GUIDELINES FOR THE DESIGN AND CONSTRUCTION OF RAILROAD OVERPASSES AND UNDERPASSES

JULY 2020

GUIDELINES FOR THE DESIGN AND CONSTRUCTION OF RAILROAD OVERPASSES AND UNDERPASSES

Table of Contents

Section	Pages
Disclaimer	**Page 3**
Definitions	**Page 4-5**
General	**Page 6-10**
Design and Construction of Railroad Underpass Structure (Construction of Railroad Bridge)	**Section I**
Design and Construction of Railroad Overhead Structure	**Section II**
Bridge Demolition and Removal Plan For Structure over Railroad	**Section III**
Design and Construction of Shoring Adjacent to and on Railroad Right-of-Way	**Section IV**
References	**Section V**
KCSR Standard Drawings – Most frequently used	
KCSR Standard Technical Specifications – By Reference	
KCSR Industrial Track Standards – By Reference	
American Railway Engineering and Maintenance of Way Association – By Reference	

Disclaimer

The following guidelines and recommendations are to be followed in design, construction, maintenance and repair of grade separation structures, underpasses and overpasses, spanning across the properties of The Kansas City Southern Railway Company, Gateway Eastern Railway Company, Meridian Speedway, LLC and The Texas Mexican Railway Company (collectively “KCSR”). Application or adaptation of each of these guidelines to individual circumstances requires application of professional engineering judgment based on site locations, operating conditions, existing contractual obligations, provisions of currently applicable Federal Railroad Administration regulations, other federal, state and local specifications, regulations, requirements, etc.

These guidelines have been prepared by KCSR as a guide in design and construction of grade separation structures and appurtenances thereto, and should be used as a guide only. KCSR assumes no liability whatsoever, for any damage to property or injury to person or persons, which may arise from use of the information contained herein, or from any omission of information, whether intentional or unintentional, as may be required in the construction of grade separation structures and appurtenances.

Definitions

AASHTO: American Association of State Highway Transportation Officials.

Agency: A public or private entity desiring to construct an overpass or underpass structure across KCSR ROW.

AISC: American Institute of Steel Construction

AREMA: American Railway Engineering and Maintenance-of-Way Association.

AREMA Manual: The American Railway Engineering and Maintenance-of-Way Manual for Railway Engineering

BMP: Bridge Management Plan. A program developed by the owner of the railroad bridge documenting plans and procedures to perform designs, inspections, maintenance and repairs to the railroad bridge to safely operate railroad traffic over the railroad bridge.

Contractor: Any party gaining access to work on KCSR ROW or other operating locations.

C&M Agreement: Construction and Maintenance Agreement

Bridge Location: Grade separation structure identified with railroad milepost and railroad station at the intersection of centerline of mainline track and centerline of the proposed roadway.

Demolition: Removal of structures, facilities or materials by use of mechanical means.

DOT: Department of Transportation – can be an agency of State, City or any municipality.

EPDM: Rubber (ethylene propylene diene monomer (M-class) rubber), a type of synthetic rubber. The M refers to its classification in ASTM standard D-1418.

RWIC/EIC/Flagman: Roadway Worker In-Charge, Employee In-Charge - a designated person qualified by KCSR to control movement of trains and equipment in the work zone. Only KCSR qualified flagger is allowed to perform flagging services on KCSR operated tracks.

FRA: Federal Railroad Administration

FRA 213: 49 CFR 213 – Track Safety Standards. This part prescribes minimum safety requirements for railroad track that is part of the general railroad system of transportation.

FRA 214: 49 CFR 214 – Railroad Workplace Safety. This part prescribes minimum Federal Safety Standards for the railroad workplace safety. The purpose of this part is to prevent accidents and casualties to employees involved in certain railroad inspection, maintenance and construction activities.

FRA 237: 49 CFR 237 – Bridge Safety Standards. This part provides guidance to bridge owners on minimum requirements for bridge inspection and maintenance.

Guidelines: The Kansas City Southern Railway Company Guidelines for the Design and Construction of Railroad Overpasses and Underpasses, latest edition.

Industry Track: A switching track serving an industry such as a mine, mill, smelter, manufacturing facility or factory.

KCSR/KCS: The Kansas City Southern Railway or any of its affiliates or subsidiaries in the USA.

Mainline Track: A track extending through a yard(s) and between stations upon which trains are operated by timetable or train order or both, or the use of which is governed by signals.

Milepost: Identification markers or posts along the railroad tracks, measured along the centerline of mainline track, indicating distance in miles from a fixed station. It should be noted that distance between two mileposts might not compute to exact miles due to changes in track alignment over time.

MSDS: Material Safety Data Sheet.

Overpass Structure: A roadway bridge, which elevates, supports and grade separates a travel way for vehicular traffic above KCSR track(s).

PTC: Positive Train Control is a system of functional requirements for monitoring and controlling train movements and is a type of train protection systems.

Railroad Bridge: Any structure with a deck, regardless of length, which supports one or more railroad tracks, or any other under grade structure with an individual span length of 10 feet or more located at such a depth that it is affected by live loads.

ROW: Right-Of-Way. Property owned or leased by KCSR.

Shoofly: Temporary track or travel way used to avoid an obstacle/construction zone/incapacitated track/etc. that blocks movement on the original alignment of track or travel way. Also means a “Detour”.

Siding Track: Auxiliary track adjacent to a mainline track normally used to meet/pass trains or used to hold trains/cuts of rail cars bound for a yard or industry.

Spur Track: Short, usually dead-end section of track extending out from a mainline or siding track used to access an industry or other railroad facility or to temporarily store railroad equipment.

SSPC: Steel Structures Painting Council Manual.

Track Curfew: A time period scheduled in advance when no trains or other on track equipment is allowed to operate within the work zone being provided on or over a track.

Track Shield : A prefabricated structure which is placed over the railroad track(s) rail and cross ties to protect the railroad track structure from any debris which may fall onto the track structure during demolition activities.

Track or Work Window: Similar to a track curfew that can hold train(s) and other on-track equipment from entering a work zone. Usually shorter duration than Track Curfew.

Underpass Structure: A railroad bridge which elevates, supports and grade separates KCSR track(s) above a roadway, drainage course, other railroad track(s), a utility, etc.

General

1. Purpose and Scope

The intent of these guidelines is to inform the Agency of KCSR's current minimum standards and requirements concerning design and construction of the bridge structures. These guidelines are not all inclusive and KCSR requirements may be revised at any time by KCSR or be modified for a certain project that may have significant impact on current or future plans of KCSR.

These Guidelines are intended and limited to provide design and construction guidelines to those elements of the project that affects not only KCSR's current usage of the property but also future developments or improvements. KCSR reserves the right to develop and use its entire property for whatever reasons. Hence, the Agency shall design the project to not affect the KCSR's property.

Design criteria shall not be less than required by these guidelines, the latest edition of the AREMA Manual, industry standards whichever provides the most restrictive specifications unless as directed or excepted by KCSR.

Continuity of safe rail operations shall be required for the duration of the project and construction work shall in no way impede the rail operations of the KCSR unless approved in writing by KCSR. To avoid delays during construction, KCSR recommend the use of prefabricated type structures that will minimize track interference and not require track outages.

If a railroad structure is to be designed and constructed, it is recommended that the selection of consultants be limited to those who have extensive knowledge and experience in design, construction and inspection of railroad structures.

Design of structures over railroad tracks should include a sequence of construction, which limits interruptions to rail operations. Agencies should consult with KCSR during the early stages of the design process to determine the operating requirements, volume of traffic and the possibility of securing track windows for the proposed design and method of construction. **KCSR will not commit to a track outage that might occur sometime in the future due to probability of changes in train traffic patterns or operation needs at that time.**

2. Process

The Agency should begin coordinating with KCSR as early in the project planning as possible to prevent issues with unacceptable design and construction methodology of the project which may result in delays to the project schedule and impact project funding, bidding or construction completion dates.

Below are steps/stages of review and construction of a grade separation project generally followed by KCSR. These steps/stages can differ based on the specifics and complexity of the project.

Below are general steps/stages involved for a successful completion of a grade separation project that can differ based on the complexity of the project.

2.1. Agency prepares conceptual plans and submits to KCSR

2.2. A preliminary Engineering Agreement is executed to reimburse KCSR for its cost to review the plans prepared by the Agency.

2.3. KCSR provides comments on the concept plan to the Agency

2.4. Through an iterative process, (Agency preparing the plans and submitting to KCSR - KCSR comments on the plans – Agency revises the plans as needed and resubmits to KCSR) plans and specifications are approved by KCSR

2.5. A Construction and Maintenance Agreement including easements, licenses or permits are executed by all parties.

2.6. Agency bids the projects

2.7. KCSR and/or its consultants review all required construction submittals and performs periodic construction monitoring of the project for conformance with approved plans and protection of railroad property and operations at Agency's cost.

