and embankments shall be located outside of the Railroad right-of-way limits. If this is not possible, piers and abutments located within the Railroad right-of-way limits must allow room for future track(s) per [Section 4.1.3](#) and Access Road per [Section 4.1.4](#).

Footings for all substructures shall be located and designed to allow a minimum of 12 feet temporary horizontal construction clearance measured at a right angle from the centerline of nearest track to the face of shoring to facilitate footing construction. Temporary shoring shall be designed per [Section 4.4.2](#).

Drilled shafts within the influence of track surcharge shall be designed and constructed with a casing to protect the track against cave-in, subsidence and/or displacement of the surrounding ground. The casing shall be designed for live loads due to the Railroad surcharge in addition to all other applicable loads. Drilled shafts shall be designed to allow the drilling operation without impacting Railroad operations.

### 5.5.1 Piers

Every effort shall be made to place piers outside the Railroad right-of-way or a minimum of 25 feet measured perpendicular from the centerline of existing or future track to the face of pier.

Piers within 25 feet of the nearest existing or anticipated future track shall be of heavy construction or shall be protected by a pier protection wall. Refer to [Section 5.5.2](#) for heavy construction requirements.

A Pier footing within 25 feet of the nearest existing or future track shall be a minimum of 6 feet below the base of rail. This will allow the Railroad to modify their longitudinal drainage system in the future and/or provide an unobstructed area for placing signal, fiber optic or other utilities.

For piers with 25 feet of clearance from centerline of nearest existing track and located within the Railroad right-of-way, the Railroad requires language in the proposed Agreement mandating the Applicant to fund the construction of pier protection walls on the bridge piers should they ever be required due to additional trackage being constructed by the Railroad or for any other legitimate reason. The Applicant shall also be responsible for modification to the pier protection wall if deemed necessary by the Railroad in the future.

Inside guardrail shall be required, between rails, for all piers located within 25 feet from the nearest existing or future track

### 5.5.2 Pier Protection

The pier protection wall shall be designed to resist the impact and redirect equipment in case of derailment. Both sides of the pier shall be protected in locations where tracks are within 25 feet on both sides of the pier.

If seismic criteria are considered, pier design may require column isolation with the wall supported on an independent footing.

All replacement or modified structures shall comply with AREMA requirements for pier protection walls.

In locations where pier columns and protection walls interfere with drainage, an alternative drainage facility shall be provided to collect and carry water to a drainage system.

AREMA defines a pier of heavy construction as: "Cross-sectional area equal to or greater than that required for the pier protection wall and the larger of its dimensions is parallel to the track". For a single column the minimum cross-sectional area is 30 sq. ft. (12' length x 2.5' width = 30 sq. ft.). Columns with 30 square feet of cross sectional area must have the larger dimension parallel to the track; for example, a 5' x 6' column with the 6' dimension parallel to the track is considered as heavy construction.

The Pier Protection detail shall be in accordance with [Plan No. 711100, sheet 6](#).

### 5.5.3 Abutments

All abutment slopes, mechanically stabilized earth walls and abutment structures shall be located outside Railroad right-of-way.

Slope layout shall provide for the minimum drainage ditch(es) or culverts required by hydraulic studies in the area; see [Plan No. 711100, sheets 1 and 5](#) for details. The toe of the slope shall terminate at the bottom of drainage ditch and must have a cut-off wall as required to protect the slope from erosion. In all cases, the toe of slope shall be below the finished track or roadway subgrade.

Top of paved slopes shall extend a minimum of two (2) feet past the abutment wall face, and terminate with either a curb or gutter to divert runoff. Paving shall have a prepared sub-base and filter fabric. Reinforced concrete or grouted rip-rap, with a minimum thickness of 4 inches, shall be placed on prepared sub-base and filter fabric.

### 5.6 Lighting

All new or modified Overhead Structures exceeding 80 feet in width shall provide a lighting system to illuminate the track area. However, subject to the Railroad Local Representative, lighting shall be provided for all structures less than eighty (80) feet in width in areas where switching is performed or where high vandalism and/or trespassing have been experienced. Care shall be taken in lighting placement such that trains will not mistake the lights for train signals nor shall they interfere with the train engineer's sight distance for existing signal aspects. All lights shall be directed downward.

Provide temporary lighting for all falsework and shoring areas.

The minimum lighting design criteria shall be an average of one (1) foot-candle per square foot of structure at the Railroad tracks. Use Holophane module 600 underdecking type luminaries or equal as required. Fixtures shall be installed on the column walls or caps of the Overhead Structure without reducing the minimum horizontal and vertical clearances.

Maintenance of lights shall be the responsibility of the Applicant. Access to perform any maintenance for lights shall be coordinated with the local Railroad operating unit.

Structures with separation over ten (10) ft. from each other shall be considered as independent structures for the purposes of lighting.

### 5.7 Drainage and Erosion

Drainage from Overhead Structures shall be diverted away from the Railroad right-of-way at all times. Scuppers from the deck shall not be permitted to discharge runoff onto the track or Access Road areas at any time. If drainage of the deck uses downspouts in the columns they shall be connected to the storm drain system or allowed to drain into drainage ditches. Concrete splash blocks or aggregate ditch lining will be required at the discharge area of downspouts. Downspouts shall be behind the face of all piers.

If the layout of abutments, piers or columns with protection walls interferes with the drainage ditches, the designer shall provide an alternative method of handling the longitudinal drainage based on a hydraulic study. This may consist of pipe culverts.

Track drainage ditch limits shall be shown to scale on the project plans and show the distance from the centerline of nearest track. A typical cross section detail shall be shown on the plans.

If the proposed bridge structure will not change the quantity and characteristics of the flow in Railroad ditches and drainage structures, the plans shall include a general note stating so.

Lateral clearances must provide sufficient space for construction of the required standard ditches parallel to the standard roadbed section. Should the proposed construction change the quantity and/or characteristics of flow in the existing ditches, the ditches shall be modified as required to handle the increased runoff. The size of ditches will vary depending upon the flow and terrain and should be designed accordingly.

All drainage systems shall be in compliance with [Section 4.5.2](#) and [4.5.3](#) and Erosion and Sediment Controls shall be in compliance with [Section 4.5.1](#).

## 6 UNDERPASS STRUCTURES

### (Railroad Structure Over Roadway)

The most desirable Grade Separation Structure from the standpoint of the Railroad is an Overhead Structure. The Applicant shall justify the use of an Underpass Structure in detail. The Underpass Structure shall be designed according to Sections 1, 2, 3, 4 and 6 of these Guidelines, the current edition of AREMA and any applicable sections of AASHTO. The Railroad strongly discourages construction of an Underpass Structure within or in the vicinity of Railroad yard limits.

#### 6.1 Design

The proposed Underpass Structure design plans shall allow the Contractor to execute a work plan that enables the track(s) to remain in service per Railroad requirements. The proposed structure shall be designed so there is no interruption to the Railroad's operation during construction.

The Railroad discourages the use of structures that are not listed in [Section 6.8.1](#) as an acceptable superstructure type. The use of Railroad standard spans where possible is encouraged. Only simple spans with ballast decks are allowed. Cast-in-place concrete superstructures are unacceptable.

#### 6.1.1 Design Loads

The proposed Underpass Structure shall be designed for the following loads:

- Live load and Impact as specified in AREMA. For multiple track structures, live load shall be calculated based on the assumption that the track(s) can be located anywhere on the bridge with the horizontal clearance to the handrail defined in [Section 6.6.1](#), and a maximum track spacing of 13 feet. For actual track spacing refer to [Sections 4.1.2](#) and [4.1.3](#).
- Dead load shall include up to 30 inches of ballast from top of deck to the top of tie and all other applicable dead load.
- Seismic design shall comply with the criteria of the current edition of AREMA, Chapter 9 - Seismic Design for Railway Structures.
- Additional loads shall be applied as specified in Chapters 8, 9, and 15 of AREMA, as applicable.

#### 6.1.2 Design Plans and Calculations

Design plans and calculations shall be in accordance with these Guidelines and submitted per [Section 3](#). Compliance with these Guidelines will expedite the review and approval process of submittals for the Grade Separation Project.

#### 6.1.3 Concrete Requirements

All concrete material, placement and workmanship shall be in accordance with Chapter 8 of the current edition of AREMA and the following:

1. Minimum Compressive Strength – 4000 lb. per square inch at 28 days.
2. Exposed surfaces shall be formed in a manner that will produce a smooth and uniform appearance without rubbing or plastering. Exposed edges of 90 degrees or less are to be chamfered  $\frac{3}{4}$ " x  $\frac{3}{4}$ ". Top surface to have a smooth finish, free of all float or trowel marks with the exception that a broom finish be used on all walkway surfaces.
3. Concrete shall be proportioned such that the water-cementitious material ratio (by weight) does not exceed the values in AREMA Table 8-1-9. Precast concrete must contain a minimum of 610 pounds of cementitious material per cubic yard of concrete. Cast-in-place concrete must contain a minimum of 565 pounds of

cementitious material per cubic yard of concrete. If fly ash is used with cement it shall be limited to 15% of cementitious material.

4. Cement shall be Type I, II or III Portland Cement per ASTM C150.
5. Course aggregate shall be size no. 67.
6. Fine aggregate shall be natural sand.
7. Admixtures, other than air entrainment, shall not be used without approval by the Railroad.
8. Membrane curing compound shall conform to ASTM C309 Type 2.
9. Apply ThoRoc Epoxy Adhesive 24LPL or approved alternate before placing new concrete against hardened surfaces.
10. For precast elements, the fabricator shall stencil the fabricator's name, date of fabrication, the bridge number, lifting weight and piece mark on each component.
11. The production facility must be pre-certified. Production procedures for the manufacture of precast members shall be in accordance with AREMA and the current edition of the Precast Concrete Institute's Manual MNL 116 for Quality Control.
12. Dimensional tolerances governing the manufacture of precast members shall conform to Division VI, Section 6.4.6 of the Precast Concrete Institute's Manual MNL 116 for Quality Control. Tolerance for location of lifting devices shall be  $\pm \frac{1}{2}$ ".
13. The area around all lifting loops shall be recessed so that the loops can be removed to a depth of  $\frac{3}{4}$ " and grouted. Properly designed lift anchors are acceptable in lieu of lifting loops.
14. The fabricator will be responsible for the loading and properly securing the precast concrete members for shipment. All concrete components shall be made available, at the Railroad's discretion, for inspection by the Engineer-of-Record and the Railroad at the fabricator's plant prior to shipment.
15. Foam used to create internal voids in a precast concrete member, such as in box beams, shall be securely tied down to prevent displacement during concrete placement.

#### 6.1.4 Reinforcing Steel Requirements

1. Reinforcing Steel shall be deformed, new billet bars per current ASTM A615 Specifications and meet Grade 60 requirements.
2. Reinforcing Steel requiring field welding or bending shall conform to ASTM A706 Specifications, Grade 60.
3. Fabrication of reinforcing steel shall be per Chapter 7 of the CRSI Manual of Standard Practice. Dimensions of bending details shall be out to out of bars.
4. Reinforcing steel is to be blocked to proper location and securely wired against displacement. Tack welding of reinforcing is prohibited. Minimum concrete cover not otherwise noted shall meet current AREMA requirements.

#### 6.1.5 Prestressing Strand Requirements

1. Prestressing strand shall be seven wire, uncoated and low relaxation which is in accordance with the requirements specified in ASTM A416, ACI 318 and AREMA Chapter 8.
2. The strand shall have an ultimate tensile strength of 270 ksi.

#### 6.1.6 Structural Steel Requirements

1. All major elements subjected to railroad live load shall conform to the following minimum specifications, except as otherwise noted:
  - a. Painted structures: ASTM A709 Grade 50,
  - b. Unpainted structures: ASTM A709 Grade 50W.
2. All bolted connections shall be made with high strength bolts.



3. Material over 4 inches in thickness that is subject to railroad live load shall conform to the following specifications:
  - a. Painted structures: ASTM A572 or ASTM A588.
  - b. Unpainted structures: ASTM A588.
4. Elements not subjected to direct railroad live load (intermediate stiffeners, lateral bracing, diaphragms, ballast curbs, etc.) shall conform to the following specifications:
  - a. Painted structures: ASTM A572 Grade 50, ASTM A36 or ASTM A992.
  - b. Unpainted structures: ASTM A588.
5. Steel bridge deck shall conform to A709 specifications, Grade 36.
6. Deck cover plates and closure plates may be per ASTM A36 specifications.
7. Anchor rods/bolts shall conform to ASTM F1554 specifications.
8. End welded studs shall be C1015, C1017 or C1020 cold drawn steel, which conforms to ASTM A108 specifications.
9. Cover plate, closure plates and anchor rods/bolts shall be galvanized after fabrication in accordance with ASTM A123, thickness Grade 100.
10. Anchor rod washers shall be zinc coated in accordance with ASTM A153 specifications.

## 6.2 Future Track and Access Road

It is required to verify the need and requirements for future tracks and/or Access Road for each project. Future track shall be in accordance with [Section 4.1.3](#). Access Roads shall be in accordance with [Section 4.1.4](#) and [6.2.1](#).

### 6.2.1 Access to Underpass Structure

For all Underpass grade separation structures, access to each end of the bridge shall be provided for Railroad off-track maintenance equipment. Access may consist of a road on the bridge, a road on a separated bridge or a roadway with turnarounds.

If the bridge maintenance Access Road is part of the main railway structure, the structure shall be designed for Cooper E-80 live load to accommodate any future track needs or modifications. A removable concrete barrier shall be provided to separate the nearest track from the Access Road by retaining the ballast. If the bridge maintenance access is a completely separate structure it shall be designed for AASHTO HS25-44 live load. The Access Road shall accommodate one 12 foot wide lane with curbs and railing.

If a bridge maintenance structure is not provided, an Access Road with a turnaround shall be designed and constructed in conjunction with the grade separation bridge structure. The turnaround pad shall start no further than 30 feet from the end of the bridge structure with the embankment shoulder a minimum of 60 feet from centerline of track. The radius for the turnaround shall be a minimum of 50 feet. Roadway grade shall not exceed 10% and shall terminate at the sub-ballast elevation. The roadway shall have sufficient width to provide for one 12 foot wide road, drainage ditch and shoulder. The turnaround pad and roadway shall be sloped to drain away from the track and carry the water to a drainage system or existing Railroad right-of-way ditches.

Access Road with a bridge maintenance structure or turnaround shall be shown in the 30% submittal and the complete design shall be included in all subsequent submittals.

## 6.3 Skew

The preferred angle of intersection between centerline of track and the centerline of bridge supports, transverse to the track, is 90 degrees. The minimum angle that will be allowed between the centerline of the track and the

centerline of bridge supports, transverse to the track, is 75 degrees for a Concrete Superstructure and 60 degrees for a Steel Superstructure.

Align bridge piers and abutments as required to comply with the above maximum skew limitations. Tie rods, diaphragms and approach slabs shall be designed per [Section 6.8.10.1](#), [6.8.8.1](#) and [6.4](#), respectively.

Where conditions preclude compliance with these skew requirements, the skew proposal will require special structural consideration and proof of adequacy.

#### 6.4 Approach Slab

On skewed abutments an approach slab is required. The bridge end of the approach slab shall be skewed and doweled with the abutment while the other end of the approach slab is perpendicular to the centerline of track to insure uniform subgrade stiffness for the ties immediately adjacent to the bridge. The approach slab shall be constructed symmetrically to the centerline of the track and shall be a minimum of 12 feet wide and extend parallel to the track a minimum of 3 feet beyond the back edge of the abutment.

#### 6.5 Structure Separation

Horizontal separation between Railroad structures or Railroad and Access Road structures shall be minimum of 5 feet clear. All other structure separations shall be in accordance with [Section 4.3](#).

#### 6.6 Clearances

Permanent clearances shall be correlated with the methods of construction to ensure compliance with the temporary clearances specified in [Section 4.4.1](#).

##### 6.6.1 Permanent Vertical Clearance

Underpass Structures shall be designed to ensure that the structure will be protected from oversized or unauthorized loads by providing sufficient vertical clearance and protective devices unless otherwise specified by the Railroad. Provide a minimum vertical clearance over the entire roadway width for all new or reconstructed structures as follows:

- 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.
- 20'-0" for steel through plate girders without bolted bottom flanges.

The vertical clearance must not be violated due to the deflection of the superstructure.

Variations from vertical clearance defined above shall be submitted to the Railroad for approval. The variance will be considered if the Railroad structure is not the lowest structure within the roadway network. All proposed structures with substandard vertical clearances shall be designed per [Section 6.7](#).

If resurfacing or any other activity is to be performed below the Underpass Structure, the owner of the roadway must submit a request for approval from the Railroad. This request must provide the existing measured and posted clearances of the structure and the proposed configuration after work is completed.

The owner of the roadway shall be responsible for graffiti removal and for posting and maintaining the clearances and any advance notifications the roadway requires. No sign shall be attached to the Railroad bridge.

## 6.6.2 Permanent Horizontal Clearance

The horizontal clearances from the centerline of the nearest track to any bridge component shall, in all cases, conform to AREMA requirements except that in curved track the minimum increase in clearance shall be 6 inches. Proposed structures that accommodate multiple tracks, future tracks and existing tracks having a spacing less than 20 feet, shall be designed for a minimum of 20 foot spacing measured centerline to centerline.

## 6.6.3 Temporary Clearances

The proposed Underpass Structure shall be designed to satisfy temporary construction clearance requirements per [Section 4.4.1](#), which shall be shown on the plans in accordance with Figure 1 on [Plan No. 711100, sheet 3](#).

## 6.7 Sacrificial Beams, Fascia Beams and Impact Protection Devices

All structures with vertical clearances less than defined in [Section 6.6.1](#) shall be protected with a sacrificial beam. Access to the sacrificial beam shall be blocked on both ends and the sacrificial beam shall be located to safeguard the bridge from oncoming vehicles.