2.8. A Final inspection and acceptance of the project by KCSR after all work within KCSR right-of-way or other work affecting KCSR' operations or its right-of-way is complete.

3. Agreements

3.1. Preliminary Engineering Agreement:

After KCSR receives conceptual plans for a grade separation project, KCSR will determine the extent of plan reviews to be performed for final approval of the project. To perform a comprehensive review of the plans, KCSR will determine if it will be done solely by KCSR internal forces or if services of an outside consultant are needed. KCSR is the sole authority to determine if services of an outside consultant are required. If outside consultant services are required, KCSR will provide a cost estimate to perform the engineering work needed to review and approve the one hundred (100) percent construction plans and specifications. An Engineering Agreement must be executed by KCSR and the Agency to reimburse KCSR for all plan review costs.

3.2. Construction and Maintenance Agreement:

After the one hundred (100) percent construction plans are approved, all parties responsible for construction, maintenance, repair and funding of the project will execute a Construction and Maintenance Agreement (C&M Agreement) for the grade separation structure. Only after this agreement is executed can the Agency proceed to construction.

The C&M Agreement shall at a minimum address the following terms and conditions:

3.2.1. Names and physical addresses of all entities that are a party to the project

3.2.2. Recitals (WHEREAS Sections) shall state purpose of the agreement, overall summary of project, location of project (project name and number, highway name and DOT number, railroad milepost, railroad station, railroad subdivision name, roadway station, City, County/Parish, State), current site conditions, etc.

3.2.3. Property – Easement or License (typically Exhibit A). Agency agrees to pay the required licensing fees or property value as stated in the Easement

3.2.4. Ownership of various elements of the project once completed (who owns and maintains the bridge, the roadway, embankments, drainage, etc.)

3.2.5. Bridge Management Plan – If the superstructure is owned by the Agency, the Agency shall prepare the Bridge Management Plan (BMP) in accordance with 49 CFR Part 237 Bridge Safety Standards. This part provides guidance to bridge owners on minimum requirements for bridge inspection and maintenance. The final version of the BMP shall be shared with KCSR for its records. Completed Annual Inspection Reports of the structure shall be forwarded to KCSR for its records.

3.2.6. Work by KCSR – Describe in detail all the tasks to be done by KCSR to complete the project. Tasks may include:

3.2.6.1. Prepare plans, specifications, bid documents, etc. – if applicable (typically Exhibit B)

3.2.6.2. Perform construction – if applicable

3.2.6.3. Perform Engineering Reviews (preliminary and final reviews)

3.2.6.4. Construction monitoring – perform inspections, reviews of shop drawings, excavation, submittals, etc.

3.2.6.5. Perform work on railroad signal facilities – if applicable

3.2.6.6. Perform work on railroad track and bridge facilities – if applicable

3.2.6.7. Make track repairs – if applicable

3.2.6.8. Procure and supply railroad track and bridge materials – if applicable

3.2.6.9. Railroad flagging (KCSR does not have flaggers on its staff and hires an outside flagging agency to perform this task)

3.2.7. Work by Agency - Describe in detail all the tasks that are done by Agency. Tasks may include:

3.2.7.1. Prepare plans, plans, specifications, bid documents and bid the project (typically Exhibit B)

3.2.7.2. Construct the project

3.2.7.3. Require its contractor to satisfy various requirements imposed by KCSR including maintaining railroad ROW in good condition, maintain and protect railroad facilities from damage by construction activities, etc.

3.2.7.4. Require its contractor to pay for railroad flagging services

3.2.7.5. Agree to not construct any temporary crossing across the tracks without KCSR's approval

3.2.7.6. Provide required minimum horizontal and vertical construction clearances
3.2.7.7. Meetings – preconstruction and progress meetings

3.2.7.8. Require its contractor to obtain proper railroad safety training

3.2.7.9. Store and secure track and signal materials provided by KCSR

3.2.7.10. Require its contractor to pay/reimburse KCSR's costs incurred due to stoppage or delays beyond what is approved by KCSR

3.2.7.11. Require its contractor to obtain Right of Entry Permit from KCSR prior to starting any work

3.2.7.12. Utilities – locating, protecting, relocating responsibility shall be of Agency's contractor

3.2.7.13. Execute Engineering Agreement (PE Agreement) for reimbursement of KCSR's expenses during review and approval of plans and specifications (typically Exhibit C)

3.2.7.14. Agree to reimburse KCSR's expenses during construction period based on the estimate of railroad force account (typically Exhibit D)

3.2.7.15. Agree to abide by KCSR's insurance requirements.

3.2.8. Final inspection and acceptance of the project,

3.2.9. Provide contact information for the project – both KCSR and Agency

3.3. Property - Easement or License

KCSR prefers to issue a License-to-Cross (License) its property to build and maintain a grade separation structure. The area of the License is limited to the external boundaries of the width of grade separation structure up to the property line of KCSR. The Agency must prepare a property description of the area to be licensed which will be included in the C&M Agreement. KCSR may charge licensing fees as compensation for loss/reduced use of property, loss of business, recording and mapping costs, etc.

The License-to-Cross issued to the Agency is limited to construction and maintenance of the grade separation structure only and does not give rights to the Agency to install or permit installation of any utilities, pipelines, etc.

In cases where an Easement on KCSR property to build the grade separation structure is required by the Agency, the Agency shall perform all work and bear all costs associated with identifying the actual owners of the land, including title search, land surveying, etc., to determine the Easement issuing party. If KCSR is the Easement issuing party, the Agency shall pay required property costs for obtaining the Easement. The Easement agreement shall be a negotiated agreement between KCSR and the Agency.

3.4. Right of Entry Agreement:

All contractors and engineers of the Agency performing any work inside the KCSR property including engineering studies, surveys, geotechnical borings, environmental explorations/inspections, construction, repairs, bridge inspections, etc., whether at the time of construction of the grade separation or at any time in future, shall obtain a Right of Entry Agreement from KCSR by paying all necessary processing and permitting fees. Only the Agency's own personnel are exempt from obtaining the Right of Entry Agreement; however, all Agency's parties, including its own, must notify KCSR of any work being planned well in advance for KCSR to determine its impact on safety and railroad operations and to determine what type of permits may be required.

3.5. Utility Agreements:

License and permission granted by any of the above agreements does not authorize the Agency to permit or install any utilities or pipelines in the licensed or permitted areas of KCSR. Each owner of respective utilities or pipelines must obtain their own utility permits from KCSR by signing a utility permit agreement and paying all associated processing and permitting fees.

4. Railroad Force Account

The Agency building the grade separation structure is responsible to reimburse KCSR for all costs incurred by KCSR for the successful completion of the grade separation project. KCSR's incurred costs will be in two phases: 1) Engineering Phase, and 2) Construction Phase.

In the Engineering Phase, KCSR's costs include the following: engineering review of plans and specifications; attending meetings - in-person or by conference calls; travel expenses (transportation, boarding, lodging, meals, etc.); and any other expenses incurred by KCSR. Costs incurred by KCSR under this phase includes all work from conceptual planning up to and including approval of final plans as well as drafting and executing the Construction and Maintenance Agreement.

In the Construction Phase, KCSR's costs include the following: attending pre-bid and preconstruction meetings; review of construction submittals (value engineering, shoring designs, shop drawings, installation procedures, etc.); construction inspections and monitoring; construction support services, etc.

In cases where KCSR will be performing design and/or construction of portions of the project or supplying railroad materials to the project, the scope of such work or materials supplied will be defined during the Engineering Phase. If KCSR performs the construction work, bidding of such work will be pursuant to KCSR's procurement procedures.

All parties understand that the estimated costs shown in the Engineering Agreement or the Construction and Maintenance Agreement will not be the upper limit of the costs, but shall be a guideline for budgeting purposes. KCSR will bill the Agency only for the actual costs incurred by it with no markups for profit. If during the course of the project, the estimated costs are found to be insufficient for KCSR to proceed with work agreed upon, KCSR will submit a cost estimate of the additional work to the Agency for approval. KCSR will proceed with the additional work only after obtaining a written approval from the Agency. KCSR will not be responsible for any financial or material costs incurred by the Agency for delays to the project due to lack of timely approval of the additional work requested by KCSR.

Section I

Design and Construction of Railroad Underpass Structure (Construction of a Railroad Bridge)

Section I
Design and Construction of
Railroad Underpass Structures

Table of Contents

	Subsection	Page No.
1.	Purpose and Scope	3
2.	Specifications, Standards and Guidelines	3
3.	Units	3
4.	Structure Selection Criteria	4
5.	List of Preferable Bridge Structures	4
6.	Access to Bridge Structure	5
7.	Bridge Layout	6
8.	Skew of Bridge	8
9.	Vertical Clearances	9
10.	Design Loads	10
11.	Special Requirements for Pre-Cast, Pre-Stressed Box or AASHTO-type Girders	11
12.	Special Requirements for Post-Tensioned Concrete Structures	12
13.	Material Requirements for Steel Structures	12
14.	Painting of Steel Structures	13
15.	Ballast Deck Bridge Structure	14
16.	Abutments	16
17.	Piers	16
18.	Structure Separation	17
19.	Site Drainage	17
20.	Shoofly Construction	17
21.	Construction Excavation	18
22.	Erosion Control	18
23.	Construction Management	18
24.	Review Submittals	19
25.	Construction of the Project	21
25.1.	Construction Submittals	21
25.2.	Site Observation During Construction	23
25.3.	As-Built Submittal	24

Appendix A

Underpass Grade Separation Data Sheet 26

Appendix B

Underpass Grade Separation Special Requirement Notes 28

1. Purpose and Scope

The intent of this section of these Guidelines is to inform the Agency of KCSR's current minimum standards and requirements concerning design and construction of underpass structures requiring construction of a railroad structure(s), including railroad bridge and culverts, spanning across highways, river ways, pedestrian walkways, other railroads tracks and bridges, etc. To expedite the design and construction review process, the Agency is advised to follow the requirements addressed in this section of the Guidelines.

2. Specifications, Standards and Guidelines

Design and construction of overhead grade separation structures shall comply with the following standard drawings and guidelines:

6.1. KCSR Standards – some frequently used Standards are included in Section V *References*. Additional Standards can be obtained by contacting KCSR.

6.2. KCSR Technical Specification for Construction Projects

6.3. KCSR Guidelines for Construction of Industry Track

6.4. The recommendations of American Railway Engineering and Maintenance-of-Way Association (AREMA) Manual of Railway Engineering, latest edition References

6.5. Other industry standards including ACI, PCI, ASTM, ASCE, AWS, AASHTO, AISC, etc.

3. Units

English units are preferred for all projects on KCSR property. Projects requiring the use of metric units shall indicate all controlling dimensions in dual units. English units are to be shown in parenthesis.

Controlling dimensions or elevations refer to, but are not limited to, the following:

3.1. Horizontal and vertical clearances

3.2. Track spacing, Railroad ROW, track stationing

3.3. Span length, width and depth of superstructure elements

3.4. Size and limits for barrier rail or splashboards and fences

3.5. Location and elevation of underground or aerial utilities and their relocation adjustments, if required

3.6. Size, elevation and location of pier or abutment footings for spans adjacent to railroad tracks

3.7. Size of structure supports (pier or abutment walls, columns)

3.8. Size and elevations of pier protection walls, if required

3.9. Shoring location and their limit(s), if required

3.10. Top of rail elevation(s) under structure and grade profile. If the track(s) are in a curve, the top of rail elevations will be required at each rail as will the design elevations of the bottom most element of the bridge structure at each of those locations.

3.11. Size and location of drainage structures and ditches

3.12. Temporary construction vertical and horizontal clearances, if required

Plans will be rejected if required controlling dimensions are not shown or not shown properly.

4. Structure Selection Criteria

4.1. Bridge structure shall be ballast deck type structure. Open deck type structures shall not be used as permanent structure unless approved by KCSR during the conceptual planning phase. Open deck type structures can be used only as a temporary structure built in conjunction with shoofly construction.

4.2. Bridge shall consist of simple spans.

4.3. Continuous spans or through truss type structures are to be avoided.

4.4. Post-tensioned structures, simple or continuous, are not acceptable.

4.5. Cast-in-place elements in a bridge on an active line is not allowed unless the bridge is built under a temporary shoofly alignment.

5. List of Preferable Bridge Structures

Following is a list of permanent bridge structures preferable to KCSR. The KCSR will require the most preferred alternative in all cases unless the Agency can provide sufficient reasons for proposing a less preferred alternative. The Agency can also propose other bridge designs not listed here for KCSR consideration with proper explanation on why the listed structure types are not acceptable. Timber span and open deck bridges are not acceptable to KCSR.

Superstructure:

5.1. Simply supported Pre-stressed concrete box girders single or double cell

5.2. Simply Supported Rolled beams with waterproofed steel deck

5.3. Simply Supported Thru Plate Girders with waterproofed steel deck

5.4. Simply Supported Steel plate girders with waterproofed steel deck

5.5. Simply Supported Pre-stressed concrete “AASHTO” type girders with cast-in-place concrete deck.

5.6. Simply Supported Through type steel girder spans

5.7. Conventionally reinforced concrete girder spans

5.8. Conventionally reinforced concrete box girders

5.9. Precast concrete arch spans are not preferable, however, in unusual circumstances, they will be considered by KCSR if conditions preclude the use of any other type of structure

5.10. Long Spans - If any of the above structure types are not suitable, the below span types may be used. KCSR shall be contacted prior to selecting the structure type.

5.10.1. Deck trusses

5.10.2. Through truss

5.10.3. Arches

NOTE: Bridges located on tracks containing concrete ties shall be built with tracks having concrete ties and those decks shall be protected with ballast mats. Concrete decks may need to be protected with waterproofing compound. Its requirements shall be verified with KCSR during the design phase.

Substructure:

5.11. Driven Piles – Steel H, pipe or concrete piles

5.12. Cased Drill Shafts – Permanent casing is required when a precast cap is installed during the bridge changeout. The precast cap, which has an embedded steel plate at the bottom, shall be welded to the permanent casing with a suitable weld size capable of supporting all design forces on that bent.

5.13. Uncased Drill Shafts – Temporary casing for the drill shaft is required when the drilled hole is subjected to railroad loading. The temporary casing can be removed after the concrete in the drill shaft has sufficiently cured to support railroad loading.

5.14. Spread Footing – Cast-in-place concrete spread footing is acceptable provided the foundation is not susceptible to scour. A detailed scour analysis report is required.

5.15. Piers – concrete or masonry

5.16. Steel Towers

6. Access to Construction Site

Agency shall provide means and methods of accessing the construction site. If KCSR's right of way will be used for access, a detailed layout of the access road including plan, profile and cross sections of the access roadway shall be submitted along with any drainage calculations required to ensure the proposed roadway doesn't interfere with KCSR's operation, inspection or maintenance of railroad facilities. The access road shall be built as far away from the active tracks as possible and shall provide a minimum clearance of twenty-five (25) feet from the centerline of the track to the nearest edge of the roadway.

Access roadway with a turnaround, if required, shall be designed and constructed in conjunction with the bridge structure. Turnaround pad shall begin no further than thirty (30) feet from the end of the bridge structure. Roadway shall have sufficient width to provide for one fifteen (15) foot wide road, drainage ditch and shoulder. Roadway and turnaround shall be constructed on compacted material and have a minimum twelve (12) inch thick aggregate base with capacity to support construction traffic. Turnaround pad and roadway shall be sloped to drain away from track subgrade and dispose water to drainage system or existing right-of-way ditches.

Access roadway structure may be part of the railway supporting structure or a completely separate structure. If access roadway structure is part of the railway bridge, the structure shall be designed for E-80 load to accommodate any future track needs or modifications. If access roadway structure is a separate structure, it shall be designed for HS20-44 live load and in accordance with the current edition of the AASHTO standard specifications for highway bridges. The access roadway width shall accommodate one twelve (12) foot lane with curbs and railing. Bridge deck shall provide curbs, railing, drainage, and joint seals.

Access roadway with turnaround or access roadway structure shall be shown in the preliminary plans and complete design shall be included in all subsequent submittals.

7. Bridge Layout

The following items shall be considered and adequately addressed in the layout of the bridge structure:

7.1. Bridge shall be laid out in such a way that rail operations is not limited or restricted during construction.

7.2. Existing track profile and cross sections shall be provided to KCSR in the conceptual design phase of the project. The proposed track shall be designed to rectify any anomalies in the existing track at the bridge and approaches for a distance that may affect the bridge design. If track raises are required, any adjustments to the existing track embankments to accommodate the track raises shall be designed as part of the project. Bridge shall be designed and constructed to the final track elevation as required by the track design.

7.3. Layout of bridge structures shall indicate the limits of KCSR right-of-way, exact locations of all existing and proposed bridge structure(s), overhead/underground utilities, pipeline locations, proposed drainage, shoofly structure(s), proposed construction sequences, etc. All construction must be scheduled to minimize the amount of track interference during construction.