Sacrificial beams shall be steel shapes (wide flange or hollow structural sections) and of sufficient strength to limit horizontal deflection, caused by the impact from oversized vehicles or loads, to 6 inches. The sacrificial beams shall also be securely anchored with cables at each end to prevent them from falling, and its soffit shall be at least 2 inches below the bridge soffit.

Concrete fascia beams used as walkways shall be installed adjacent to the proposed structure and may also serve as a sacrificial beam. If a concrete fascia beam is used as a sacrificial beam it shall have a 6" x 6" x 1" embedded steel angle facing oncoming traffic and shall be adequately anchored to the bridge seats at an elevation at least 2 inches below the bridge soffit.

All concrete spans, where sacrificial beams are not required, shall be protected with impact protection devices installed over the full width of traveled lanes and attached to the bridge soffit. See [Plan No. 711200, sheet 13](#).

## 6.8 Superstructure

The size of the superstructure must accommodate future track(s) per [Section 4.1.3](#) and Access Road per [Section 4.1.4](#). For typical cross sections of superstructures see [Plan No. 711200, sheets 2 through 9](#).

### 6.8.1 Acceptable Superstructure Types

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 50 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.

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.

#### 6.8.2 Deck Type and Width

In all cases, when using a steel superstructure the use of a steel deck is preferred. The deck width shall be a function of future track, Access Road, existing track(s), minimum horizontal clearance per [Section 6.6.2](#) and a minimum of 20 foot spacings between centerlines of tracks.

#### 6.8.3 Composite Deck

Under normal working loads, composite action may be expected between a concrete deck and its supporting girder steel members when shear transfer devices are used. The bottom of the deck slab shall be placed at least one inch below the top of supporting steel members. For design purposes, the supporting girders shall be designed to satisfy deflection criteria and carry E65 live, impact and dead loads without utilizing any composite action, and E80 live, impact, and dead loads utilizing composite action. Composite action may be mobilized to satisfy the deflection-length ratio requirement of Chapter 15, Article 1.2.5 of AREMA, provided shear transfer devices are installed. Steel decks may be utilized in composite action to satisfy the deflection-length ratio requirement. However, composite action shall not be assumed to satisfy strength requirements.

#### 6.8.4 Ballast Retainers, Fences and Handrails

Ballast retainers must be designed to prevent ballast from falling on the roadway. Handrails with fencing shall be provided on both sides of the deck and shall meet FRA and OSHA requirements. Handrails and fences shall be simple designs that require minimum maintenance and shall meet clearance requirements of [Section 6.6.1](#). Fences are required over all roadways, trails and sidewalk areas.

The top of ballast retainer shall be minimum of 30 inches above top of deck if fascia beam is used in accordance with typical sections shown in Appendix A. If fascia beam is not used, top of ballast retainer shall be 36 inches above top of deck.

#### 6.8.5 Walkway

Walkways on bridges, over highways or other locations where spillage of ballast or lading is possible shall be constructed of solid material and a curb or toe board shall be provided. In accordance with [Section 6.6.1](#), the clear distance from centerline of track to the ballast retainer for bridges without a walkway shall be a minimum of 8'-0". To prevent cracking under live loads, provide 1/4 inch wide control joints at less than 10 foot spacing on concrete curbs, walkways and ballast retainers.

Ballast section may be used as walkway, at the discretion of the Railroad, provided the permanent horizontal clearances are in accordance with [Section 6.6.2](#). If a solid walkway surface is required, it shall be a minimum of 2'-6" wide and be provided on both sides of the structure.

#### 6.8.6 Drainage

A minimum longitudinal grade of 0.2% on the superstructure shall be provided to ensure adequate drainage. The designer may provide drainage toward one end of the structure, or when the structure's length is excessive, provide adequate deck grades to drain the structure to both ends. If the top-of-rail grade is less than 0.2% over the length of the structure then the depth of ballast may be varied along the structure.

The top of the concrete deck shall be sloped a minimum of 0.5% transversely.

For concrete decks, a longitudinal collection system shall be provided on top of the waterproofing along the face of parapet or curb to drain water. Longitudinal drains shall be connected to the storm drain system or properly discharged at the toe of embankment slopes. See [Plan No. 711200, sheet 10](#).

If an approach grade descends toward the bridge, drainage from the approach shall be intercepted by an appropriate system so that it will not drain onto the bridge.

Inadequate drainage facilities can severely limit the life span of the superstructure. When designing drainage facilities for a structure two important criteria to keep in mind are:

1. Drains should be constructed of corrosion resistant material and the use of PVC shall not be permitted.
2. Drains should not discharge on other bridge elements or traffic passing underneath the structure.

The drip groove located on the bottom of the deck slab or fascia beam shall end 3 feet before the face of the abutment.

### 6.8.7 Waterproofing

Waterproofing and protective panels shall comply with the recommendations of Chapter 8, Part 29 of AREMA. The waterproofing shall be one layer of Butyl Rubber or EPDM membrane and shall be bonded to the entire bridge deck surface with adhesive applied in accordance with the recommendations of the membrane manufacturer. A Butyl Rubber or EPDM membrane shall be 0.06 inches thick, minimum. Field splices shall be the tongue and groove type per AREMA Chapter 8, Part 29, Detail No.3, Figure 8-29-3. Protective asphalt panels shall be placed in two layers with total thickness not less than 1 inch and shall be laid with joints staggered. Protective panels shall be bonded to the membrane and each other. For waterproofing details see [Plan No. 711200, sheet 11](#).

Alternatively, a cold liquid spray on waterproofing meeting AREMA requirements, with a single ½ inch layer of protective asphalt panels, may be acceptable to the Railroad.

Six inches of ballast shall be placed over waterproofing immediately upon acceptance by the Railroad. No construction traffic is allowed on waterproofing until the ballast covering is in place. Waterproofing installation shall be observed and approved by the manufacture's representative.

### 6.8.8 Steel Superstructure

The thickness of structural steel, except for fillers, shall not be less than 3/8 inch. Steel, subject to corrosive influences, shall be of greater thickness than otherwise specified to protect them against deterioration.

The thickness of gusset plates connecting the chords and web members of a truss shall be proportional to the force being transferred but not less than 1/2 inch.

The minimum diameter of high strength bolts shall be 7/8 inch diameter.

Floor beams shall be a minimum of 21 inches in depth.

The allowable bearing pressures as recommended in AREMA Chapter 15 shall be used for steel superstructures bearing on concrete substructures.

All fracture critical members as defined by AREMA shall be designated as FCM on the plans. Fracture critical members shall be designed for a minimum service temperature and Charpy V-Notch Toughness as required for the corresponding zone.

The Designer shall provide details such that all exposed parts will be accessible for inspection, cleaning and painting. Not less than 18 inches of clearance shall be provided between the flanges of parallel lines of beams or girders having depths in excess of 38 inches.

All designs must provide drain holes for pockets or depressions that may hold water so that steel areas drain effectively. Structural members shall not be sealed by welding except as approved by the Railroad.

In built-up steel girders, provide at least 2 feet between the web and the flange shop-welded splices.

#### 6.8.8.1 Diaphragms or Cross Frames

Diaphragms or Cross Frames shall be provided for all steel spans. Jacking stiffeners or jacking beams are required for all steel structures.

#### 6.8.8.2 Mechanically-Connected: Bottom Flanges and Intermediate Stiffeners

Girders shall have mechanically-connected bottom flanges and intermediate stiffeners when:

- The girder span is over a roadway and the use of two girders per span or track cannot be avoided (such as a through plate girder).
- 20 feet of vertical clearance cannot be provided.

Cover plates, flange elements and intermediate stiffeners shall comply with the following requirements.

1. Cover plates of girders with bolted flanges shall be equal in thickness or shall diminish outwardly in thickness. No plate shall be thicker than the flange angles. The gross area of cover plates in any flange shall not exceed 70 percent of the total flange. The total flange consists of cover plates, flange angles directly connected to the cover plates and side plates. The area of any flange element (flange angle, cover plate or side plate) shall not exceed 50 percent of the total flange.
2. Flange elements that are spliced shall be covered by extra material equal in section to the element spliced. There shall be enough bolts on each side of the splice to transmit to the splice material the stress value of the part cut. Flange angles may be spliced with angles or with a full penetration weld. No two elements shall be spliced at the same cross section or within the development length of another spliced element. Welded splices will not be allowed in plate elements of bolted flanges.
3. All intermediate stiffeners shall have a bolted connection to the web.

#### 6.8.9 Painting of Steel Structures

Painting of steel structures shall comply with the current requirements of AREMA, AASHTO specifications and recommendations of the Steel Structures Painting Council (SSPC).

Paint shall be applied in accordance with the Manufacturer's recommendations or as recommended by the SSPC, whichever is most restrictive.

The painting system, including primer and top coats, shall be submitted by the Applicant for review and approval by the Railroad and must be maintained by the Applicant.

## 6.8.10 Concrete Superstructure

Live load distribution for precast prestressed concrete single or double cell box beams shall be in accordance with Chapter 8, Part 2, Reinforced Concrete Design, Article 2.2.3.c of AREMA. This means that it shall not be assumed that the live load is necessarily equally distributed to the number of boxes supporting the tracks.

Box shaped (Single or Double void) or AASHTO type precast prestressed concrete beams for all spans shall be designed with end and interior diaphragms. Interior diaphragms shall be spaced equally across the span length.

Strands at the ends of precast prestressed concrete members shall be recessed a minimum of 1 inch into the member and the pocket filled with grout.

For AASHTO type beams, the designer shall provide a minimum of eighteen (18) inches clear between the bottom flanges to accommodate inspection and repair.

### 6.8.10.1 Tie Rods

Transverse tie rods shall be provided for all concrete spans utilizing single cell box beams. Transverse tie rods shall be used at span ends and intermediately spaced at maximum intervals of 25 feet. Wherever possible, transverse tie rods in end and interior diaphragms shall be placed perpendicular to the centerline of webs to facilitate application of transverse post-tensioning.

The minimum size of tie rod shall be 1-1/4 inches in diameter. Tie Rods shall be threaded steel bars with a minimum  $f_y = 36$  ksi. Tie rods shall be tensioned as necessary to ensure that all beam sides are in contact without causing any vertical displacement of the beams from the bearings. The tie rod shall be protected in one of the following ways:

1. Rod, plates and nuts shall be hot dip galvanized per ASTM A123 and A153 specifications.
2. All assembly parts left plain but void between rod and hole to be pressure grouted. The tie rod anchor assembly shall be recessed into the concrete and shall have 1 inch minimum grout cover.

## 6.9 Substructure

Pier and or abutment dimensions must accommodate future track(s) and Access Road per [Section 4.1.3](#) and [4.1.4](#).

Footings for all substructures shall be located and designed to allow a minimum of 12 feet measured perpendicular from centerline of nearest active track to face of shoring to facilitate footing construction. Temporary shoring shall be designed per [Section 4.4.2](#).

Cross-hole Sonic Log (CSL) Testing may be required by the Railroad to evaluate the integrity of drilled shafts/caissons. The Plans and Specifications shall include provisions for this testing.

Drilled shafts within the influence of track surcharge shall be designed with temporary casing for protection against cave-in, subsidence and or displacement of surrounding ground. Casing shall be designed for live load due to the Railroad surcharge in addition to all other applicable loads. Drilled shafts shall be designed to allow the drilling operation to proceed without impacting the Railroad operation.

### 6.9.1 Piers

Columns shall be at least 0.2H in thickness at the base. Slope the top of bridge seat to drain. If weathering steel is used for the superstructure, detail the bridge seat to minimize water staining concrete surfaces.

Provide a minimum edge distance of 6 inches from edge of masonry plate or bearing to edge of concrete.



Provide a minimum of 18 inches beyond the outside edge of outermost masonry plate or bearing to end of the pier.

Single column piers shall not be considered for Underpass Structures. Piers with a minimum of two columns shall be provided. A solid pier wall with minimum of 4 feet thickness is preferable.

Bridge piers adjacent to roadways shall be protected from vehicular traffic as required per AASHTO and State Department of Transportation standards.

#### 6.9.2 Abutments

Slope the top of bridge seat to drain. If weathering steel is used for the superstructure, detail the bridge seat to minimize water staining concrete surfaces.

The abutments shall be wide enough to satisfy the Railroad standard roadbed. For multiple track bridges, the abutment width shall be sufficient to provide for the standard shoulder, plus 20 feet for each existing or future track.

Provide a minimum edge distance of 6 inches from edge of masonry plate or bearing to edge of concrete.

Sloping embankments in front of abutments shall be paved or have grouted rip-rap on top of filter fabric.

The year of construction shall be shown at the face of abutment backwall. Numbers shall be embedded into the concrete and be 6 inches size and located where visible.

Wing walls shall be designed to support 2:1 embankment slopes and provide positive ballast containment.

#### 6.10 Sequence of Construction

It is essential that the construction proceed with no interference to Railroad operations. Continuity of safe rail operation will be required for the duration of the project. The Applicant should contact the Railroad Local Representative in the preliminary design stages to determine the Railroad operation requirements.

The most effective method for maintaining traffic is to temporarily reroute Railroad traffic around the construction site using detour tracks (shooflys). Shooflys shall be designed per [Section 4.1.1](#).

The use of shooflys for the construction of the permanent structures will minimize traffic interference with railroad operations. However, if construction requires interruption of rail traffic or track and time windows, approval from the Local Service Unit Superintendent of the area is required. No design shall advance without written approval. Prior to the start of any construction on Railroad right-of-way, a Railroad Right-of-Entry Agreement (if applicable) is required per [Section 2.3](#).

#### 6.11 Construction Excavation

Excavations for construction of footings, piers, columns, walls and other facilities that require shoring to support active tracks shall comply with BNSF/UPRR Temporary Shoring Guidelines

#### 6.12 Temporary Structures

Temporary railroad bridges used for a shoofly must be designed in accordance with AREMA and these Guidelines. Temporary open deck bridges with walkways may be used if a protective cover over the roadway and sidewalks is provided or if the roadway is closed to traffic during construction.



## 7 TRAILS

### (Non-Vehicular Crossing over or under the Railroad)

All Trails impacting the Railroad shall be designed in accordance with Section 1, 2, 3, 4 & 7 of these Guidelines, the Manual of Uniform Traffic Control Devices (MUTCD), AASHTO code and any applicable sections of AREMA.

#### 7.1 At Grade Crossing

The Railroad does not allow at grade Trail crossings. Alternative plans should be considered to avoid crossing Railroad tracks at grade. At grade crossings immediately adjacent to an existing public roadway crossing with existing Highway Railroad warning devices may be considered. However, all costs associated with the installation of the new crossing surface and crossing warning device changes or relocation will be borne by the Applicant. Scope of proposed crossing work will be determined at a joint diagnostic meeting between the Railroad and Applicant. The Trail must conform to Railroad and MUTCD requirements.

#### 7.2 Trail Parallel to Track

The Railroad does not allow Trails parallel to the track on Railroad right-of-way and does not permit the use of Railroad Access Roads for trail use. Railroad bridges can not be used to serve Trail traffic or support a structure serving Trail traffic. Fences or barriers such as vegetation, ditches, and/or berms shall separate Trails that are outside the Railroad right-of-way and running parallel to the track to stop trespassers from entering the Railroad right-of-way. See [Plan No. 711000, sheet 2](#).

#### 7.3 Grade Separated Crossing

Consider the use of existing structures to cross the Railroad tracks. In accordance with Homeland Security requirements some Railroad sites and structures are off limits for Trail use and crossing.

##### 7.3.1 Overhead Crossing (Trail over Railroad)

New and existing Overhead Structures must be designed or modified with a protective curved fence. See [Plan No. 711100, sheet 4](#). New Overhead Structures shall be designed per [Section 5](#) of these Guidelines.

##### 7.3.2 Underpass Crossing (Railroad Structure over Trail)

The Railroad discourages the construction of new Underpass Structures. If an Underpass Structure is the only feasible structure type for the proposed site, a detailed type selection report must be submitted to justify its use.

###### 7.3.2.1 New Underpass Crossing

New Underpass Structures shall be designed per [Section 6](#) of these Guidelines.

All pipe and concrete box culverts shall be designed per Railroad requirements and any applicable sections of AREMA. Confined structures are discouraged. To improve safety and sight distance all structures shall be tangent without curvature. The clear width and height of pedestrian structures shall be subject to the project site and structure length. The line of sight, historical security data and lighting shall be used for determining the required size of opening. Vertical Clearance shall not be less than 8 feet.

###### 7.3.2.2 Crossing Under Existing Structures

An open deck structure shall be modified to a ballast deck or solid deck structure to maintain a safe crossing under a Railroad structure. If modifying an existing open deck structure is not practical, provide a protective cover over the Trail.

Protection from falling debris is required for the crossing of pedestrians safely under active rail bridges. The overhead protection shall extend a minimum of 30 feet out on each side of the Railroad structure, or further as designated by the Railroad's Central Engineering department. However, the protective cover shall not reduce the existing hydraulic opening, shall not function as a debris catcher and shall not impact proper inspection of the structure by Railroad personnel.

Measuring the from bottom of the Railroad structure to the top of the protective cover shall not be less than three feet to allow for inspection and shall not be attached to the structure. If the Applicant can not meet these requirements then the Applicant shall provide a removable hatch to allow Railroad personnel to inspect the bridge structure.

The protective cover shall be removable and can be removed, at the Applicant's expense, without advanced notice if deemed necessary by the Railroad.

A protective cover shall be required, meeting the above criteria, for ballast deck bridges unless the superstructure meets the requirements of [Section 6.8.4](#).