7.4. No utility attachments will be permitted on the new bridge structure. Existing or future utilities shall be placed underground and away from bridge structure.

7.5. The Agency constructing the bridge structure shall be solely responsible for all utility work associated with the construction of the bridge structure. One new utility application permit application shall be submitted by the respective utility company when proposing a new crossing or relocating an existing line or abandoning an existing line. Relocation of any existing utilities must be performed by the owners of said utility at no cost to KCSR.

7.6. Bridge structure shall be designed to provide positive drainage of the bridge deck. This can be obtained by either sloping of the deck longitudinally if required by track profile or by sloping transversely by sloping the waterproofing membrane. Designer may provide drainage toward one end of structure or, when structure length is excessive, provide adequate deck grades to drain the structure to both ends. If the top of rail grades remain constant over the length of structure, the depth of ballast may be varied but should be taken into account in the design.

7.7. For a bridge located within a curve, the girders, abutments and piers shall be located with reference to chords.

7.8. Sloping embankments in front of abutments shall be paved.

7.9. The distance from the centerline of bridge structure to the nearest railroad milepost and to a nearest existing permanent railroad structure, such as a bridge, culvert, rail crossing diamonds, etc. shall be shown on the plans in a conspicuous manner. The direction of increasing milepost is to be shown. Include the railroad milepost number (carried to second decimal place) at the intersection of the centerline of the railroad track and centerline of the roadway, drainage way, other track(s), utility, etc. Railroad stationing is to be shown and identified along track centerline. Basis of railroad stationing is to be noted in the plans.

7.10. The Agency shall provide the latitude and longitude of the structure at the following locations:

7.10.1. Intersection of centerlines of the railroad tracks and the feature being crossed

7.10.2. Intersection of the centerline of the track and the bridge at the inside face of the backwalls at both abutments.

7.11. Bridge structure(s) having multiple tracks shall be designed to accommodate any future shifting or relocation of track.

7.12. The year of construction shall be shown at the face of back-wall. Numbers shall be embedded into the concrete and shall be six (6) inches tall.

7.13. Mounting of roadway signs on any element of the bridge structure is prohibited.

7.14. Where bridge supports are provided in the roadway median, proper crash protection features shall be installed.

7.15. On high embankments where retaining wall are to be built, handrails shall be installed on the retaining wall for protection of railroad personnel.

7.16. Drainage is an important aspect of the design and shall be carefully considered.

7.17. Designer shall provide details such that all exposed parts will be accessible for inspection, cleaning and painting. Not less than eighteen (18) inches clear shall be provided between the flanges of parallel lines of beams having depths in excess of thirty-eight (38) inches.

7.18. 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 KCSR.

7.19. A bridge that spans a waterway shall be designed with adequate opening area underneath the bridge to pass, at a minimum, a one hundred (100) year flood event. A minimum freeboard of twenty four (24) inches above the design flood event shall be provided. It is preferable to span the entire width of the main drainage channel with no piers or bents in the channel.

7.20. A reinforced concrete collar shall be constructed to enclose any bent that is within the main drainage channel. The concrete collar shall be a minimum of twelve (12) inches above the mean highwater level. The upstream end of the collar shall be tapered to avoid damage to it from direct impact of debris floating in the water. The collar shall be embedded a minimum distance of twelve (12) inches below the scour depth to provide proper support. The bent shall be designed to carry the additional weight from the collar. Designer shall verify with KCSR during the conceptual design phase on this requirement.

7.21. The bridge shall be laid out with double bents or piers or shafts, etc. spaced evenly along the bridge length (approximately every one hundred fifty (150) feet) to distribute the longitudinal forces from railroad traffic. These bents shall not be placed within the main drainage channel.

7.22. On projects where the bridge is extended beyond the limits of the existing abutment, track embankment approach at that end of the bridge shall be regraded and replaced with compacted subballast for a depth of twelve (12) inches below the bottom of the existing ballast and for a minimum distance of thirty (30) feet from the end of the bridge backwall.

7.23. On projects where proposed bridge abutment lies in front of the existing abutment or on proposed bridges where no track embankment approach exist, all organic matter and loose material shall be removed and the subgrade regraded in such a way as to drain the water away from the centerline of the track prior to placing compacted subballast fill to the required grade and slope.

7.24. No rail joints shall be found within twenty-five (25) feet from the ends of the bridge back wall.

7.25. Low chord elevation of the proposed bridge shall meet or exceed requirements stated in KCSR Guidelines and Standards, AASHTO or AREMA Manual, whichever is greater.

7.26. New top of rail elevation on the proposed structure shall be at least twelve (12) inches higher than the existing. Make necessary adjustments to the approach embankment widths as necessary to accommodate this track raise.

8. Skew of Bridge

The preferred angle of roadway, drainage way, other track(s), utility, etc. crossing the bridge structure relative to the centerline of track is ninety (90) degrees. However, in cases where a ninety

(90)-degree crossing cannot be obtained, the maximum skew of bridge structure from ninety (90) degrees shall not exceed the following for various types of structures:

Table 8.1. Allowable Skew in Railroad Bridges

Type of Structure	Skew in Degrees
Steel spans (Beams, Deck Girders, Through Plate Girders)	30 degrees, maximum
Pre-stressed concrete with concrete deck (AASHTO Beams)	30 degrees, maximum
Pre-stressed concrete box girders	15 degrees, maximum
Box girders - conventionally Reinforced	20 degrees, maximum
Trusses and Arches	Zero Degrees

Provide information on the alignments of roadway, bridge piers, and abutments as required to comply with the above maximum skew limitations.

Where conditions preclude any other solution, the skew proposal will require special structural consideration and proof of adequacy. Skews in excess of fifteen (15) degrees are not permitted for continuous structures.

At the ends of a skewed bridge, reinforced concrete support slabs shall be provided for each track. Ends of track slab shall be perpendicular to the centerline of the track and be fourteen (14) foot minimum width placed symmetrically to the centerline of the track or equal to the outside width of the bridge, whichever is more. Length of track slab, also called approach slab, where provided, shall be twelve (12) foot minimum beyond the back face of backwall as measured along track centerline.

9. Vertical Clearances

Bridge structure shall be designed and provide sufficient vertical clearances as shown in table below. Under unavoidable circumstances, KCSR may issue a variance to the clearances stated in table 8.1 on a case by case basis during the design phase. Protective devices to ensure that structure will be protected from oversized and unauthorized high loads shall be provided.

Table 9.1 Vertical Clearances

Structure Over	Vertical Clearance
Freeways	17.5 ft.
Designated aerial routes	17.5 ft.
Local roads and streets	16.0 ft.
Rural roads	15.5 ft.
Pedestrian under crossing (no vehicles)	8.0 ft.
Recreational roads	12.5 ft.

Vertical clearance signs showing the distance between the highest roadway surface elevation and the lowest elevation of the bottom of the crash beam shall be posted at the bridge and on both approaches to the bridge. Where inadequate vertical clearances are provided, additional advance warning signs shall be posted on both approaches of the roadway a distance of at least one-half mile from the bridge.

Vertical clearance signs shall not be affixed to the bridge superstructure.

All structures with vertical clearances less than stated in Table 8.1, except pedestrian only under crossing (no vehicles), shall be protected with steel collision impact devices. Collision impact devices shall be installed over the full width of traveled lanes and attached to the bridge substructure. Collision impact devices shall be installed a minimum of five (5) foot ahead of the main supporting member, or as approved by KCSR, and shall not carry any railway loads. Collision impact devices shall be of steel shape (wide flange or tubing) and of sufficient strength to limit horizontal deflection to six (6) inches caused from the impact from oversized vehicle or load. Additionally, it shall be anchored sufficiently to the bridge seat at an elevation of at least six (6) inches below the bridge soffit.

If resurfacing or any other activity is to be performed on a roadway below the bridge structure, the owner of the roadway must submit a request for approval from KCSR. This request must provide the existing **measured** and posted clearances of the structure and the proposed configuration after work is completed. In no way will proposed work adversely impact clearances provide in Table 8.1 unless otherwise approved by KCSR.

The owner of the roadway shall be responsible of posting and maintaining structure sign clearances and any advance street notifications as required.

10. Design Loads

10.1. Bridge structures shall be designed for all loads specified in Chapters 8, 9, or 15 of the latest version of the AREMA Manual. The design of bridge structures shall also comply with the seismic criteria of the current edition of AREMA Manual, Chapter 9 – *Seismic Design for Railway Structures*.

10.2. Live Load and Impact Load shall be as specified in the AREMA Manual.

10.3. All underpass structures shall be designed for a maximum of thirty (30) inches of ballast (top of deck to bottom of tie) to account for future track raises. Structures shall be constructed to the required grades with the minimum depth of ballast under the tie of eight (8) inches for timber ties, and twelve (12) inches for concrete ties. Agency to confirm with KCSR what type of ties will be used on the bridge prior to proceeding with the design.

10.4. Where KCSR has previously approved a bridge superstructure consisting of steel beams with concrete deck, minimum requirements contained in this section must be accommodated. Under normal working loads, composite action may be expected between a concrete deck and its supporting steel members, when shear transfer devices are used. The bottom of the deck slab shall be placed at least one (1) inch below top of supporting steel members. For design purposes, the supporting steel member shall be proportioned to carry E65 live, impact, and dead loads without taking into account any composite action, and E80 live, impact, and dead loads taking into account composite action. Composite action may be taken into account when

satisfying the deflection-length ratio requirement of AREMA Manual Chapter 15 provided shear transfer devices are installed.

10.5. Live load distribution for pre-cast pre-stressed single or double cell boxes shall be in accordance with AREMA Manual Chapter 8, Part 2 *Reinforced Concrete Design*. Live load shall not be assumed to be distributed to the number of boxes supporting the tracks. For multiple track structures, live load shall be distributed based on the assumption of the track being in any location.

10.6. Structure shall be designed for longitudinal forces stated in latest version of AREMA Manual.

10.7. In the analysis of piers, retaining walls and abutments, account shall be taken of all superimposed loads carried directly on them, such as building walls, columns, or bridge structures; and of all loads from surcharges caused by railroad tracks, highways, building foundations, or other loads supported on the backfill. Piers must also be designed for stream flow pressures, ice flow pressures and collision forces where applicable.

10.8. In calculating the surcharge due to track loading on an abutment and or wing walls that are in line with the abutment back walls, the entire load shall be taken as distributed uniformly on the surface of the ballast immediately below the tie, over a width equal to the length of the tie. With increased depth, the width for distribution can be increased on slopes of one (1) horizontal to two (2) vertical with surcharge loads from the adjacent tracks not being permitted to overlap.

10.9. To account for variability in backfilling and the dynamic effects of axle loads, abutment back walls above bridge seats shall be designed for earth pressures and live load surcharge increased by one hundred (100) percent. This does not apply to the portion of the abutment below the bridge seat or the stability of the abutment.

10.10. In calculating the surcharge due to track loading above a wall and parallel, or roughly parallel, to the wall, the entire load shall be taken as distributed uniformly over a width equal to the length of the tie.

10.11. The stability of the abutment or wall as a whole unit, regardless of the distribution of the loads and surcharges, shall always be checked and shall conform to the requirement of AREMA Manual, Chapter 8, Section 5.4, *Stability Computation*.

10.12. Live Load impact shall not be considered in the design of an abutment or pier unless the bridge bearings are supported by a structural beam, such as the seat of a spill-through abutment or a pier cap supported by individual columns, piles or shafts. In such a case, the impact shall be applied to the beam only, and not to footings or piles.

10.13. For the design of abutments and piers, consideration must be given to all forces transmitted from the superstructure to the substructure, depending on the bearing fixity conditions.

11. Special Requirements for Pre-cast, Pre-stressed Box or AASHTO-type Girders

11.1. Box-shaped (single or double void) or AASHTO-type pre-cast pre-stressed girders, except those in KCSR's Standards, for all spans shall be designed with end and

interior diaphragms. Interior diaphragms shall be spaced equally across the span length. Provide diaphragms as follows for various span lengths:

Table 11.1 Diaphragm Spacing

SPAN LENGTH IN FEET	NUMBER OF INTERIOR DIAPHRAGMS
35 - 50	1
51 - 75	2
Over 76	3

Above number of diaphragms per span is the minimum required. The definite number to be considered in each case depends on the particular design, span lengths, member rigidities, etc. Diaphragm spacing should not exceed twenty-five (25) foot center to center. Refer to AASHTO requirements for more details.

11.2. Transverse tie rods shall be installed at the end and each interior diaphragm. Minimum size of tie rod to be one and one-quarter (1-1/4) inch in diameter. Tie rod to be protected in one of the following ways:

11.2.1. Rod, plates and nuts shall be hot dip galvanized per ASTM A123 and A153.

11.2.2. All assembly parts left plain, but void between rod and hole shall be pressure grouted. Tie rod anchor assembly shall be recessed into the concrete and shall have one (1) inch minimum grout cover.

11.3. Strands at the ends of pre-cast pre-stressed members shall be cut maximum one (1) inch and minimum one half inch into the member and the resulting recessed pocket filled with grout.

11.4. For AASHTO beams, the designer shall provide twelve (12) inch minimum gap between the bottom flange of each beam to accommodate inspections and repairs.

11.5. The keyway in pre-cast concrete box girders (if provided) and AASHTO girders shall be bonded with high strength epoxy or non-shrink cementitious grout. Strength of epoxy or grout to be at least equal to the strength of concrete member being bonded. Refer to AASHTO specifications for more details and requirements.

12. Special Requirements for Post-Tensioned Concrete Structures

Use of post tensioned concrete structures are prohibited on KCSR bridges.

13. Material Requirements for Steel Structures

13.1. All materials shall confirm to the minimum requirements as stated in the latest version of AREMA Manual unless otherwise approved by KCSR.

13.2. Thickness of structural steel (except for fillers) shall not be less than 0.335 inch thick. Parts subject to corrosive influences shall be of greater thickness than otherwise specified or steps taken to protect same against such influences.

13.3. 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 one-half (1/2) inch.

13.4. Minimum size of high strength bolt for bolting structural members shall be seven-eighth (7/8) inch diameter conforming to ASTM F3125 Grade A325 Type 3 specifications.

13.5. The allowable bearing pressures as contained in AREMA Chapter 15 Steel Structures are to be used for steel superstructure bearing on concrete substructure.

13.6. All fracture critical members (FCM) shall be designated as FCM in the plans. Fracture critical members shall be designed for a minimum service temperature of minus thirty (–30) degrees F corresponding to Zone 2. Frequency of testing shall be in accordance with ASTM specifications.

13.7. All structural steel shall conform to ASTM A709 grade 50W unless otherwise required by design.

13.8. Steel ballast pan shall conform to ASTM A709 grade 50.

13.9. All surfaces of structural steel shall be cleaned per Steel Structures Painting Council (SSPC) specifications SSPC-SP6.

13.10. All miscellaneous steel plates shall conform to ASTM A36 or A709 Grade 36 specifications.

13.11. Anchor bolts for bearing devices shall conform to ASTM F1554 Grade 105; Anchor bolt nuts shall be in accordance with ASTM A563 Grade DH heavy hex; and, washers shall be F436 Type 1 unless otherwise required by design.

13.12. Bearing pads and cushioning pads shall conform to the requirements of the latest version of AREMA Manual.

13.13. All bridges with concrete deck and concrete ties shall have a minimum twelve (12) inches of ballast under the concrete tie.

13.14. Bridge decks designed with concrete ties shall receive a ballast mat protection on the concrete deck. Contractor to submit the ballast mat materials for review and approval by KCSR.

14. Painting of Steel Structures

KCSR prefers the use of weathering or galvanized steel in lieu of any steel type that requires painting. In cases where weathering or galvanized steel cannot used, steel structures must be painted. Designer shall consult with KCSR prior to finalizing material specifications.

14.1. Painting of steel structures shall comply with the requirements of current AASHTO specifications and recommendations of SSPC.

14.2. Paint shall be applied in accordance with the manufacturer’s recommendations or in compliance with the recommendations of SSPC, whichever is most restrictive.

14.3. Painting system, including primer and top coats, shall be submitted by the Agency for review and approval by KCSR.

14.4. Painted structure must be maintained by Agency proposing the bridge structure at no cost to KCSR.

15. Ballast Deck Bridge Structure

15.1. Deck Width

Deck width is the width of the bridge measured from inside face of parapet/handrails to inside face of parapet/handrails or between centerline of girders whichever is greater. For single track bridge structure on tangent alignment, the deck width shall be not less than seventeen (17) feet. In curved track, the deck width shall be increased by an additional one and one half (1.5) inches for every degree, or fraction thereof, of curvature. The track shall be centered on the bridge with a clearance of not less than eight (8) feet six (6) inches or minimum required by a State, whichever is greater. Refer to AREMA Manual for the latest requirements, however, clearance shall not be less than what is stated above. For multiple tracks, an allowance of twenty (20) feet shall be provided for each additional existing or future track measured center to center of tracks.