#### 7.4 Drainage

The drainage pattern of the site before and after construction shall be analyzed. Adequate drainage provisions shall be incorporated into the plans and specifications. Detailed Hydraulic Report may be required subject to site condition. The Hydraulic report must meet the Railroad Hydraulic Criteria per [Sections 4.5.2](#) and [4.5.3](#).

#### 7.5 Fence

The Applicant shall specify the appropriate fencing to contain the Trail traffic, within the Trail, crossing the Railroad right-of-way. Fence limits are subject to each project site and must be determined on a case by case basis. Refer to [Section 4.6](#) for fence requirements and [Plan No. 711000, sheet 1](#) for fence details.

All Railroad right-of-way fencing, for Trails adjacent to the Railroad right-of-way, must be provided, installed outside Railroad right-of-way and maintained by the Applicant.

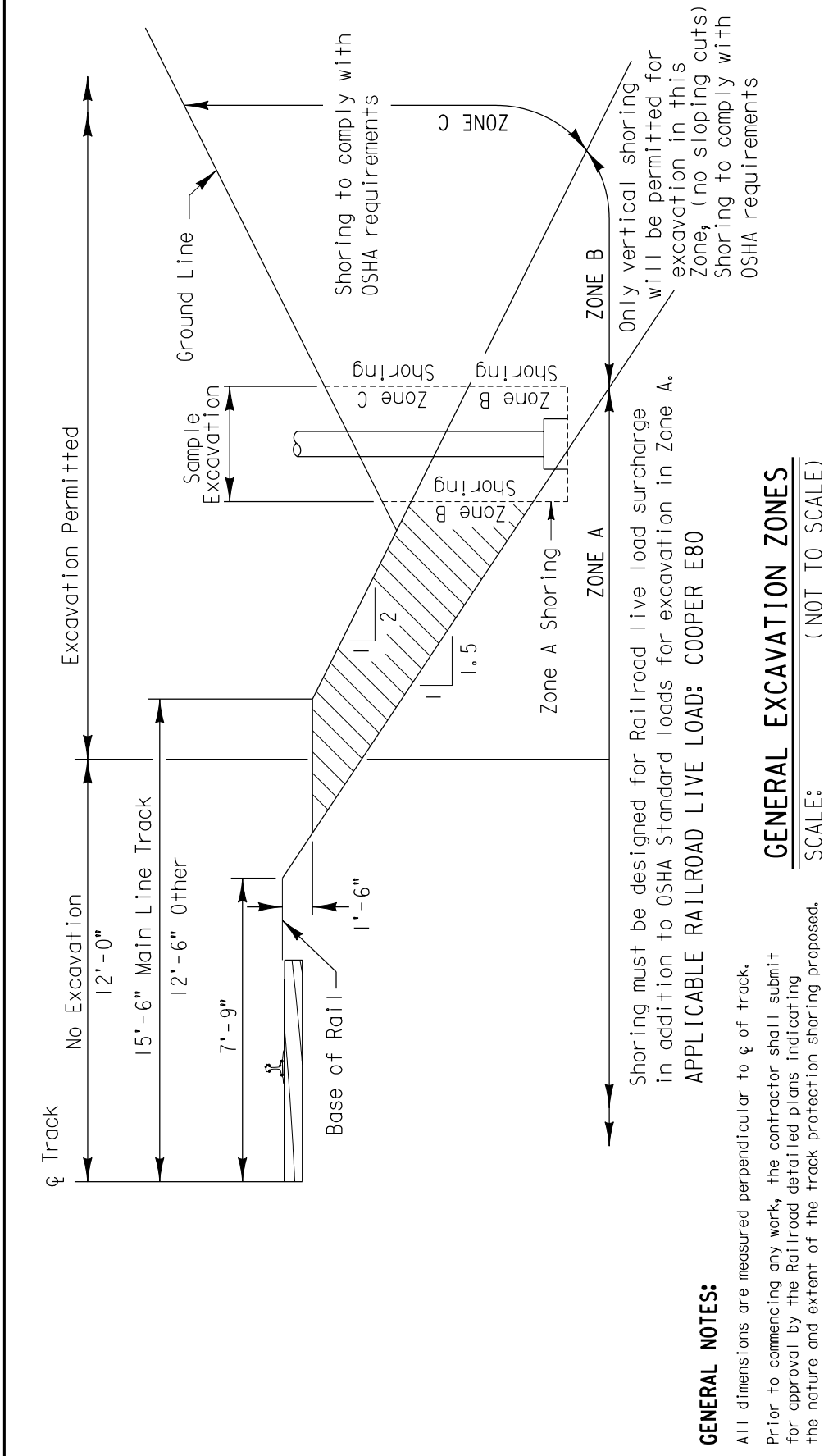
#### 7.6 Signs

All access to Trails crossing railroad track shall be protected with bollard posts and signs prohibiting non-authorized vehicular access.

All advisory and regulatory signs shall be in compliance with MUTCD and AASHTO. "No Trespassing" signs shall be posted every 500 feet.

#### 7.7 Lighting

Adequate lighting shall be provided per AASHTO Roadway Lighting Design Guide requirements. Dark confined and isolated Trail crossings hidden from public view may attract illegal activities. Line of sight is extremely important when visibility is a matter of safety and security. The lighting design shall account for the impact on train operations. Lighting shall provide visibility for the Trail without directing light toward the train traffic.



**GENERAL NOTES:**

All dimensions are measured perpendicular to  $\phi$  of track. Prior to commencing any work, the contractor shall submit for approval by the Railroad detailed plans indicating the nature and extent of the track protection shoring proposed. The contractor shall install the temporary shoring system per the approved plans. Design of the temporary shoring system to comply with **GUIDELINES FOR TEMPORARY SHORING.**

For excavations which encroach into Zone A or B, shoring plans shall be accompanied by design calculations. Plans and calculations must be signed and stamped by a Professional Engineer registered in the state where the work will be performed.

Shoring must be designed for Railroad live load surcharge in addition to OSHA Standard loads for excavation in Zone A. **APPLICABLE RAILROAD LIVE LOAD: COOPER E80**

**GENERAL EXCAVATION ZONES**  
SCALE: \_\_\_\_\_ (NOT TO SCALE)

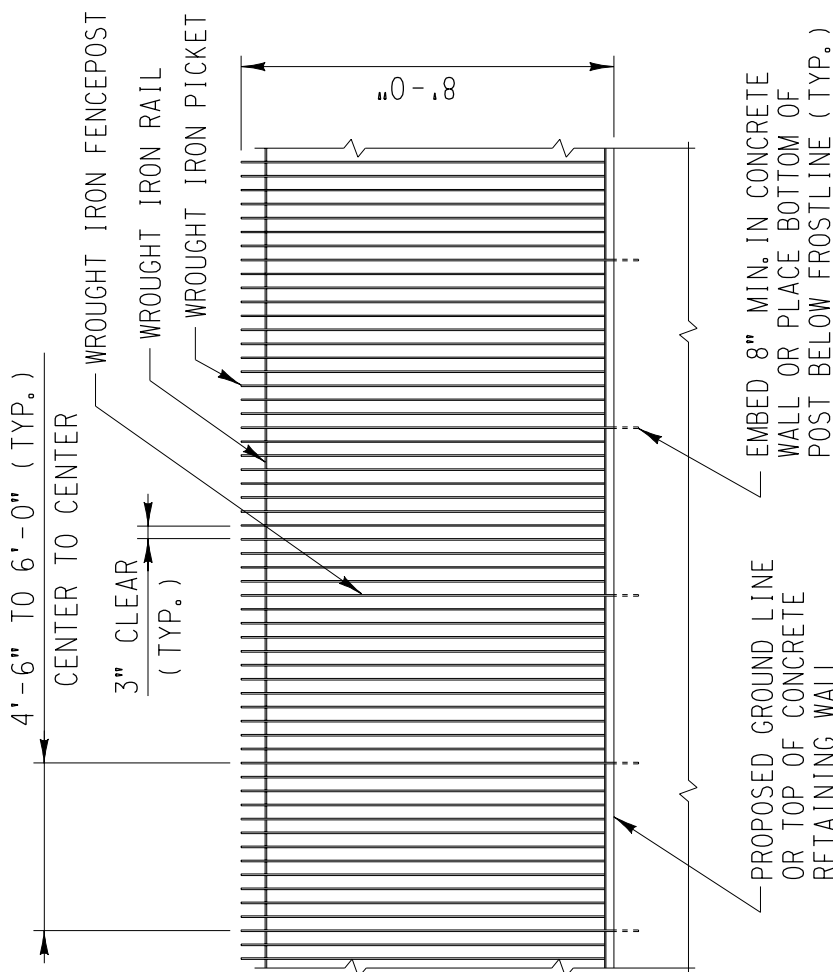
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 APPROVED:  
*K.H. Jenkinson*  
 BNSF - ASSISTANT DIRECTOR STRUCTURES DESIGN  
*Berg J. Mark* 9-104  
 UPRR - MGR SPECIAL PROJECTS STRUCTURES DESIGN

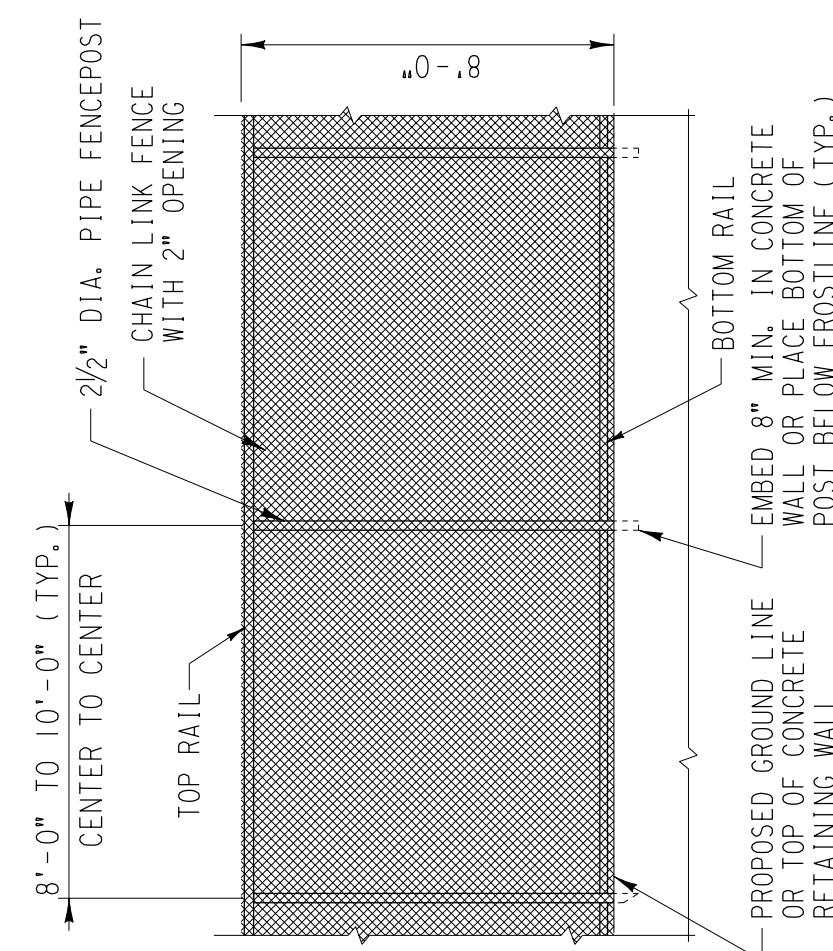


**GENERAL SHORING REQUIREMENTS**

FILE OWNER: UPRR DATE: 5-6-03 SHEET: 1 OF 1  
 PLAN NO.: 710000 PLOTTED: \$\$\$DATE\$\$\$ \$TIME





### WROUGHT IRON PICKET FENCE



### CHAIN LINK FENCE

## FENCE ELEVATION



SCALE:  $\frac{3}{16}'' = 1'-0''$

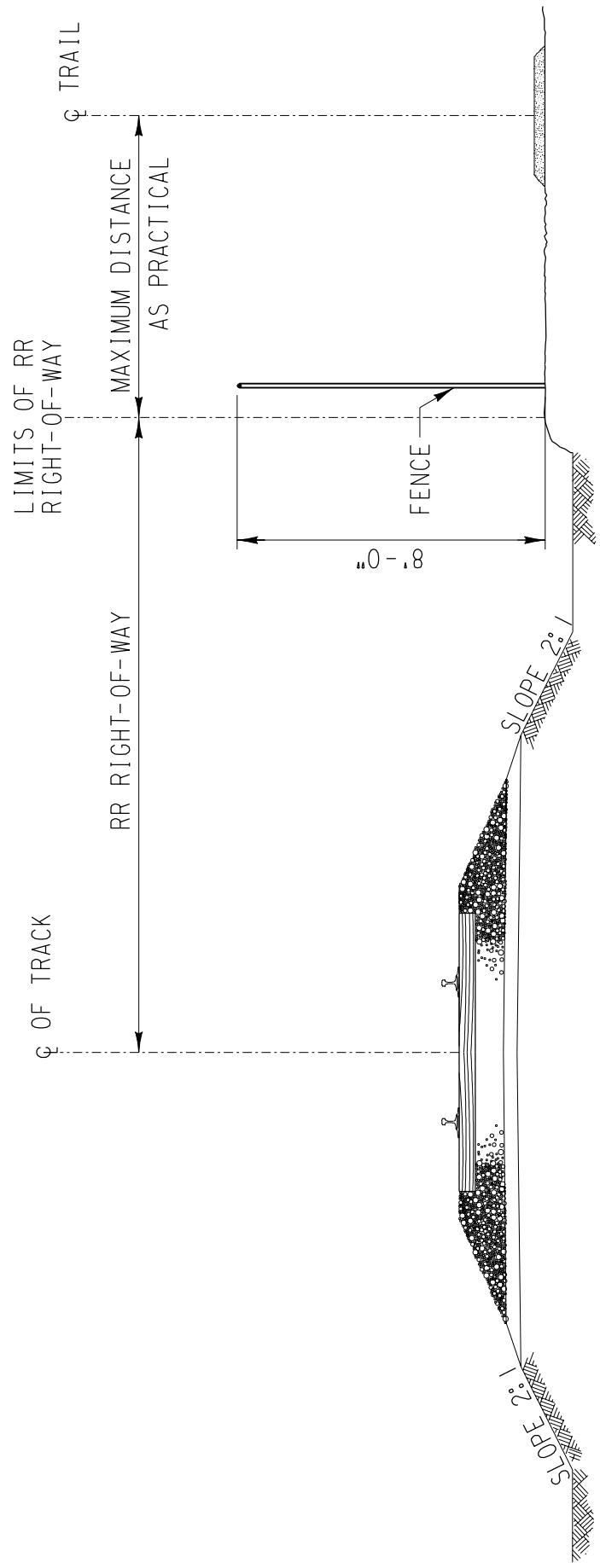



**BRIDGE STANDARDS**  
RIGHT-OF-WAY FENCING

**FENCE DETAILS**

FILE OWNER: UPRR    DATE: 1/24/07  
 PLAN NO.: 711000    SHEET: 1

REVISIONS		DESIGN BY: RAF	DRAWN BY: FJS	CHECKED BY: KHJ
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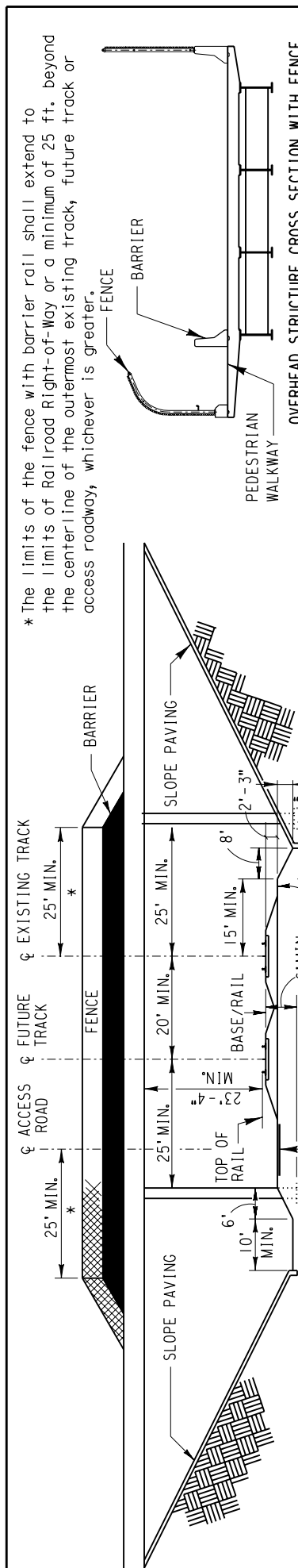
**TYPICAL SECTION WITH STANDARD FLAT BOTTOM DITCH**



**BRIDGE STANDARDS**  
 RIGHT-OF-WAY FENCING  
**FENCE REQUIREMENTS FOR ADJACENT TRAIL OUTSIDE RAILROAD RIGHT-OF-WAY**

DESIGN BY: RAF    DRAWN BY: FJS    CHECKED BY: KHJ  
 APPROVED:  
*K.H. Jernison*  
 BNSF - ASSISTANT DIRECTOR STRUCTURES DESIGN  
*Burge J. Meyer*  
 UPRR - MGR SPECIAL PROJECTS STRUCTURES DESIGN

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\* The limits of the fence with barrier rail shall extend to the limits of Railroad Right-of-Way or a minimum of 25 ft. beyond the centerline of the outermost existing track, future track or access roadway, whichever is greater.

NOTE: WIDTH AND HEIGHT SUBJECT TO HYDRAULIC REQUIREMENTS. SEE PLAN NO. 711100, SHEET 5.