15.2. Curb Height:

The top of ballast curb or walkway shall be approximately the same elevation as the base of highest rail plus eight (8) inches to accommodate possible future track raises but not less than twenty-four (24) inch in height. Where concrete ties are used, the curb height shall not be less than thirty (30) inches in height.

15.3. Walkway:

Walkways on bridges shall not be less than three (3) foot wide.

KCSR prefers that the track bed itself be considered as a walkway instead of providing a raised platform. Deck width shall be wide enough to accommodate both the walkway and the track structure. The clear distance from centerline of track to ballast retainer for bridge with walkway shall be at least eight feet six inches (8’-6”).

In cases where walkways have to be built adjacent to the girders and in-between the knee braces or on the outside face of the girders, walkways shall not be less than three (3) feet wide. Walkway surface material shall be of bar grating type per KCSR Standards. Grip strut walkway grating is not acceptable. Structural members (such as floor beam knee braces) may not be considered as an obstruction to the walkway.

Walkways on bridge structures over roadways or other locations where spillage of ballast or lading is possible, walkway grating shall have openings less than one quarter (1/4) inches and a curb or toe board provided. Walkway grating or a metal mesh capable of supporting twenty (20) pounds per square foot load shall be provided to cover the open space between the walkway surface and the girders to prevent accidental fall of personnel thru the opening.

To prevent cracking under live loads, provide one-quarter (1/4) inch wide joints at a maximum spacing of ten (10) feet on concrete curbs, walkways, and ballast retainers.

15.4. Handrail:

Handrails shall be provided on both sides of the bridge deck. Horizontal clearances from the centerline of the nearest track shall not be less than eight feet six inches (8'-6") for tangent track, and an additional one and one-half (1.5) inches for every degree, or fraction thereof, of curvature on a curved track, or as prescribed by AREMA Manual, Chapter 15 *Steel Structures,* whichever is greater. Handrails shall be simple designs that require minimum maintenance. Variations from the handrail types shown in the KCSR Standards shall be submitted for approval by KCSR.

15.5. Depth of Ballast:

The depth of ballast beneath ties under the lowest rail shall be eight (8) inches minimum for timber ties and twelve (12) inches minimum for concrete ties at the time of construction. Structures shall be designed to accommodate thirty (30) inches of ballast for future track raises measured from top of deck to bottom of tie at the low rail which may require taller ballast curbs.

15.6. Drainage on Bridge:

The deck of steel bridges shall be sloped transversely not less than two tenths (0.2) percent. A transverse slope on steel bridges shall be provided by varying the thickness of the waterproofing membrane such that the required minimum waterproofing membrane thickness is at the low end. Low points on top of the trough shall be located not less than six (6) feet zero (0) inches from the centerline of any track and shall be within the outside beams or girders. A longitudinal collection system shall be provided to dispose the water without permitting it to enter the ballast section and backfill beyond the limits of the bridge structure.

All cast-in-place concrete ballast troughs shall be sloped transversely not less than two tenths (0.2) percent. A longitudinal collection system shall be provided on top of 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.

If an approach grade descends toward the bridge structure, drainage from the approach shall be intercepted by appropriate means to prevent it from draining onto the bridge structure.

15.7. Waterproofing and Protective Panels:

Waterproofing and protective panels shall comply with KCSR preferred waterproofing method of spray-applied-waterproofing with integrated ballast mat protection. The recommendations of the AREMA Manual Chapter 8, Part 29 *Waterproofing* may be proposed for KCSR consideration.

If the cold liquid-applied elastomeric membrane is used, it shall be in accordance with AREMA Chapter 8.

Butyl Rubber or EPDM membrane waterproofing system is **not** acceptable to KCSR. Asphalt board protection system for the waterproofing membrane is not acceptable to KCSR.

Waterproofing and protective panels are applicable to both concrete and steel structures.

16. Abutments

The abutments shall be designed in accordance with the recommendations of the AREMA Manual Chapter 8, Part 5, *Retaining Walls, Abutments and Piers*. The abutments shall be wide enough to match the bridge section described in Section 14 of these Guidelines and satisfy KCSR standard roadbed as shown in Section V, *References*. For multiple track bridges, the abutment width shall be sufficient to provide for standard shoulder, plus twenty (20) feet for each existing or future track. Single piece abutment and two-piece abutment with abutment cap and backwall bolted together are acceptable depending on the construction methodology. The choice of abutments shall be verified with KCSR prior to finalizing the design.

Abutment cap and pedestals supporting a steel bearing assembly shall have a minimum edge distance of six (6) inches. Weep holes shall be provided to relieve water pressure from the back of the abutment. If weathering steel is used for superstructure, details on top of abutment seat should indicate method of collecting and disposing of water without staining concrete surfaces.

Wing walls shall be designed to support the designed embankment slopes, but should in no case be designed for a slope steeper than 2H:1V without approval of KCSR.

Handrails shall have a return connected to the back wall and/or wing walls.

17. Piers

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

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

17.3. Single column piers should not be considered for a bridge structure. The solid pier wall piers shall have a minimum thickness of four (4) feet.

17.4. Slope top of pier to drain. If weathering steel is used for superstructure, details on top of pier seat should indicate method of collecting and disposing of water without staining concrete surfaces.

17.5. Bridge piers adjacent to roadways shall be protected from vehicular traffic by constructing protective highway barriers in accordance with AASHTO or State DOT Standards whichever is more restrictive.

17.6. See additional requirements for spacing and layout of piers in Section 2 Item 6 Bridge Layout of these Guidelines.

18. Structure Separation

To accommodate maintenance requirements, parallel structures shall have a minimum separation of five (5) feet.

19. Site Drainage

Maintaining the existing drainage and providing for future drainage improvements is of the utmost importance. Existing railroad ditches must be maintained at all times.

Drainage plans must be included with the general plans submitted to KCSR for approval. These plans must include hydrologic computations, indicating the rainfall intensity and duration of the design storm used, as well as the method of analysis. All designs shall be based on a one-hundred (100) year rainfall event.

When the proposed construction will change the quantity and/or character of flow in the track ditches, the ditches shall be modified as required to accommodate the changed conditions.

Approval of the drainage plan does not relieve the submitting Agency and/or designer of ultimate responsibility and liability for a satisfactory drainage design.

20. Shoofly Construction

The Agency shall sequence construction of the proposed bridge structure such that safe railroad operations are continued throughout the duration of the project.

If rerouting of the active railroad track is required to build the bridge, a shoofly shall be designed to comply with current rail operations and existing conditions. .

The shoofly shall be designed in such a way as to carry the same rail traffic and at the same speed as the existing alignment. The shoofly shall be spaced at a far enough distance from the existing alignment such that the construction activities for the new bridge will not significantly affect the normal rail operations. The track structure shall be built of new track materials (rail, ties, OTM, etc.) with rail size matching the existing track. The shoofly connections to the existing alignment shall not be via a turnout. Shoofly track embankment shall be in accordance with KCSR specifications for a new track.

Agency will be responsible for acquiring any property outside of the KCSR ROW for the construction of the structure or facilitating a shoofly. Agency will provide KCSR easement rights allowing railroad operations and maintenance activities on and across this property for the duration of the project, until the trackage is returned to the existing permanent alignment.

If additional drainage structures are to be installed on the shoofly (culverts, bridges, etc.), they shall be designed to the same standards as the permanent structures required by these Guidelines unless otherwise approved by KCSR in writing. Bridges that are temporary in nature on the shoofly may be open deck timber structures built in accordance with KCSR standards.

Designer shall submit shoofly design for review by KCSR in the early stages of project design. No design should advance without such approval.

KCSR will inspect and maintain the shoofly track at Agency’s cost. KCSR will only perform inspections of bridges and culverts and will advise the Agency of any repairs required. Agency or its

agent(s) will be responsible for performing all maintenance activities on these temporary structures at Agency's cost.

21. Construction Excavation

Excavations for construction of footings, piers, columns, walls or other facilities that affect KCSR track or signal structures shall be designed and constructed in accordance with Section IV, *Design and Construction of Shoring Adjacent to and on Railroad Right-of-Way*.

22. Erosion Control

The general plans for the bridge structure shall indicate the proposed methods of erosion control and must specifically address means to prevent scouring and silt accumulation in the ditches and culverts and to prevent fouling the track ballast, sub-ballast and existing drainage system(s).

Existing slopes and track ditches shall be maintained at all times throughout the construction period. Upon completion of construction and establishment of all permanent erosion control measures, all temporary erosion control devices and silt deposits shall be removed. Additionally, all slopes and ditches restored and properly protected.

Agency shall furnish to KCSR all copies of Storm Water Pollution Plans and approved permitting when required.