**ELEVATION**  
PERPENDICULAR TO TRACKS

**GENERAL**  
Fence shall be provided as indicated on the cross sections and elevation view on both sides of the Overhead Structure in ALL new or modified structures.  
Barrier rail for Overhead Structures, without walkways, that may be subject to snow removal shall be a minimum of 42 inches in height with a 4 foot wide shoulder or 30 inches in height with a 6 foot wide shoulder. See Plan No. 711100, Sheet 4.  
Lights are to be installed on the underside of the Overhead Structure where shadows cast by the structure would interfere with Railroad operations.  
Slope paving shall be provided where end slopes are equal to or exceed 2 horizontal to 1 vertical.  
Falsework for construction of overhead structures shall comply with Railroad Requirements.  
Demolition of existing Overhead Structures shall comply with Railroad Demolition Requirements. Temporary shoring shall be designed in accordance with Railroad Guidelines for Temporary Shoring.  
Applicant shall be responsible for identification, location and protection of existing utilities.  
Call the following numbers at least 48 hours prior to commencing work to determine location of fiber optics:  
UPRR "Call Before You Dig", 1-800-336-9193  
BNSF "Call Before You Dig", 1-800-533-2891.

**PIERS**  
Piers shall be located outside Railroad Right-of-Way.  
Pier protection walls shall be provided in accordance with AREMA Chapter 8, Part 2.1.5 for piers within 25 feet of the centerline of track.  
Top of footings located within 25 feet from centerline of track shall be a minimum of 6 feet below base of rail and a minimum of 1 foot below flowline of ditch.


**DRAINAGE**  
Drainage from the Overhead Structure shall be diverted away from and not discharged onto the tracks, roadbed and Railroad Right-of-Way.  
At minimum, a standard "v"-shaped or flat-bottom ditch shall be provided on each side of the tracks as necessary.  
Culverts may be installed in lieu of standard Railroad ditches when approved by Railroad Central Engineering. Maintenance of culverts will be at Applicant's expense.

**FUTURE TRACKS AND ACCESS ROAD**  
Space is to be provided for one or more future tracks as required for long range planning or other operating requirements. Where provision is made for more than two tracks, space is to be provided for an access road on both sides of tracks.

**CLEARANCES**  
Minimum vertical clearance shall be 23'-4" above the top of high rail within 25' of centerline of track. Additional clearance may be required for construction purposes or if sag of vertical curve must be adjusted or if future track raise for flood considerations or maintenance is probable.  
Minimum horizontal clearances, measured at right angle from centerline of track, shall be as shown in elevation view. For minimum construction clearances, see Plan No. 711100, Sheet 3.

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APPROVED:  
*K.H. Jemison*  
BNSF - ASSISTANT DIRECTOR STRUCTURES DESIGN  
*George J. Meyer*  
UPRR - MGR SPECIAL PROJECTS STRUCTURES DESIGN

**BNSF RAILWAY**  **BRIDGE STANDARDS**  
GRADE SEPARATION GUIDELINES (OVERHEADS)  
**GENERAL OVERHEAD STRUCTURE DRAWING**

FILE OWNER: UPRR    DATE: 1/24/07  
PLAN NO.: 711100    SHEET: 1  
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## PLAN

1. North Arrow
2. Centerline of bridge and/or centerline of project.
3. Track layout and limits of Railroad right-of-way with respect to centerline of main lines.
4. Footprint of proposed superstructure and substructure including existing structure if applicable.
5. Show and label future tracks, access roadways and existing tracks as main line, siding, spur, etc.
6. Indicate point of minimum vertical clearance and distance, measured perpendicular, from the centerline of nearest track.
7. Horizontal clearance at right angle from centerline of nearest existing or future track to the face of obstruction such as substructure above grade.
8. Horizontal clearance at right angle from centerline of nearest existing or future track to the face of nearest foundation below grade.
9. Indicate horizontal spacing at right angle between centerlines of existing and/or future tracks.
10. Limits of shoring and minimum distance at right angle from centerline of nearest track.
11. Locate and show all existing facilities and utilities and their proposed relocation, if required.
12. Toe of slope and/or limits of retaining wall.
13. Existing and proposed contours.
14. Limits of barrier rail and fence.
15. Indicate minimum structure separation for adjacent structures.
16. Indicate Railroad Milepost and direction of increasing Milepost.
17. Direction of flow for all drainage systems within project limits.
18. Timetable direction arrows, nearest Railroad station and end station of Railroad Subdivision.

## ELEVATION

1. Individual span length and total bridge length.
2. Limits of barrier rail and fence with respect to centerline of track.
3. Depth of foundation below bottom of tie.
4. Horizontal clearance at right angle from centerline of nearest existing or future track to the face of obstruction such as substructure above grade.
5. Indicate horizontal spacing at right angle between centerlines of existing or future track to the face of foundation below grade.
6. Minimum horizontal clearance at right angle from centerline of nearest existing or future track to the face of foundation below grade.
7. Indicate top and bottom of pier protection wall elevation relative to top of rail elevation.
8. Controlling dimensions of drainage ditches and/or drainage structures.
9. Top of rail elevations for all tracks.
10. Minimum permanent vertical clearance above top of high rail to the lowest point under the bridge.
11. Existing and proposed groundline & roadway profile.
12. Show elevation of existing or relocated utilities.
13. Show slope and specify type of slope paving. Toe of slope shall be shown relative to drainage ditch and top of subgrade.

14. Show and label future tracks, access roads and existing tracks as main line, siding spur, etc.
15. Show location of deck joints.
16. Location of deck drains.

## TYPICAL SECTION

1. Total width of superstructure.
2. Width of shoulder and/or sidewalk.
3. Type of barrier rail, fence and their heights.
4. Depth of superstructure.

## TITLE BLOCK

1. The name & logo of engineering firm or project owner.
2. Drawing title.
3. Railroad milepost number and subdivision.
4. City, county and state.
5. Project name and location.
6. Date.
7. Latitude and longitude.


## RAILROAD PROFILE GRADE DIAGRAM

1. Show existing and proposed track profile at the bridge location and a minimum of 1,000 feet past each edge of the bridge.

Note: The Railroad Milepost is calculated at the intersection of centerlines of the Overhead Structure and Existing Track. All separate Overhead Structures shall have individual Milepost designations.

and/or future tracks.

to top of rail elevation.

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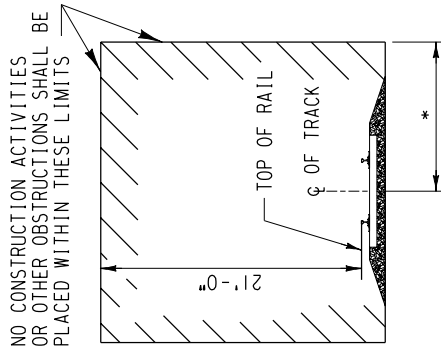


**BRIDGE STANDARDS**  
GRADE SEPARATION GUIDELINES (OVERHEADS)  
**MINIMUM**  
**LAYOUT REQUIREMENTS FOR OVERHEAD STRUCTURES**

FILE OWNER: UPRR    DATE: 1/24/07    SHEET: 2  
 PLAN NO.: 711100

**CONSTRUCTION NOTES:**

1. Any shoring system that impacts the Railroad's operation and/or supports the Railroad's embankment shall be designed and constructed per Railroad Guidelines for Temporary Shoring.
2. All demolition within the Railroad's right-of-way and/or demolition that may impact the Railroad's tracks or operations shall comply with the Railroad's Demolition requirements.
3. Erection over the Railroad's track shall be planned such that it enables the track(s) to remain open to traffic per Railroad requirements.
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.



**MINIMUM CONSTRUCTION CLEARANCE ENVELOPE**

(NORMAL TO RAILROAD)

FIGURE 1

\* 15'-0" for BNSF and 12'-0" for UPRR

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APPROVED:

*K.H. Jemison*  
BNSF - ASSISTANT DIRECTOR STRUCTURES DESIGN

*Borge J. Meyer*  
UPRR - MGR SPECIAL PROJECTS STRUCTURES DESIGN

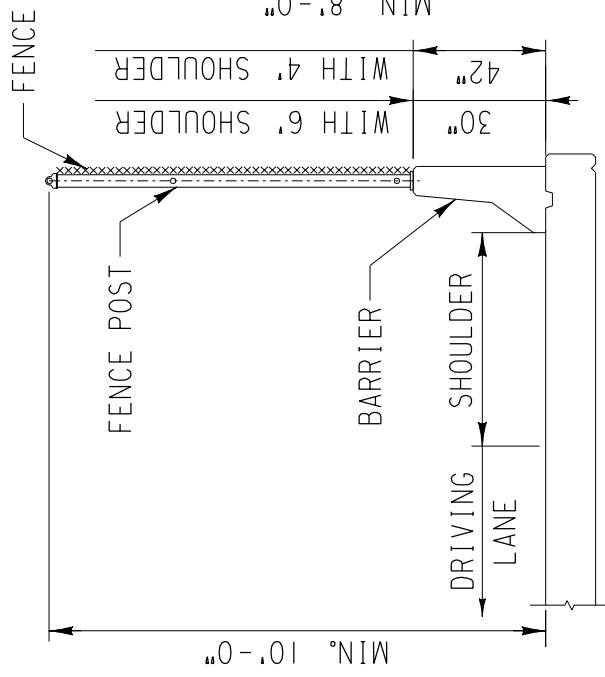


**BRIDGE STANDARDS**  
GRADE SEPARATION GUIDELINES (OVERHEADS)

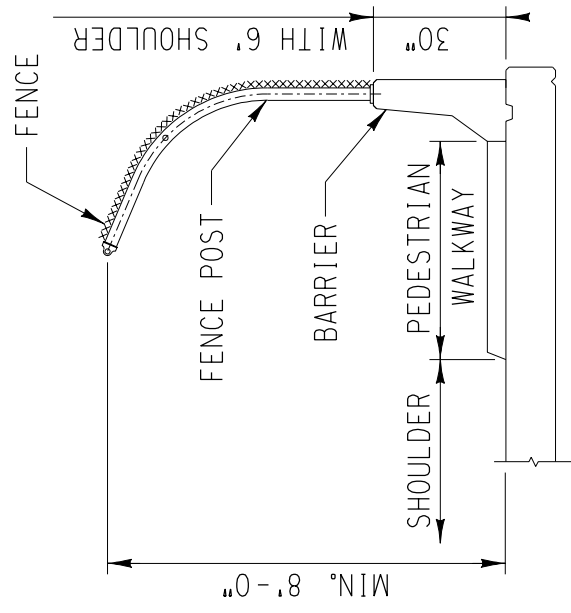
**CONSTRUCTION NOTES**

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PLAN NO.: 711100	SHEET: 3

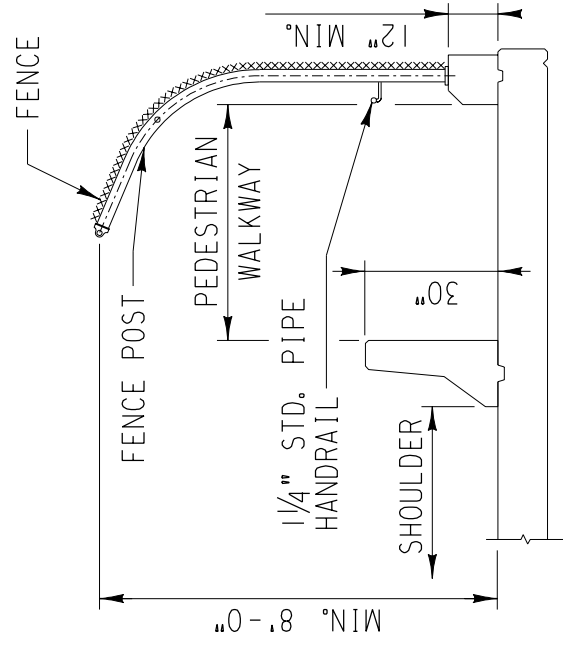




**FENCE ON BARRIER**





**WALKWAY FENCE ON BARRIER**



**WALKWAY FENCE ON CURB WITH BARRIER**

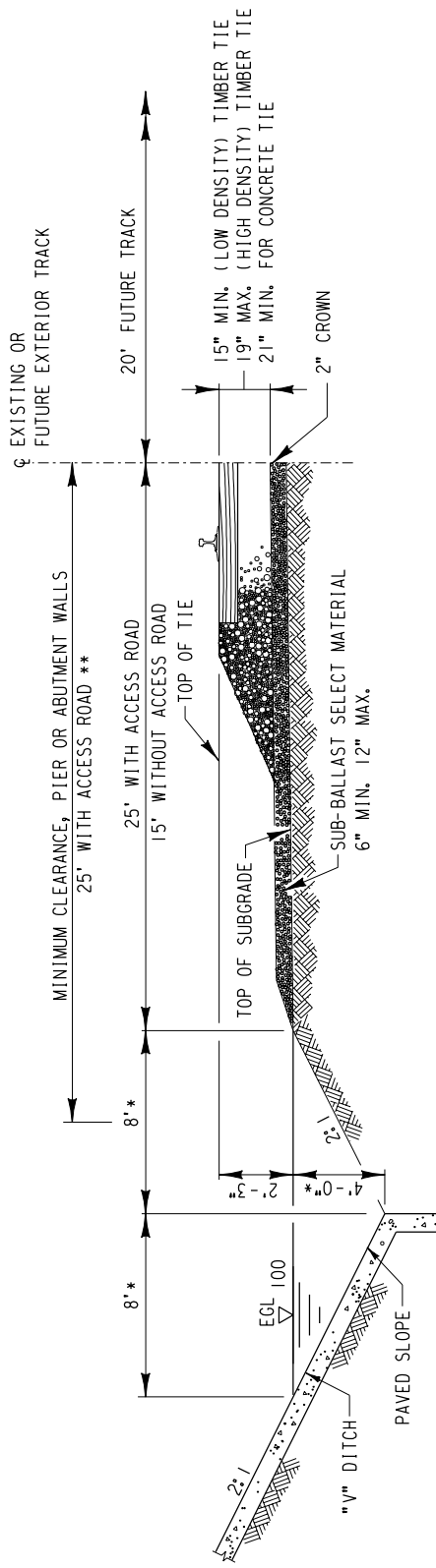
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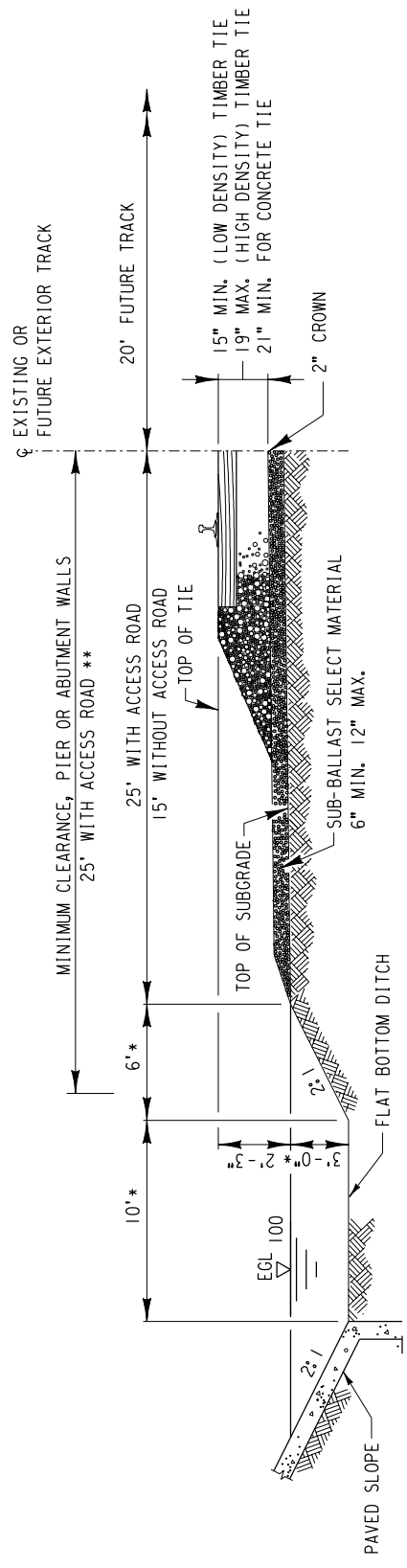
**BRIDGE STANDARDS**  
 GRADE SEPARATION GUIDELINES (OVERHEADS)

**OVERHEAD STRUCTURE BARRIERS AND FENCES**

FILE OWNER: UPRR	DATE: 1/24/07	SHEET: 4
PLAN NO.: 711100		



TYP. SECTION AT ABUTMENT SLOPES WITH STD. "V" DITCH



TYP. SECTION AT ABUTMENT SLOPES WITH STD. FLAT BOTTOM DITCH

- NOTE:
- MINIMUM DITCH SIZES ARE SHOWN. DITCH SIZE TO BE INCREASED AS REQUIRED BASED ON RR HYDRAULIC CRITERIA.
  - \* WIDTH AND HEIGHT SUBJECT TO HYDRAULIC REQUIREMENTS.
  - \*\* LOCATION OF PIER, BENT COLUMNS OR ABUTMENT WALLS SHOULD NOT INTERFERE WITH THE DRAINAGE IN THE AREA. IF MINIMUM STANDARD DITCHES ARE NOT PROVIDED IN THE LAYOUT, LONGITUDINAL CULVERTS SHALL BE PROVIDED THAT WILL HANDLE THE DRAINAGE AS REQUIRED BY THE HYDRAULIC STUDIES.