23. Construction Management

In addition to KCSR providing construction monitoring of the project at important milestones, Agency shall provide qualified staff to manage the construction of the project. Following are the minimum requirements for the Agencies Construction Management Team:

23.1. Agency to submit names of personnel to be used in the project and their assigned duties.

23.2. Provide a list of projects each person has actively worked on including bridge structures (highway or rail), underground facilities and drainage structures.

23.3. Provide verifiable list of employment including a current resume for each person on the Construction Management Team.

23.4. Minimum personnel for Construction Management Team for a typical bridge structure will consist of:

23.4.1. Project Manager – Shall be a Professional Engineer currently licensed in the state where the work is being performed with a minimum of ten (10) years of qualified experience in bridge construction and the management of bridge construction projects.

23.4.2. Resident Engineer – Shall be a Professional Civil Engineer currently licensed in the state where the work is being performed with a minimum of five (5) years' experience in the field of bridge construction work.

23.4.3. Construction Inspector – Shall be familiar with concrete and steel construction and have current certifications in the fields they will be responsible for inspecting.

23.5. All field members of Construction Management Team are required to have successfully completed the KCSR On-Track Safety and Bridge Fall Protection class. This training must be renewed annually and shall be provided by KCSR approved trainers only. A list of approved trainers can be obtained from KCSR.

23.6. All contractor submittals shall be reviewed by the Construction Management Team and approved by the Agency. Following Agency's approval, the submittal(s) shall be submitted to KCSR for further review and comments. No work shall be performed inside the KCSR right-of-way without prior review and concurrence by KCSR.

24. Review Submittals

Agency shall submit various aspects of the project for review and approval by KCSR. Submittals must be complete, clearly explained and orderly. Submittals are to be in acceptable electronic format in pdf format and in CAD format when requested. KCSR prefers to not have any submittals in paper format. Review of submittals will be done by KCSR and/or by an outside consultant at the expense of the Agency. Submittals shall consist of the following:

24.1 Preliminary Conceptual Submittal

24.1.1. Plan view of proposed bridge structure to indicate the span lengths, the existing and proposed track alignment with railroad stationing and railroad milepost, skew angle of abutments and piers, site drainage, KCSR ROW lines, etc. Plan shall show the location of a shoofly, if applicable, indicating the footprint of the bridge structure in relation to centerline of shoofly. Minimum distances from near track and location of shoring, if required, shall be shown. Location of the proposed and the existing bridge, if one exists, shall be located using KCSR milepost, station and subdivision name.

24.1.2. Location of all existing facilities and existing and/or relocated utilities within the KCSR ROW. Identify and specify the relocation of any facility or utility. The presence of existing or proposed fiber optic cables on KCSR ROW 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.

24.1.3. Elevation view indicating the abutments, piers, foundations, minimum vertical clearance above roadway, type of footings, etc. Proposed elevations are to be provided for top of roadway, top of piers and abutment caps, top of foundations, bottom of beams, top of bridge deck, top of rail, etc.

24.1.4. Typical superstructure cross sections at every pier and abutment indicating horizontal and vertical dimensions of deck structure, rail and ballast structure, waterproofing material, deck drainage, track spacing, horizontal clearances, handrail, etc.

24.1.5. Track plan and profile of existing and proposed railroad track(s) with elevations across the bridge structure and for a distance of at least one thousand (1,000) feet beyond the bridge ends or as may be required. Plan

and profile to include all drainage structures, subgrade elevations, ditch flowlines, etc.

24.1.6. Railroad track roadbed cross sections along railroad track using railroad stationing at one hundred (100) foot intervals along tangent track and fifty (50) foot intervals along curved track. Cross sections with break points from track centerline including elevations depicting the rail, ties, track ballast, roadbed subgrade, subballast, slopes and drainage ditches which includes the one hundred (100) year event water surface elevation, etc.

24.1.7. Existing and proposed alignment of the proposed shoofly alignment, if applicable, with all design data and information complete as listed in previous subsections.

24.1.8. A completed Appendix A *KCSR Underpass Grade Separation Data Sheet* document.

24.1.9. The survey of existing track, embankment, utilities, etc. shall be completed using State Plane Coordinates.

24.2. 60% Submittal

24.2.1. Complete design of superstructure and substructure of the bridge

24.2.2. Complete design of proposed railroad track and/or shoofly track alignment

24.2.3. Inclusion of KCSR special requirement notes in plan set (contact KCSR to obtain the latest requirements)

24.2.4. Table of materials used in bridge and track structures along with their specifications

24.2.5. Deck and waterproofing details

24.2.6. Geotechnical reports/recommendations sealed and signed by a Professional Engineer currently licensed in the state where the work is being performed

24.2.7. Complete set of structural calculations signed and sealed by a Professional or Structural Engineer currently licensed in the state where the work is being performed. Computer run output or data sheet calculations shall be supplemented with sample calculations and clearly defined sketches. All assumptions shall be clearly indicated.

24.2.8. Hydrology and Hydraulic calculations, reports and recommendations, if drainage is affected that are sealed and signed by a Professional Engineer currently licensed in the state where the work is being performed.

24.2.9. General notes providing structure design criteria; detailed list of loads and load conditions used in the design; load rating of the bridge for 286,000lb and 315,000lb cars and E-80 trains for normal, maximum and fatigue for speeds 10 (ten) mph, twenty five (25) mph, forty (40) mph and fifty nine (59)

mph; construction methods; material compliance specifications; construction sequencing; survey control points (both Agency and KCSR); reference coordinates; one hundred (100) year event flood elevations; welding, bolting and riveted connection specifications; deflection table; a table showing loads and stresses in various members; etc. Obtain the latest requirements by contacting KCSR.

24.2.10. ROW plans showing limits of proposed project within KCSR ROW which are both permanent and temporary in nature. Legal property descriptions shall be provided for each. All ROW documents to be properly sealed by a Profession Surveyor licensed in the state the work is being performed.

24.2.11. Construction schedule providing dates for tasks such as pre-bid and pre-construction meetings, project start, substructure work on each particular pier, superstructure work, track work, etc.

24.3. 90% Submittal

24.3.1. Revisions to plans and calculations as dictated by review of the 60% submittal. Revisions to plans and calculations resubmitted and properly sealed by a Professional or Structural Engineer licensed in the state in which the work is being performed.

24.3.2. Project Special Provisions

24.3.3. Revised construction schedule

24.4. Final Submittal

24.4.1. Final bridge structure plans and structural calculations sealed and signed by a Professional or Structural Engineer currently licensed in the state in which the work is being performed.

24.4.2. Final hydrology and hydraulic calculations and reports signed and sealed by a Professional Engineer currently licensed in the state where the work is being performed.

24.4.3. Final special provisions

25. Construction of the Project

Construction of the project shall be done in accordance with KCSR approved plans and specifications, per the executed Construction and Maintenance Agreement, per any changes or modifications to the approved plans and specifications during the course of the project, and as directed or required by KCSR and the Agency. Agency shall require its contractor to abide by the project schedule so as to minimize the effect on railroad operations.

25.1 Construction Submittals

During construction of the bridge structure, KCSR requires the review of material data sheets to determine compliance with the specifications. It is required that product information for all material specified in the table below be submitted by the Agency or their representative

to KCSR for review following their own review and approval of the material. The Agency approved submittal may be forwarded to an outside consultant for review and comment. The consultant may reply directly to the Agency or its representative following consultation with KCSR. During the review process, the consultant and design engineer shall be free to and is encouraged to communicate and resolve issues. Following is a list of some of the material submittals to be provided to KCSR by the Agency. KCSR reserves the right to request additional submittals.

Table 25.1 Submittals

ITEM	REVIEW SUBMITTAL	NOTES
1	Shop Drawings	Steel and Concrete Members
2	Bearings	For all structures
3	Concrete Mix Designs	For substructure and superstructure
4	Rebar & Strand Certifications	For substructure and superstructure
5	28-day concrete strength	For substructure and superstructure
6	Waterproofing material certification	Waterproofing and protective boards
7	Structural Steel certifications	All fracture critical members
8	Test reports	All fracture critical members
9	Foundation Construction Reports	Pile driving, drill shaft construction, bearing pressure test reports for spread footings, cross sonic logging (CSL) testing, pile driving analysis (PDA), load testing of shafts (if required)
10	Shoring Plans and Calculations	Section IV, *Design and Construction of Shoring Adjacent to and on Railroad Right-of-Way*
11	Track Shielding – when temporary track crossings are constructed	Section V, *References*
12	Erection/Lift Plans	Design shall be signed and sealed by a Professional Engineer (See Lift Plan Guidelines)
13	Embankment Compaction Repots	Section V, *References*
14	Track Materials	Section V, *References*
15	Train and Track Curfew Plan	Submit planned curfews of stoppage of rail operations during various stages of construction.
16	Fabrication Plants	Fabrication of bridge elements shall be done in ASCE, PCI, ACI, State DOT approved plants only. Submit detailed plant certification paper work.
17	Fabrication Inspection Reports	Submit detailed inspection reports of various elements of the bridge elements

18	Laydown yard	Submit location of the construction laydown yard. If using KCSR property, proper approval and permits from KCSR must be obtained.
19	Utility Relocation	All coordination with utility relocation shall be done by the Agency or its contractor. Detailed plans and permits obtained shall be submitted.