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APPROVED:

*K.H. Jemison*  
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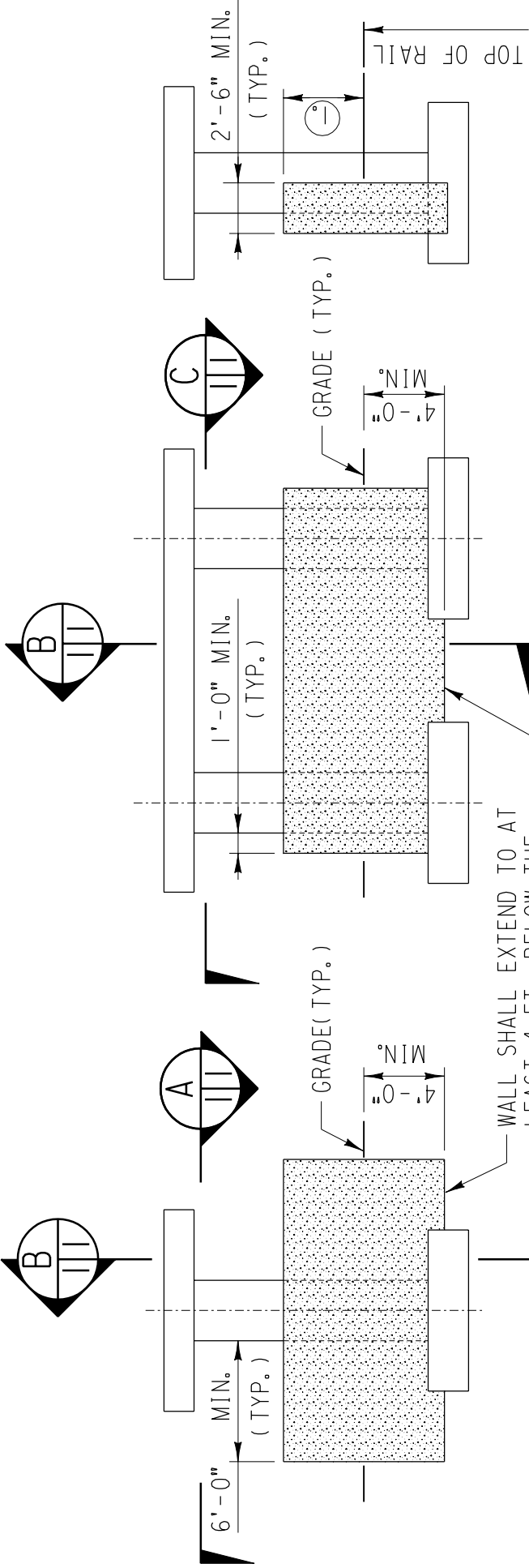
*Burge & J. Meyer*  
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**BRIDGE STANDARDS**  
 GRADE SEPARATION GUIDELINES (OVERHEADS)

**TYPICAL SECTIONS AT ABUTMENT SLOPES**

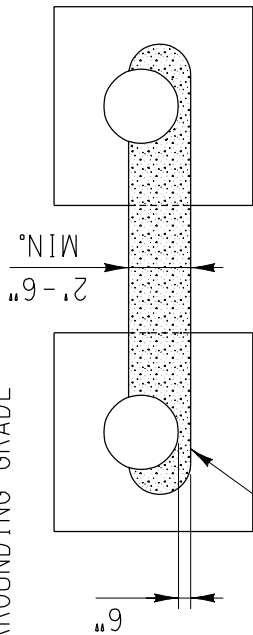
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WALL SHALL EXTEND TO AT LEAST 4 FT. BELOW THE LOWEST SURROUNDING GRADE

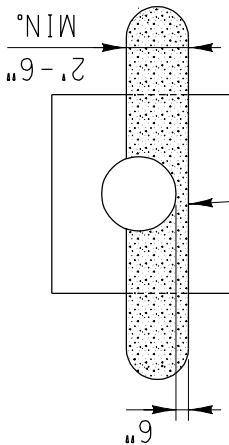
**SECTION B**  
SCALE: 1/8" = 1'-0"

1. 6'-0" MINIMUM FOR PIERS FROM 12 FT. TO 25 FT. CLEAR FROM THE CENTERLINE OF TRACK. 12'-0" MINIMUM FOR PIERS LESS THAN 12 FT. CLEAR FROM THE CENTERLINE OF TRACK.



FACE OF PROTECTION WALL TRACK ON ONE SIDE OF COLUMNS. TWO OR MORE COLUMNS

**SECTION C**  
SCALE: 1/8" = 1'-0"



FACE OF PROTECTION WALL TRACK ON ONE SIDE OF COLUMNS. SINGLE COLUMN

**SECTION A**  
SCALE: 1/8" = 1'-0"



**BRIDGE STANDARDS**  
GRADE SEPARATION GUIDELINES (OVERHEADS)

**STANDARDS FOR PIER PROTECTION WALLS**

FILE OWNER: UPRR DATE: 1/24/07 SHEET: 6  
PLAN NO.: 711100

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APPROVED: *K.H. Jemison*  
BNSF - ASSISTANT DIRECTOR STRUCTURES DESIGN  
*Burge & Meyn*  
UPRR - MGR SPECIAL PROJECTS STRUCTURES DESIGN

## PLAN

1. North Arrow
2. Alignment of centerline of bridge and/or horizontal control line of project, centerline of existing track(s), centerline of future track(s), centerline of shoofly, centerline of roadway. Identify tracks as main, siding, etc.
3. Angle between centerline of roadway and centerline of bridge. Skew angle of substructure.
4. Horizontal distance between centerlines of main track(s) and adjacent existing and/or future tracks.
5. Individual span length(s) and total bridge length from face to face of backwalls.
6. Limits of Railroad right-of-way with respect to centerline of main track. Limits of Right-of-Way fencing.
7. Footprint of proposed superstructure and substructure including approach slabs and existing structure, if applicable.
8. Footprint of roadway, sidewalks, retaining walls, etc.
9. Location of access roadway(s) and turnarounds.
10. Timetable direction arrows, nearest railroad station and end station of railroad subdivision.
11. Railroad Milepost measured at the inside face of backwall, at the low milepost bridge end.
12. Point of minimum vertical clearance.
13. All existing facilities and utilities and their proposed relocation, if required.
14. Limits of shoring including minimum distance at right angle from centerline of nearest track.
15. Limits of grading, with existing and proposed contours.
16. Minimum structure separation for adjacent structures.
17. Direction of flow for all drainage systems within project limits.
18. Location of geotech borings.

## ELEVATION

1. Individual span length(s) and total bridge length from inside face to face of backwalls.
2. Distance from nearest Railroad Milemarker to inside face of backwall at the low milepost bridge end.
3. Profile grade of bridge.
4. Profile grade and top of rail elevations for main track.
5. Roadway section.
6. Minimum vertical clearance from roadway to bridge.
7. Limits of handrail/fence on bridge.
8. Location of fixed and expansion bearings.
9. Location and type of substructure with elevations.
10. Numbering of spans, abutments and piers.
11. Existing and proposed groundline, including slope paving.
12. Existing and proposed utilities.
13. Depth of foundation below roadway.

## TYPICAL SECTION

1. Centerline of bridge and/or horizontal control line of project, centerline of existing track(s), centerline of future track(s). Identify tracks as main, siding, etc.
2. AREMA clearance envelope.
3. Horizontal distance between centerline of tracks, distance from centerline of track to face of ballast retainer and handrail/fence.
4. Total width of superstructure.
5. Width of walkway.
6. Height and type of ballast retainer, handrail/fence.
7. Depth of superstructure.
8. Rail, tie and ballast system with vertical distance from top of rail to top of deck and minimum depth of ballast under the tie (12").
9. Cross slope of deck, if applicable, and waterproofing system.
10. Girder spacing.
11. Diaphragms: Steel - end and intermediate  
Concrete - tie rods.

## TITLE BLOCK

1. The name & logo of engineering firm or project owner.
2. Drawing title.
3. RR Milepost number and subdivision.
4. City, county and state.
5. Project name and location.
6. Date.
7. Latitude and Longitude.

## RAILROAD PROFILE GRADE DIAGRAM

1. Show existing and proposed track profile at the bridge location and a minimum of 1,000 feet past each end of the bridge.



**BRIDGE STANDARDS**  
GRADE SEPARATION GUIDELINES (UNDERPASS)

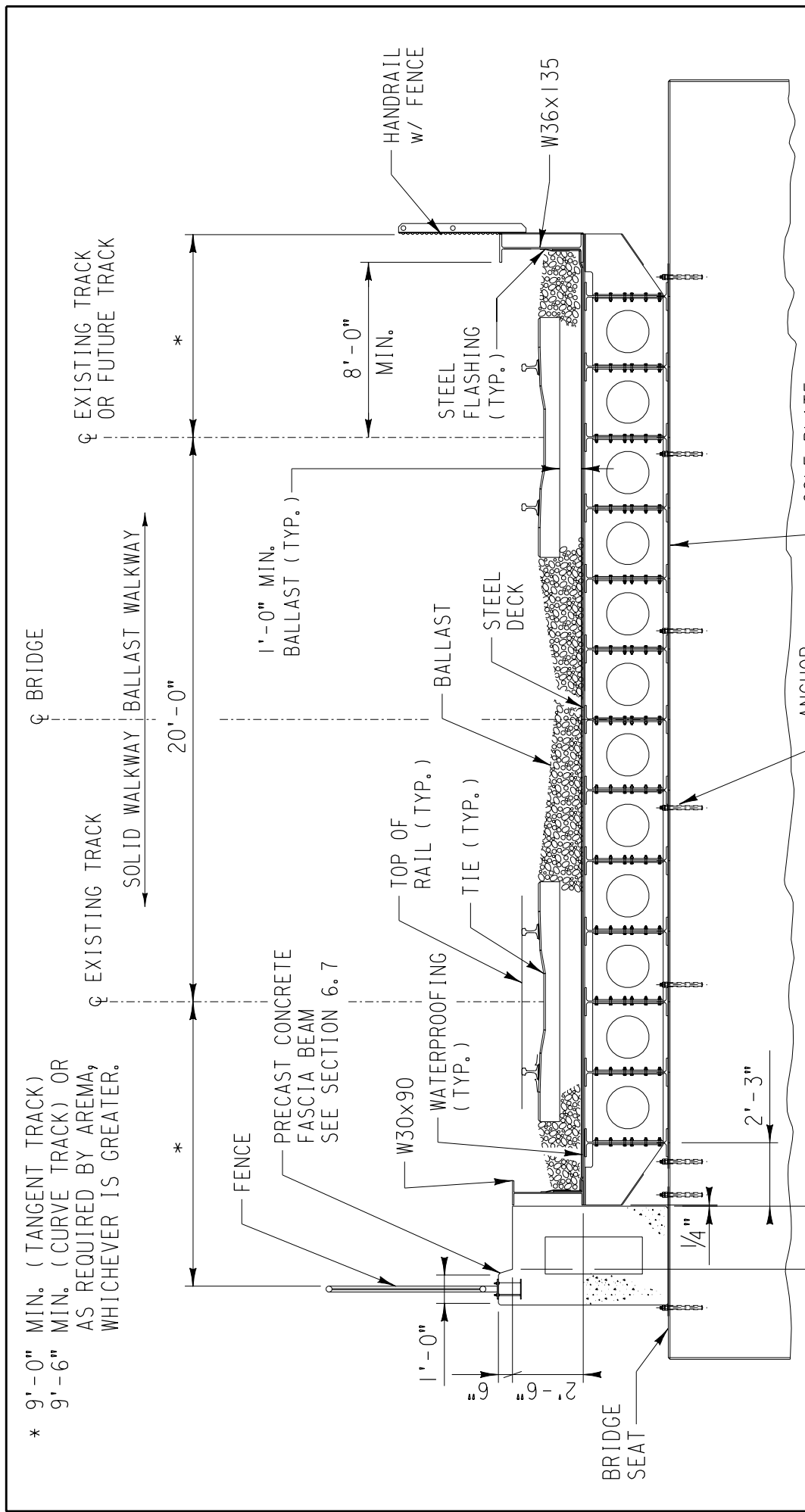
**MINIMUM LAYOUT REQUIREMENTS FOR UNDERPASS STRUCTURES**

FILE OWNER: UPRR    DATE: 1/24/07  
PLAN NO.: 711200    SHEET: 1

DESIGN BY: RAF		DRAWN BY: FJS		CHECKED BY: KHJ	
APPROVED:					
REVISIONS					
DATE	LTR.	DESCRIPTION			
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*K.H. Jemison*  
BNSF - ASSISTANT DIRECTOR STRUCTURES DESIGN

*Burge & Meyn*  
UPRR - MGR SPECIAL PROJECTS STRUCTURES DESIGN



**BNSF RAILWAY**

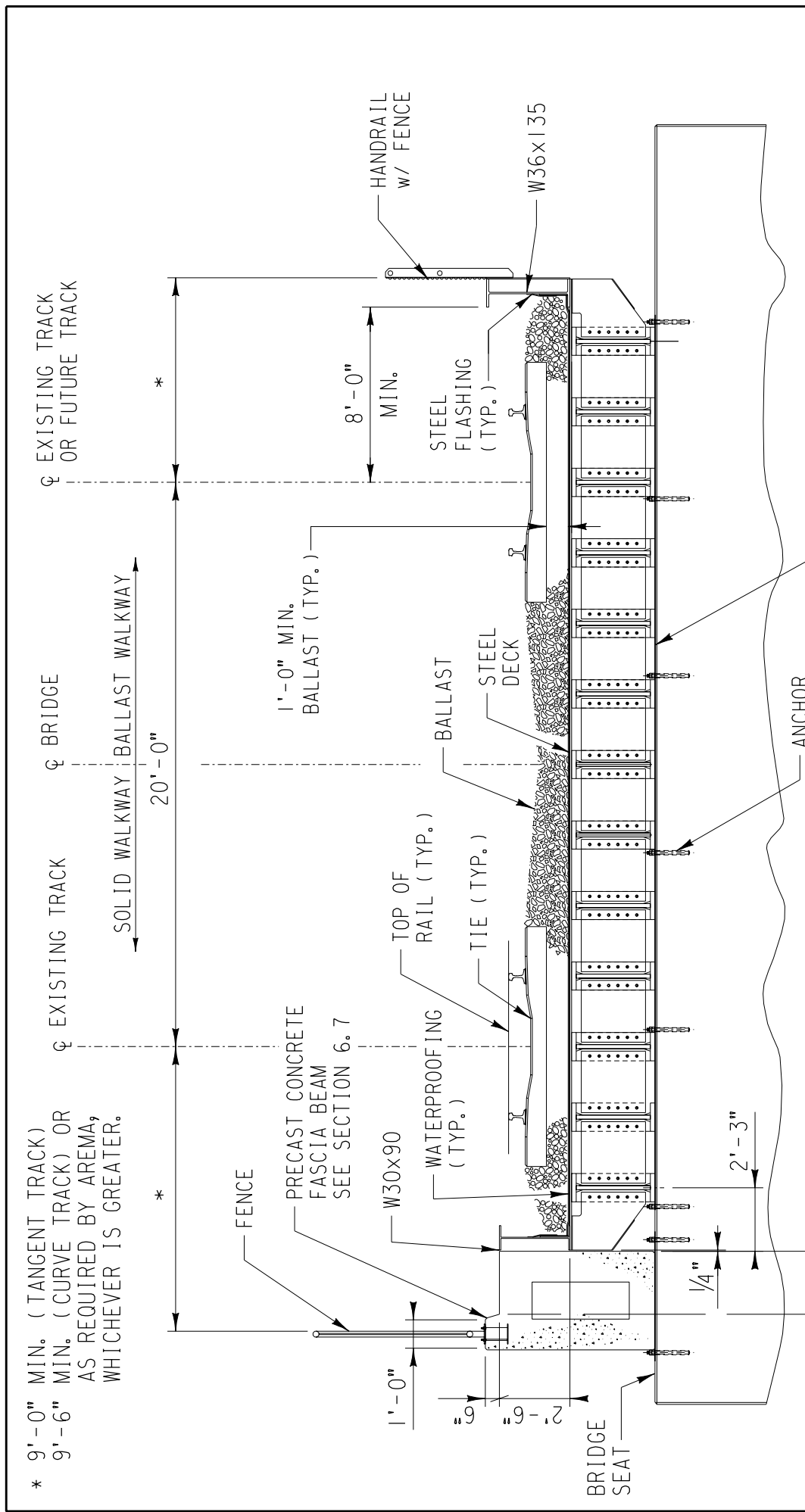
**UNION PACIFIC**


**BRIDGE STANDARDS**  
GRADE SEPARATION GUIDELINES (UNDERPASS)

**ROLLED BEAMS w/ STEEL PLATE DECK**

FILE OWNER: UPRR    DATE: 1/24/07    SHEET: 2  
 PLAN NO.: 711200

REVISIONS		DESIGN BY: RAF	DRAWN BY: KDM	CHECKED BY: KHJ
DATE	LTR.	APPROVED:		
/		<p><i>K.H. Jemison</i> BNSF - ASSISTANT DIRECTOR STRUCTURES DESIGN</p> <p><i>Burge &amp; Meyr</i> UPRR - MGR SPECIAL PROJECTS STRUCTURES DESIGN</p>		
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**BNSF RAILWAY** 

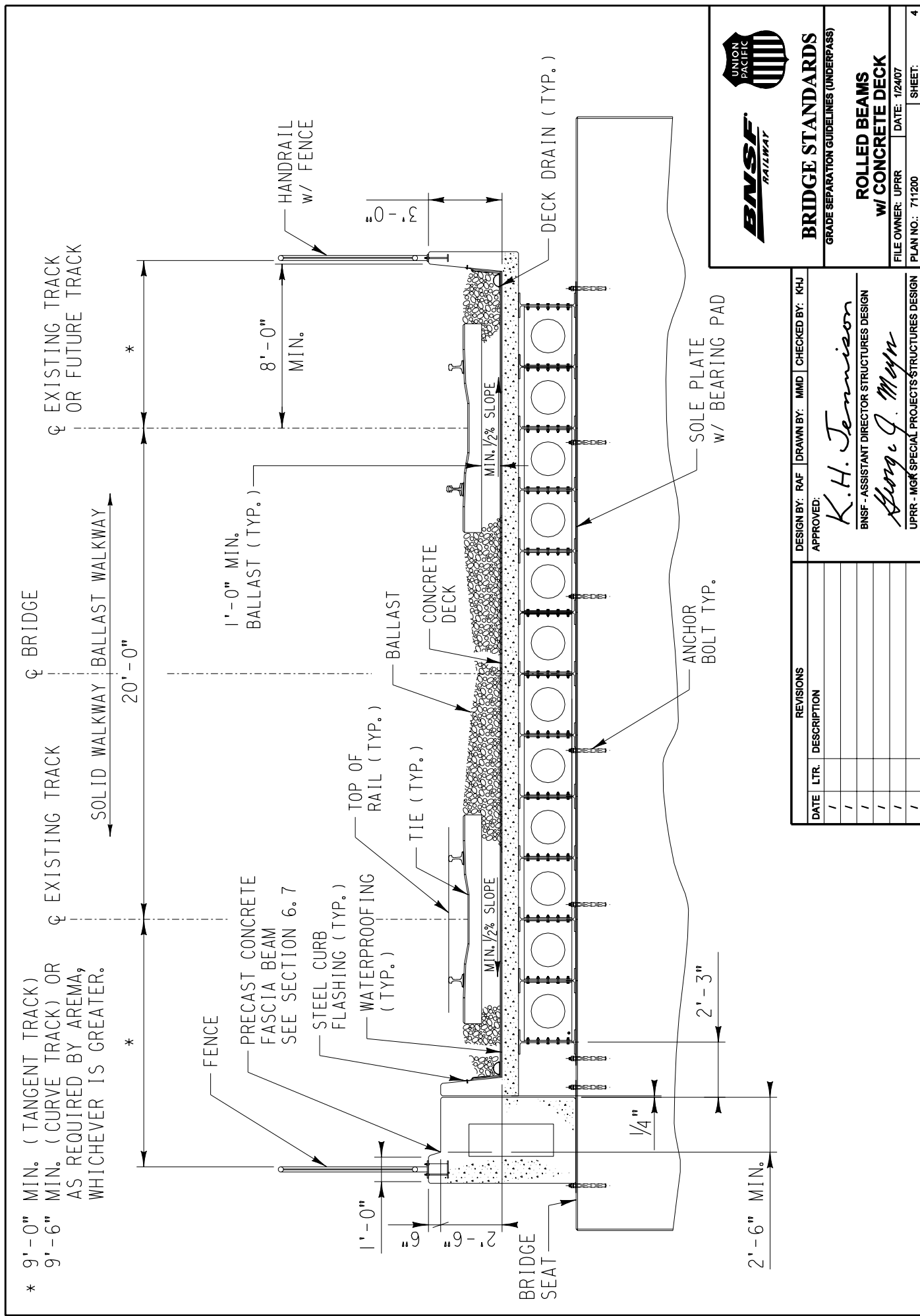
**BRIDGE STANDARDS**  
GRADE SEPARATION GUIDELINES (UNDERPASS)

**STEEL PLATE GIRDERS W/ STEEL PLATE DECK**

FILE OWNER: UPRR | DATE: 1/24/07 | SHEET: 3  
 PLAN NO.: 711200

DESIGN BY: RAF | DRAWN BY: KOM | CHECKED BY: KHJ  
 APPROVED: *K.H. Jemison*  
 BNSF - ASSISTANT DIRECTOR STRUCTURES DESIGN  
*George J. Meyer*  
 UPRR - MGR SPECIAL PROJECTS STRUCTURES DESIGN

REVISIONS	
DATE	DESCRIPTION
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**BNSF RAILWAY**

**UNION PACIFIC**

**BRIDGE STANDARDS**

GRADE SEPARATION GUIDELINES (UNDERPASS)

**ROLLED BEAMS W/ CONCRETE DECK**

FILE OWNER: UPRR    DATE: 1/24/07

PLAN NO.: 711200    SHEET: 4

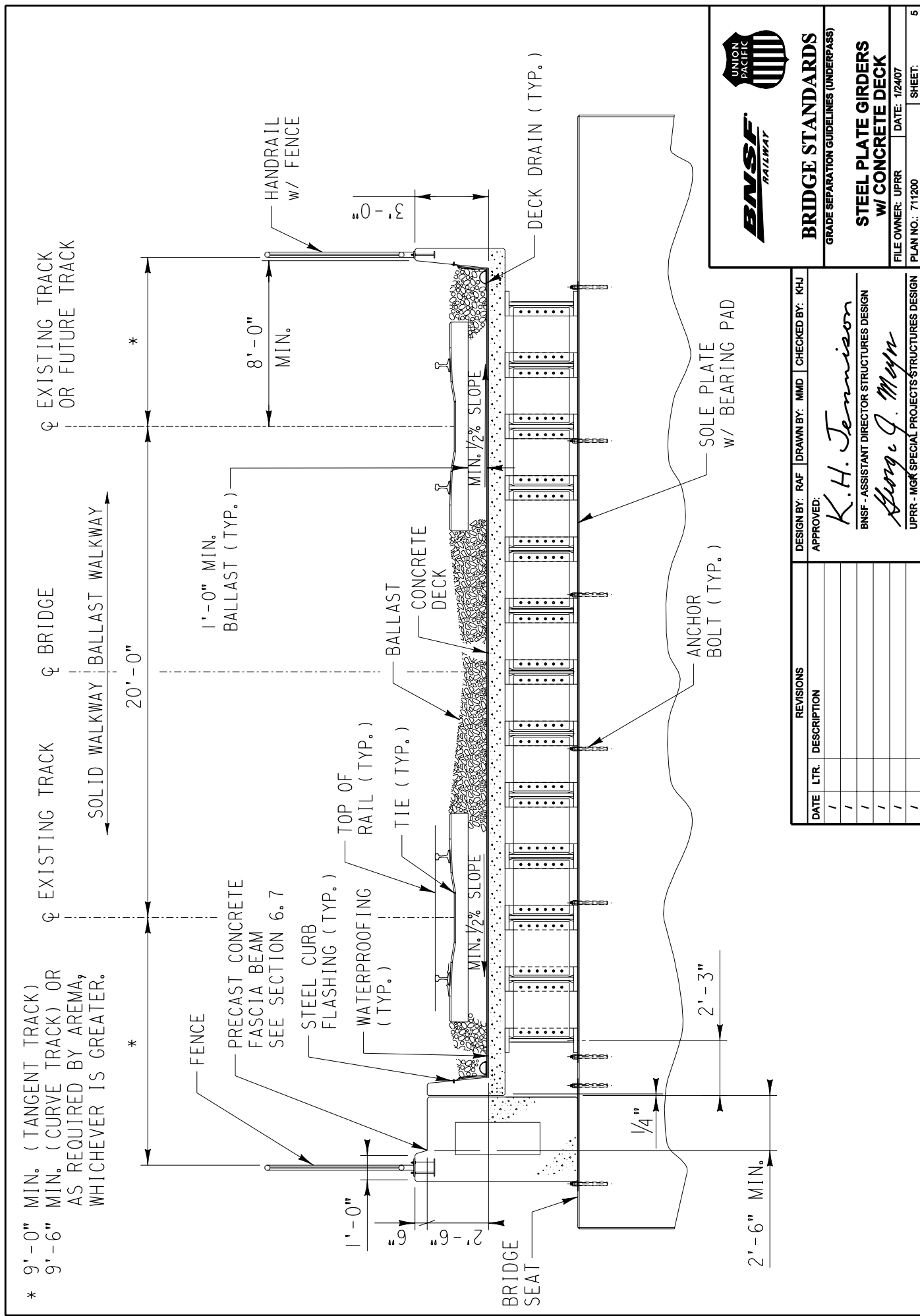
DESIGN BY: RAF    DRAWN BY: MMD    CHECKED BY: KHJ

APPROVED:

*K.H. Jemison*  
BNSF - ASSISTANT DIRECTOR STRUCTURES DESIGN

*George J. Meyer*  
UPRR - MGR SPECIAL PROJECTS STRUCTURES DESIGN

REVISIONS	
DATE	DESCRIPTION
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**BRIDGE STANDARDS**  
 GRADE SEPARATION GUIDELINES (UNDERPASS)

**STEEL PLATE GIRDERS w/ CONCRETE DECK**

FILE OWNER: UPRR | DATE: 1/24/07 | SHEET: 5  
 PLAN NO.: 711200

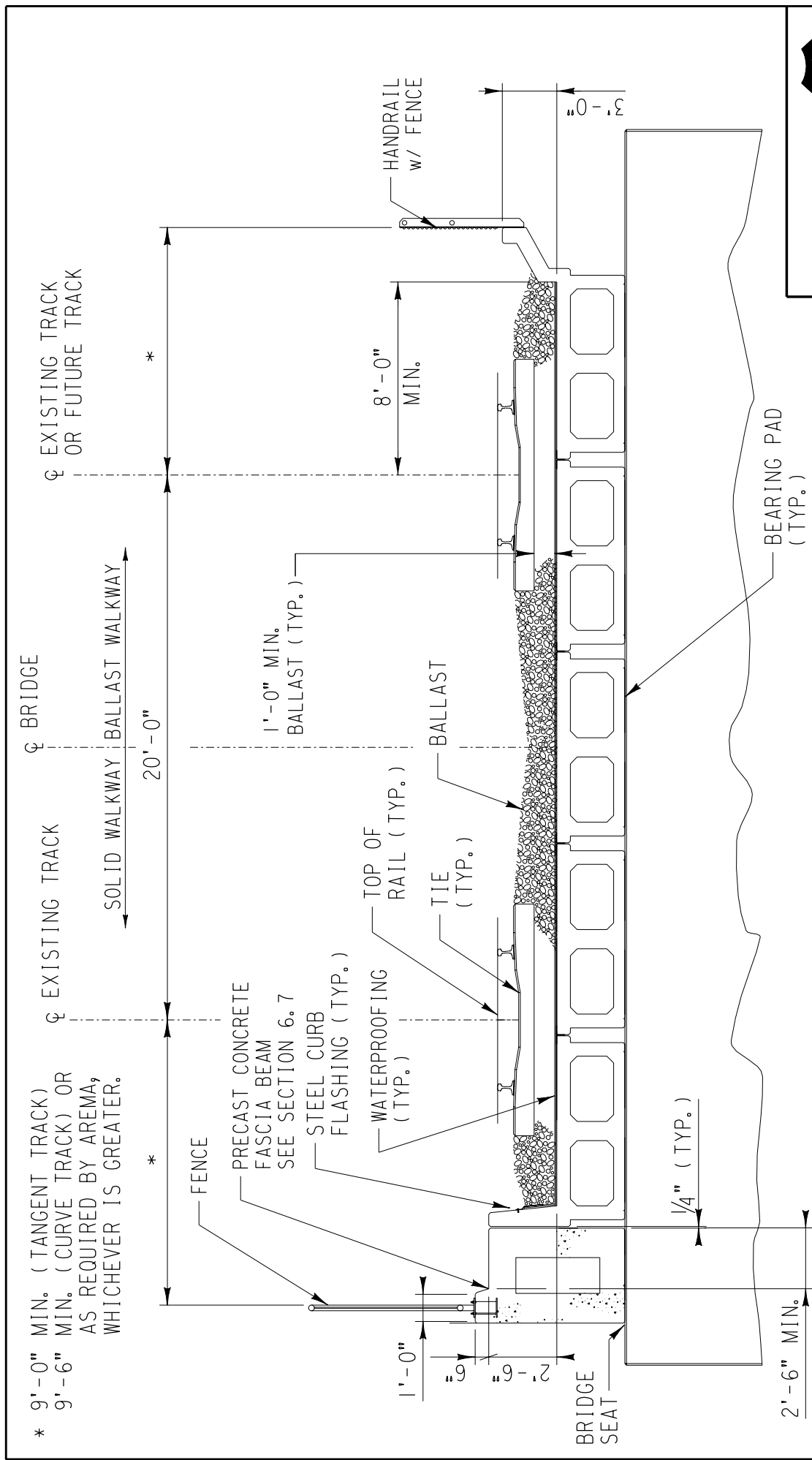
DESIGN BY: RAF | DRAWN BY: MMD | CHECKED BY: KHJ  
 APPROVED:

*K.H. Jemison*  
 BNSF - ASSISTANT DIRECTOR STRUCTURES DESIGN

*George J. Meyer*  
 UPRR - MGR SPECIAL PROJECTS STRUCTURES DESIGN

REVISIONS	
DATE	DESCRIPTION
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\* 9'-0" MIN. (TANGENT TRACK)  
 9'-6" MIN. (CURVE TRACK) OR  
 AS REQUIRED BY AREMA,  
 WHICHEVER IS GREATER.

BRIDGE

EXISTING TRACK  
 OR FUTURE TRACK

SOLID WALKWAY BALLAST WALKWAY

\*

20'-0"

1'-0" MIN.  
 BALLAST (TYP.)

8'-0"  
 MIN.

1'-0"

2'-6"

BRIDGE  
 SEAT

1/4" (TYP.)

2'-6" MIN.

BEARING PAD  
 (TYP.)

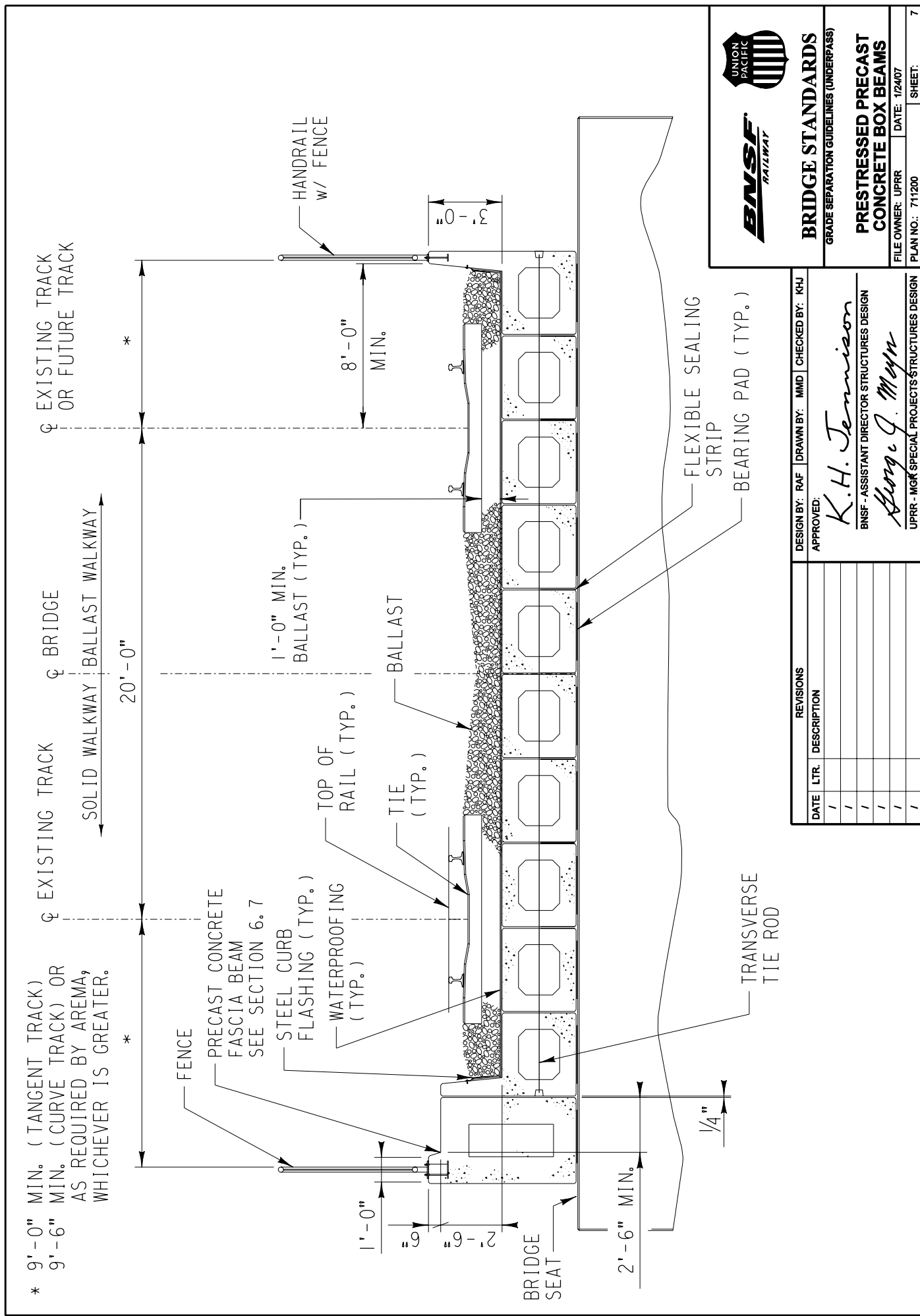


**BRIDGE STANDARDS**  
 GRADE SEPARATION GUIDELINES (UNDERPASS)  
**RR STANDARD PRESTRESSED  
 PRECAST CONCRETE  
 DOUBLE CELL BOX BEAMS**

DESIGN BY: RAF DRAWN BY: KDM CHECKED BY: KHJ  
 APPROVED:  
*K.H. Jernison*  
 BNSF - ASSISTANT DIRECTOR STRUCTURES DESIGN  
*George J. Meyer*  
 UPRR - MGR SPECIAL PROJECTS STRUCTURES DESIGN

REVISIONS	
DATE	DESCRIPTION
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FILE OWNER: UPRR DATE: 1/24/07  
 PLAN NO.: 711200 SHEET: 6  
 PLOTTER: 4/17/2007 9:17:19 AM



\* 9'-0" MIN. (TANGENT TRACK)  
 9'-6" MIN. (CURVE TRACK) OR  
 AS REQUIRED BY AREMA,  
 WHICHEVER IS GREATER.

REVISIONS		DESIGN BY: RAF	DRAWN BY: MMD	CHECKED BY: KHJ
DATE	LTR.	DESCRIPTION		
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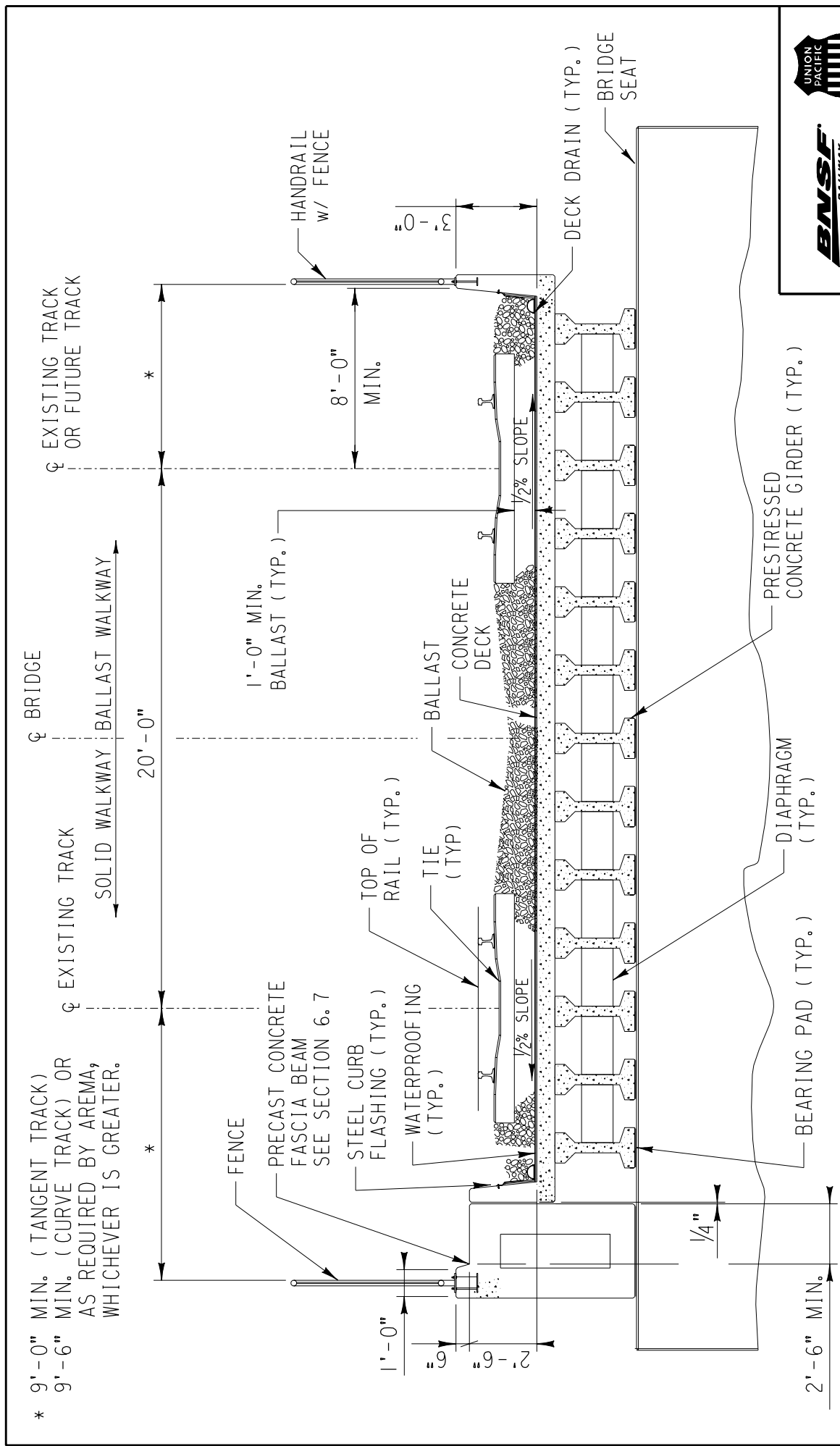
APPROVED:  
*K.H. Jemison*  
 BNSF - ASSISTANT DIRECTOR STRUCTURES DESIGN  
*Bryce J. Meyer*  
 UPRR - MGR SPECIAL PROJECTS STRUCTURES DESIGN



**BRIDGE STANDARDS**  
 GRADE SEPARATION GUIDELINES (UNDERPASS)

**PRESTRESSED PRECAST  
 CONCRETE BOX BEAMS**

FILE OWNER: UPRR    DATE: 1/24/07  
 PLAN NO.: 711200    SHEET: 7



\* 9'-0" MIN. (TANGENT TRACK)  
 9'-6" MIN. (CURVE TRACK) OR  
 AS REQUIRED BY AREMA,  
 WHICHEVER IS GREATER.

ϕ BRIDGE

ϕ EXISTING TRACK  
 OR FUTURE TRACK

SOLID WALKWAY BALLAST WALKWAY

20'-0"

\*

\*

FENCE

PRECAST CONCRETE  
 FASCIA BEAM  
 SEE SECTION 6.7

STEEL CURB  
 FLASHING (TYP.)

WATERPROOFING  
 (TYP.)

TIE  
 (TYP.)

TOP OF  
 RAIL (TYP.)

BALLAST

CONCRETE  
 DECK

1/2% SLOPE

PRESTRESSED  
 CONCRETE GIRDER (TYP.)

BEARING PAD (TYP.)

DIAPHRAGM  
 (TYP.)

PRESTRESSED  
 CONCRETE GIRDER (TYP.)

DECK DRAIN (TYP.)

BRIDGE  
 SEAT

HANDRAIL  
 w/ FENCE

8'-0"  
 MIN.

1'-0"

2'-6"

1/4"

2'-6" MIN.



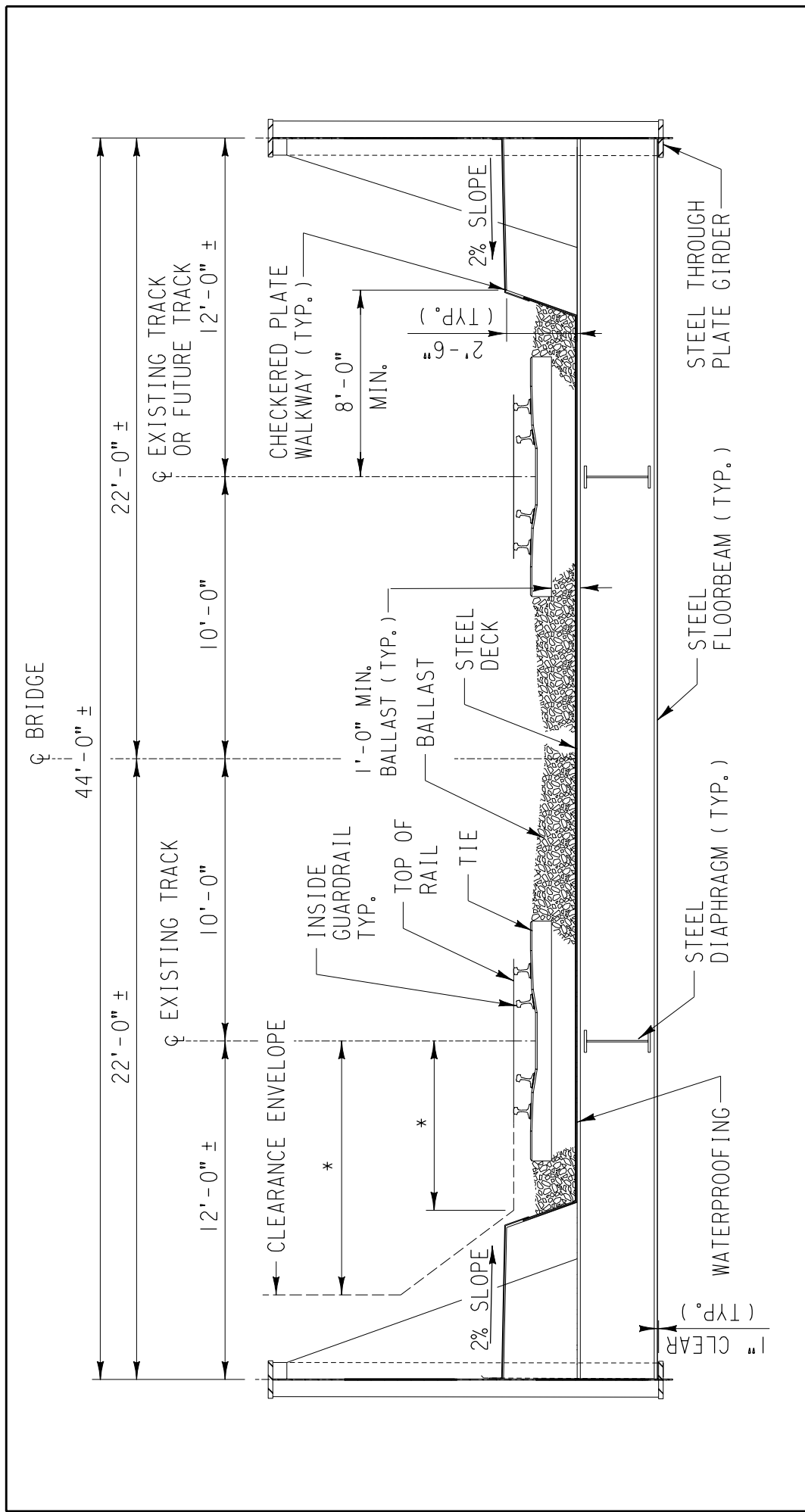
**BRIDGE STANDARDS**  
 GRADE SEPARATION GUIDELINES (UNDERPASS)  
**PRESTRESSED PRECAST  
 CONCRETE AASHTO TYPE  
 GIRDER w/ CONCRETE DECK**

FILE OWNER: UPRR DATE: 1/24/07  
 PLAN NO.: 711200 SHEET: 8


PLOTTED: 4/17/2007 9:17:49 AM

DATE	LTR.	REVISIONS DESCRIPTION	DESIGN BY: RAF	DRAWN BY: FJS	CHECKED BY: KHJ
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APPROVED:  
*K.H. Jemison*  
 BNSF - ASSISTANT DIRECTOR STRUCTURES DESIGN  
*George J. Meyer*  
 UPRR - MGR SPECIAL PROJECTS STRUCTURES DESIGN

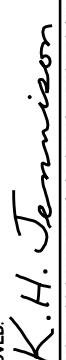



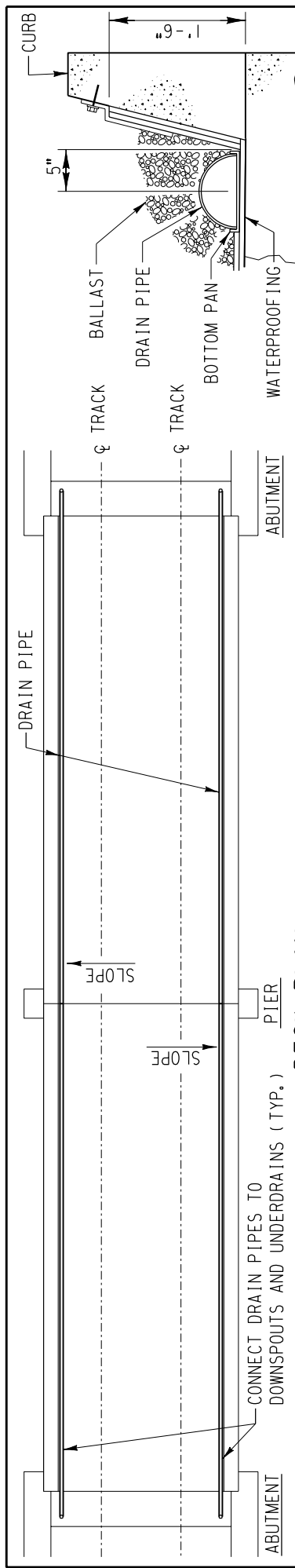
\* SEE SECTION 6.6.1

**BNSF RAILWAY** 

**BRIDGE STANDARDS**  
 GRADE SEPARATION GUIDELINES (UNDERPASS)  
**STEEL THROUGH PLATE GIRDERS W/ STEEL PLATE DECK**

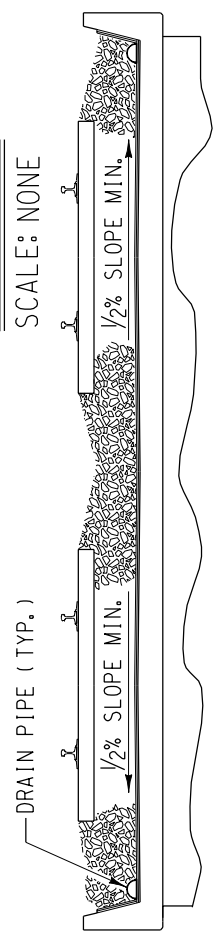
FILE OWNER: UPRR    DATE: 1/24/07  
 PLAN NO.: 711200    SHEET: 9  
 PLOTTED: 3/30/2007 2:56:23 PM

REVISIONS		DESIGN BY: RAF	DRAWN BY: KOM	CHECKED BY: KHJ
DATE	LTR.	APPROVED:		
/		 K.H. Jernison BNSF - ASSISTANT DIRECTOR STRUCTURES DESIGN  George J. Meyer UPRR - MGR SPECIAL PROJECTS STRUCTURES DESIGN		
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**DECK PLAN**

SCALE: NONE

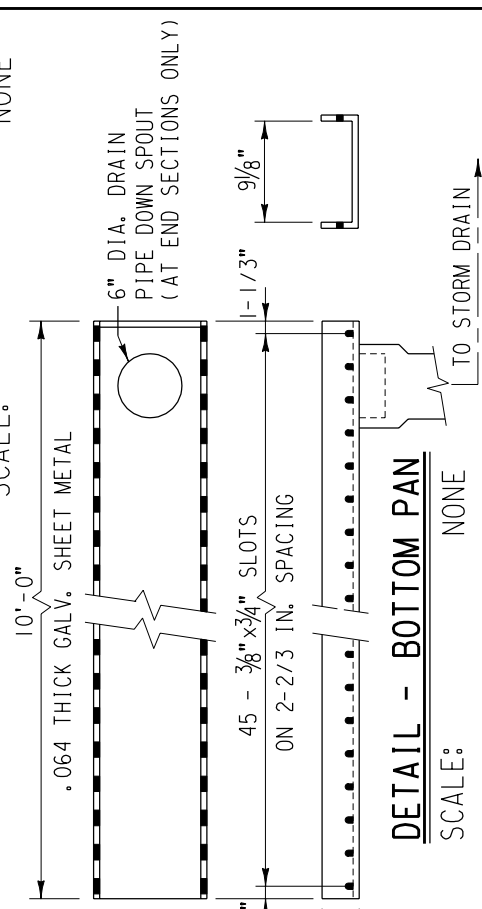


**TYPICAL DECK SECTION**

SCALE: NONE

**LOCATION OF DRAIN PIPE**

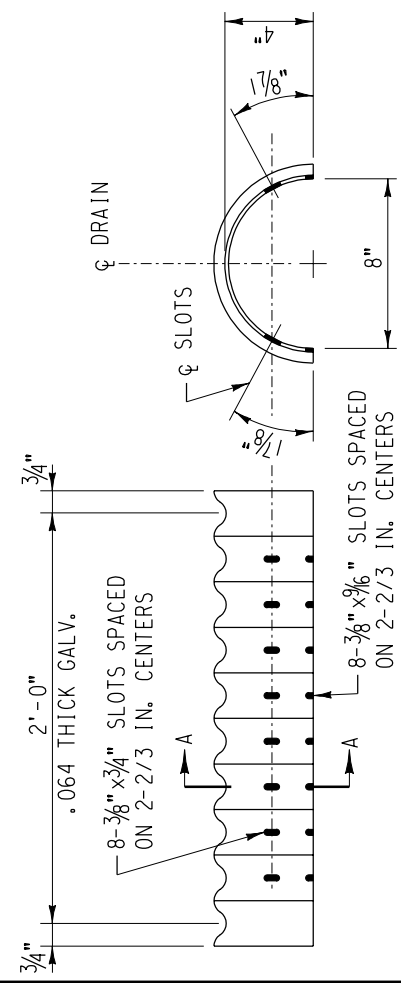
SCALE: NONE



**DETAIL - BOTTOM PAN**

SCALE: NONE

NOTE: LAP DRAIN PIPE ONE CORRUGATION AT EACH END.



**DETAIL - DRAIN PIPE**

SCALE: NONE

SECTION A-A

DATE	LTR.	REVISIONS DESCRIPTION
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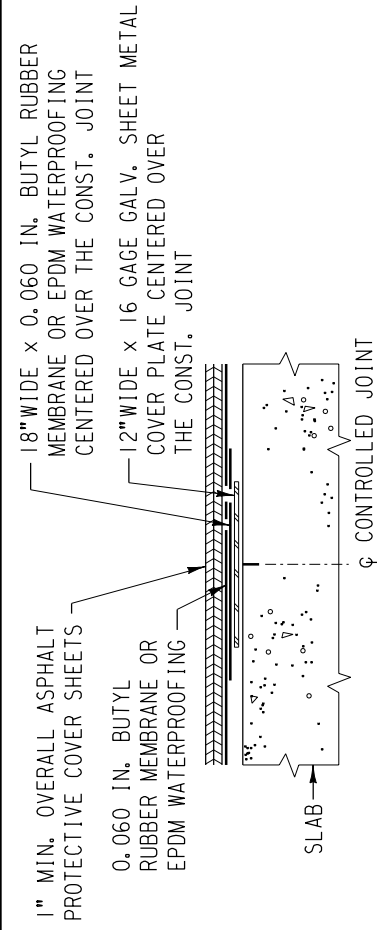
DESIGN BY: RAF DRAWN BY: IMM CHECKED BY: KHJ  
APPROVED:

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BNSF - ASSISTANT DIRECTOR STRUCTURES DESIGN  
*Burge & Meyr*  
UPRR - MGR SPECIAL PROJECTS STRUCTURES DESIGN

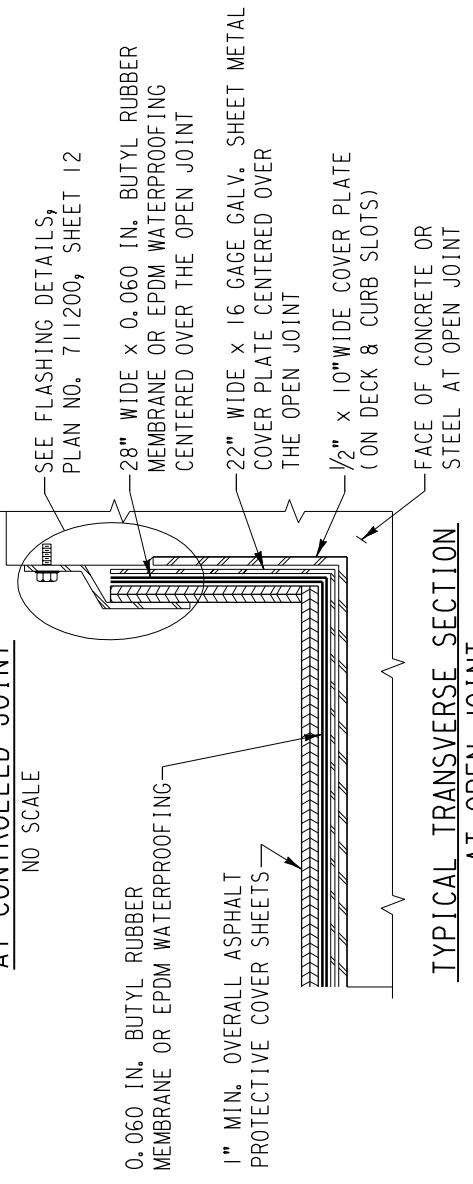
**BRIDGE STANDARDS**  
GRADE SEPARATION GUIDELINES (UNDERPASS)

**CAST-IN-PLACE CONCRETE DECK DRAIN DETAILS**

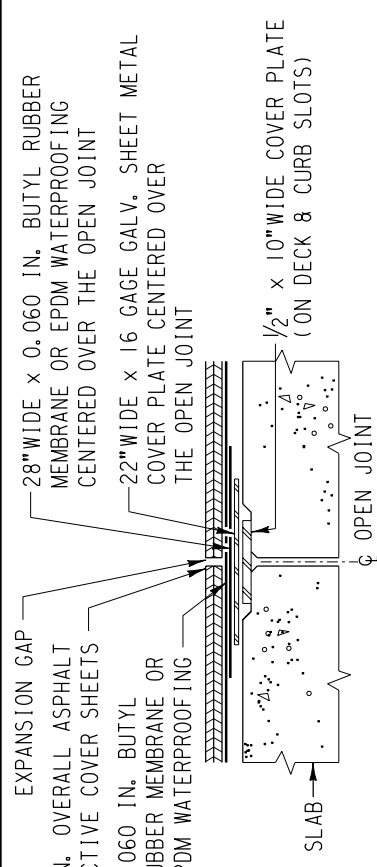
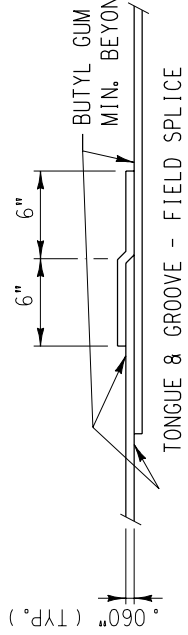
FILE OWNER: UPRR DATE: 1/24/07 SHEET: 10  
PLAN NO.: 711200



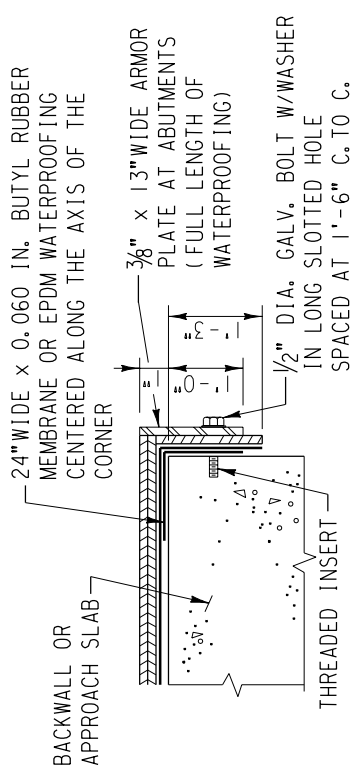
TYPICAL LONGITUDINAL SECTION AT CONTROLLED JOINT  
 NO SCALE



TYPICAL TRANSVERSE SECTION AT OPEN JOINT  
 NO SCALE



TYPICAL LONGITUDINAL SECTION AT BENTS & BACKWALL  
 NO SCALE



TYPICAL LONGITUDINAL SECTION AT END OF BACKWALL / APPROACH SLABS  
 NO SCALE

REVISIONS		DESIGN BY: RAF	DRAWN BY: FJS	CHECKED BY: KHJ
DATE	LTR.	DESCRIPTION		
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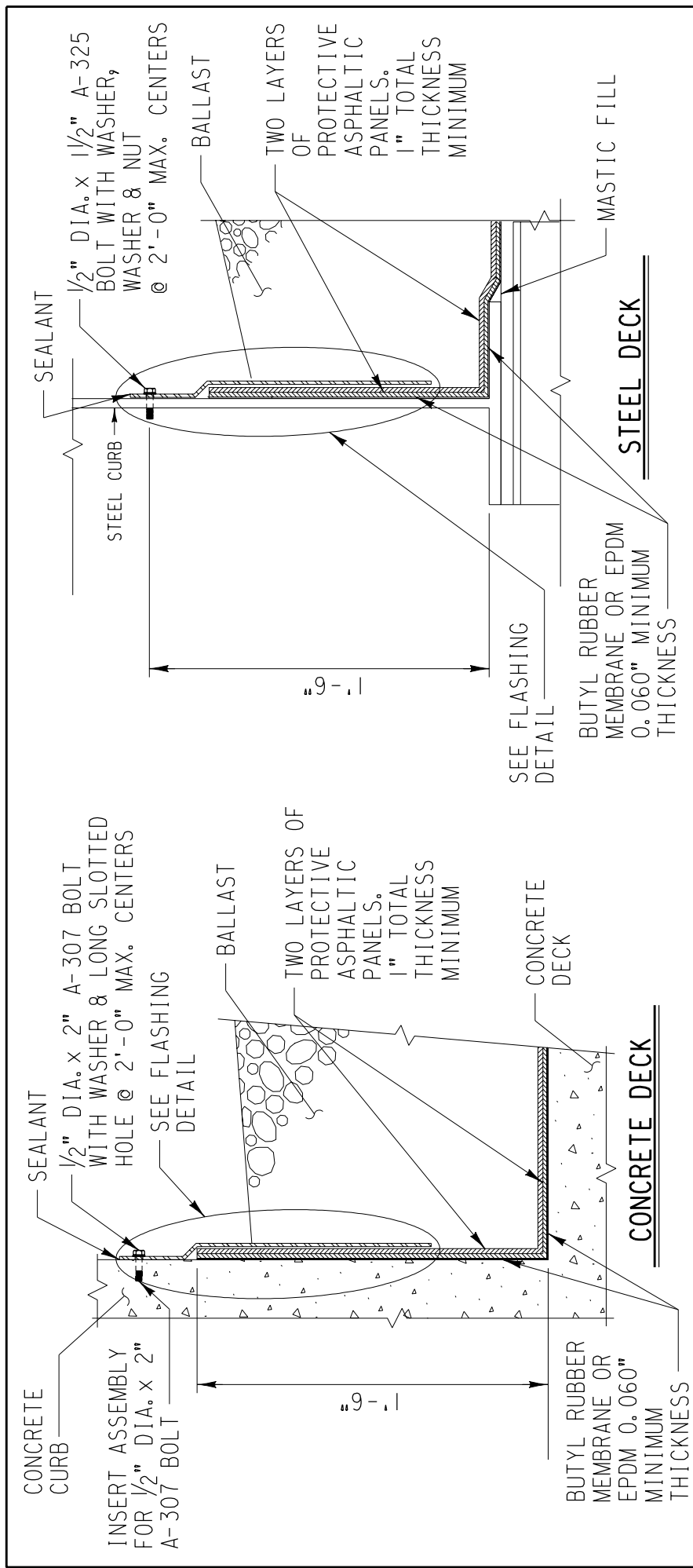
APPROVED: *K.H. Jemison*  
 BNSF - ASSISTANT DIRECTOR STRUCTURES DESIGN

*George J. Meyer*  
 UPRR - MGR SPECIAL PROJECTS STRUCTURES DESIGN



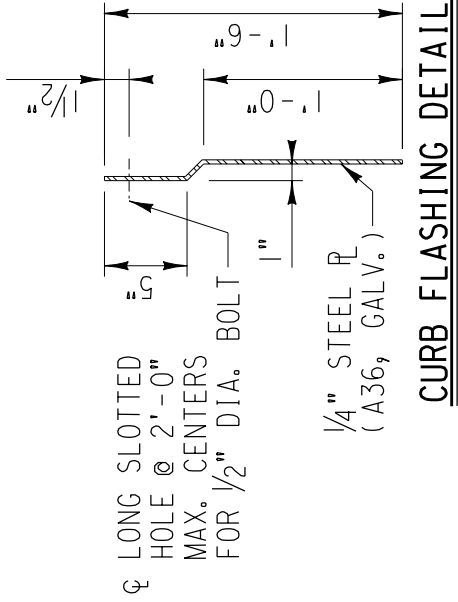
**BRIDGE STANDARDS**  
 GRADE SEPARATION GUIDELINES (UNDERPASS)

**WATERPROOFING DETAILS**



NOTES:

- ALL STRUCTURAL STEEL PLATES, BOLTS AND WASHERS SHALL BE GALVANIZED.
- DISCONTINUE FLASHING OVER PIERS AND ABUTMENTS.



**BNSF RAILWAY**

**UNION PACIFIC**

**BRIDGE STANDARDS**

GRADE SEPARATION GUIDELINES (UNDERPASS)

**FLASHING DETAILS FOR WATERPROOFING**

FILE OWNER: UPRR | DATE: 1/24/07

PLAN NO.: 711200 | SHEET: 12

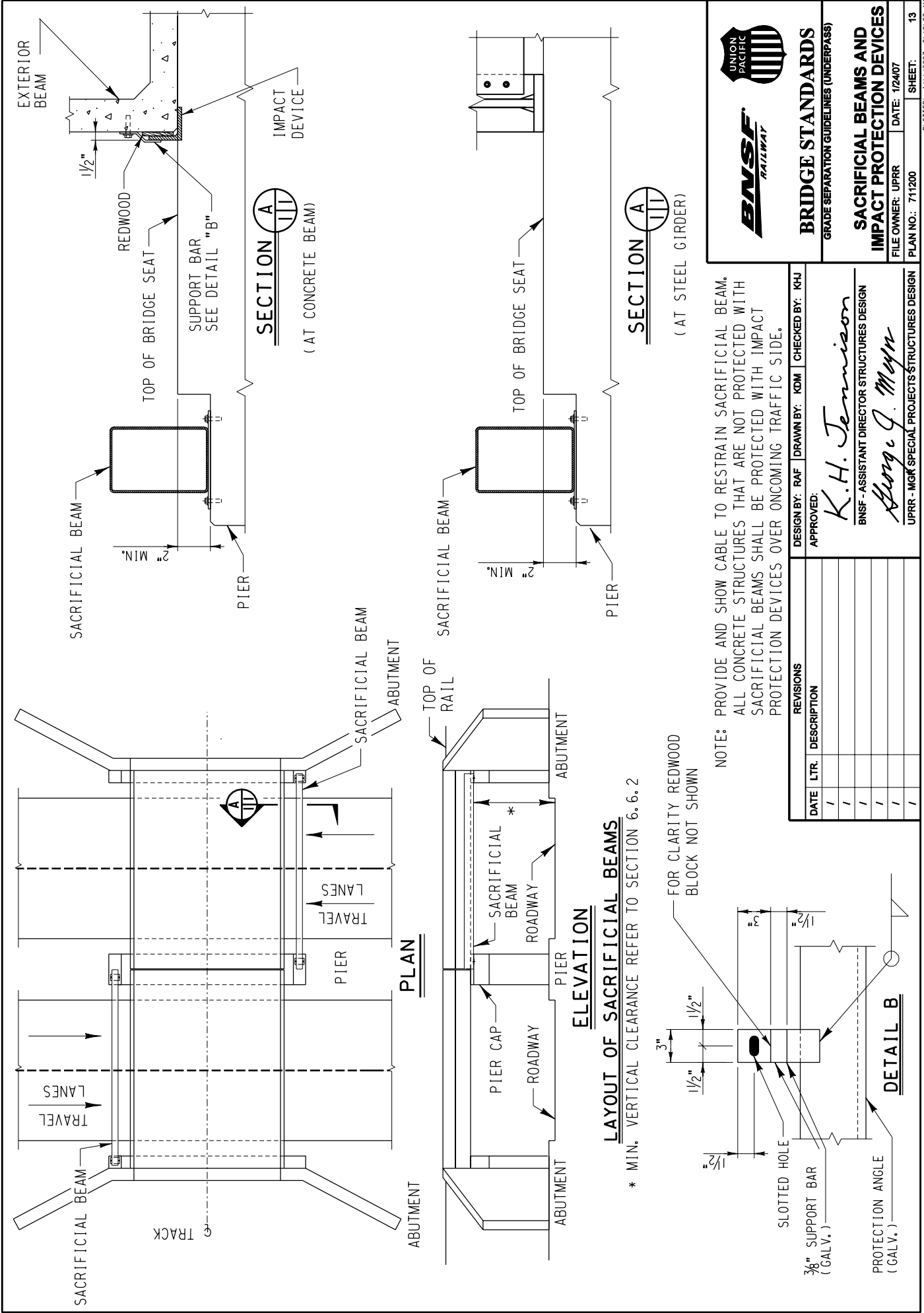
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REVISIONS		DESIGN BY: RAF	DRAWN BY: MMD	CHECKED BY: KHJ
DATE	LTR.	DESCRIPTION		
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APPROVED:

*K.H. Jemison*  
BNSF - ASSISTANT DIRECTOR STRUCTURES DESIGN

*Burg J. Meyer*  
UPRR - MGR SPECIAL PROJECTS STRUCTURES DESIGN



NOTE: PROVIDE AND SHOW CABLE TO RESTRAIN SACRIFICIAL BEAM. ALL CONCRETE STRUCTURES THAT ARE NOT PROTECTED WITH SACRIFICIAL BEAMS SHALL BE PROTECTED WITH IMPACT PROTECTION DEVICES OVER ONCOMING TRAFFIC SIDE.

DATE	LTR.	REVISIONS DESCRIPTION
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DESIGN BY: RAF    DRAWN BY: KOM    CHECKED BY: KHJ  
 APPROVED: *K.H. Jemison*  
 BNSF - ASSISTANT DIRECTOR STRUCTURES DESIGN  
*Burge & Meyr*  
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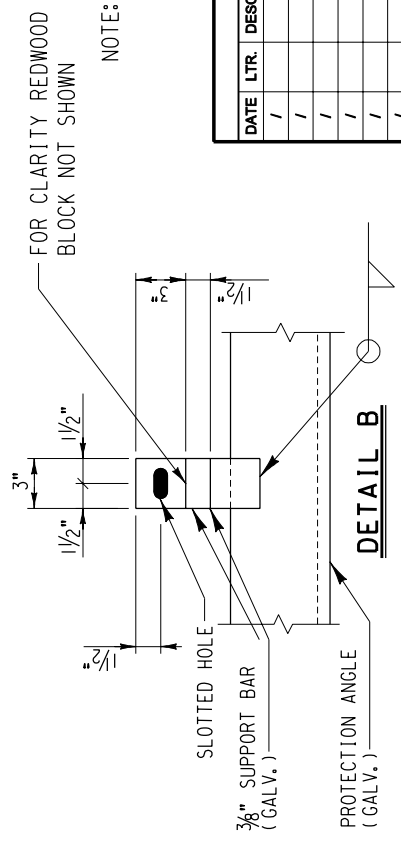
**BNSF RAILWAY**    **UNION PACIFIC**

**BRIDGE STANDARDS**  
 GRADE SEPARATION GUIDELINES (UNDERPASS)

**SACRIFICIAL BEAMS AND IMPACT PROTECTION DEVICES**

FILE OWNER: UPRR    DATE: 1/24/07    SHEET: 13  
 PLAN NO.: 711200    PLOTTER: 4/17/2007 9:18:09 AM

**LAYOUT OF SACRIFICIAL BEAMS**  
 \* MIN. VERTICAL CLEARANCE REFER TO SECTION 6.6.2



**SECTION A**  
 (AT CONCRETE BEAM)

**SECTION A**  
 (AT STEEL GIRDER)

**SECTION A**  
 (AT CONCRETE BEAM)

**SECTION A**  
 (AT STEEL GIRDER)