25.2 Site Observation during Construction

In addition to the office reviews, site observations will be performed at significant milestone events during construction, including the following if applicable:

- Pre-construction meeting
- Shoring installations
- Acceptance inspection of any shoofly structure, roadbed and track, prior to placing them in service.
- Reinforcement and concrete placement for main bridge substructure and/or superstructure
- Steel erection for main bridge structure
- Erection of pre-cast concrete bridge superstructure
- Acceptance of waterproofing (prior to placing ballast)
- Railroad track construction
- Periodic inspections, once a month or after a major rain event, of erosion control measures, access roads, temporary structures, shoring, auditing of adherence to railroad safety rules, etc.
- Final observation and acceptance of the bridge structure and track

Site observation is 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 KCSR.

A construction schedule shall be provided to inform KCSR of the anticipated dates when various events of construction are to occur. This schedule shall be updated on a regular basis but not less frequent than monthly, to allow site visits to be scheduled by KCSR or its outside consultant.

Failure of the Agency to maintain the schedule or update the KCSR and its outside consultant may result in visits being made at inappropriate times thereby necessitating additional visits at additional costs to the project. Agency will reimburse KCSR for these additional costs due to poor communications. If portions of the project are done without KCSR's supervision, KCSR reserves the right to have the Agency or its contractor to remove and reconstruct those portions of the project at no cost to KCSR.

A detailed inspection report of the site visit along with photographs shall be submitted to KCSR. The inspection report shall contain date of inspection, inspector's name, entity the inspector is working for, RWIC's name, summary of job safety briefing, detailed information on track protection, detailed description of contractor's work, start and end time of work, list of any safety rule violation and how it was remediated, job site cleanliness, any damages to railroad property, etc.

25.3 As-Built Submittal

The Agency or their representative shall submit As-Built documents to KCSR at the completion of the project prior to closing project. As-built design and shop drawings are to be in electronic (MicroStation or AutoCAD platform) and Adobe PDF format only (no paper). Following is a list of these documents.

Table 25.3 As Built

ITEM	AS BUILT	NOTES
1	Design Plans, specifications, calculations, etc.	Final as-built bridge, track and signal plans
2	Shop Drawings	Final plans
3	Material Submittal log and approved submittals	Those that were used on the project.

Appendix A

Underpass Grade Separation Data Sheet

Underpass Grade Separation Data Sheet

1.	Location:				
		City	County/Parish	State	
2.	Agency Name				
	Proposed Bridge Location	RR Milepost		RR Station	
		RR Subdivision			
		Highway Station			
3.	Highway	DOT #		Agency Project #	
		Highway Name/Number		Highway Station	
		Highway Subdivision		Vert. Clearance	
4.	Description of Project:				
5.	Utilities on Railroad Property:				
	Name (owner)	Identify Adjustments Required		Contact Person	
6.	List all the at-grade crossings that will be eliminated by the construction of this grade separation:				
	DOT# and Name of Roadway		Milepost	Railroad Warning Devices Station	
7.	***Existing*** Bridge: (List each span length and bridge type)	Span #	Support 1 type	Support 2 type	Span type
	Proposed Bridge: (List each span length and bridge type)	Span #	Support 1 type	Support 2 type	Span type
8.	Total Length of Bridge:	EXISTING:		PROPOSED:	
9.	Offset to Shoofly Alignment:		Shoofly Length		
10.	Shoofly Alignment – On Embankment and/or Bridge -Describe Briefly				
11.	Drainage: (Describe how drainage from roadway is to be addressed)				
12.	Scheduled Letting Date:				

ALL INFORMATION ON THIS DATA SHEET TO BE SUBMITTED TO KCSR
Attach additional sheets if more information is to be provided

APPENDIX B

UNDERPASS GRADE SEPARATION SPECIAL REQUIREMENT NOTES

Appendix B

Underpass Grade Separation Special Requirement Notes

The plans and specifications prepared and submitted by the Agency shall include the following requirements:

1. The Contractor is responsible to coordinate all work with KCSR and meet KCSR requirements during the construction.

2. The Contractor shall submit proposed method of erosion and sediment control, including maintenance thereof and obtain approval of these methods from KCSR.

3. The Contractor shall inform KCSR of any excavation which is to be performed on KCSR ROW. If KCSR determines temporary shoring is necessary, such shoring shall be designed and constructed in accordance with KCSR requirements. All shoring plans and calculations shall be prepared, stamped, and signed by a Professional Engineer licensed in the state which the work will be performed. KCSR review and concurrence of Agency prepared shoring plans and calculations shall be required before construction begins.

4. Erection of a structure over KCSR ROW shall not interrupt nor interfere with use, operation and maintenance of KCSR facilities pursuant to KCSR requirements.

5. KCSR will not allow any work to be performed inside KCSR ROW without a permit. When a train/railroad equipment passes the work site, all equipment and personnel must clear the area to a distance of twenty (25) feet from the track centerline and secure all equipment.

6. All equipment booms to be turned away from tracks when not in use or when a train or railroad equipment pass the site.

7. Falsework clearances shall comply with KCSR's minimum construction clearances. The minimum temporary construction vertical clearance to any falsework from top of rail shall be twenty-two (22) feet and the minimum temporary construction horizontal clearance to any falsework from track centerline shall be fourteen (14) feet unless otherwise specified in the plans. Dropping of falsework or any other construction material on the tracks is not permitted.

8. All permanent vertical and horizontal clearances shall be verified prior to project closing.

9. For KCSR coordination, refer to the KCSR Special Provisions contained in the Construction and Maintenance Agreement.

10. Railroad flagging shall be in accordance with KCSR requirements. Performance of any work by Contractor in which person(s) or equipment will be within twenty-five (25) feet of any track, or will be near enough to any track that any equipment extension (such as, but not limited to, a crane boom) will reach within twenty-five (25) feet of any track, will require railroad flagging services or other protective measures. Flagging services shall be provided by a KCSR approved flagging Contractor. Nothing shall preclude or limit the KCSR's right to require a railroad flagger when, in KCSR's sole judgement, the services of a railroad flagger are necessary to protect the KCSR's operations or property.

11. Before entering the KCSR property outside the limits of Agency's easements, the Contractor must obtain and execute a Contractor's right of entry agreement with the KCSR including paying all the fees and flagging expenses associated with the right of entry.

12. The Contractor shall provide the insurance as required by KCSR.

13. The Contractor shall invite KCSR and/or its representatives to the pre-construction meeting and to all project progress meetings.

Section II

Design and Construction of Railroad Overhead Structure

Section II

Design and Construction of Railroad Overhead Structure

Table of Contents

	Subsection	Page No.
1.	Purpose and Scope	3
2.	Standard Drawings and Guidelines	3
3.	Units	4
4.	New or Modified Structures	4
5.	Permanent Clearances	4
6.	Construction Clearances	6
7.	Safety Barrier and Splashboards	6
8.	Safety Fences	7
9.	Parallel Structures	7
10.	Piers	8
11.	Pier Protection Walls	8
12.	Adjustment to Utilities	9
13.	Abutment Slopes	9
14.	Drainage and Erosion Control from Structure	10
15.	Lights	11
16.	Review Submittals	11
17.	Preliminary Submittal	11
18.	Final Submittal	14
19.	Construction Submittals	15

Appendix A

1.	Overhead Grade Separation Data Sheet	18
2.	Overhead Submittal Checklist	19

1. Purpose and Scope

The intent of this section of these Guidelines is to inform the Agency of KCSR's current minimum standards and requirements concerning design and construction of structures spanning over KCSR's right-of-way, railroad tracks or structures constructed within or across the railroad right-of-way. Examples of grade separation overhead structures include highway overpasses, pedestrian bridges, pipe rack bridges, overhead railroad bridges, etc. To expedite the design and construction review process, the Agency is advised to follow the requirements addressed in this section of the Guidelines.

2. Standard Drawings and Guidelines

Design and construction of overhead grade separation structures shall comply with the following standard drawings and guidelines:

17.1. Standard Drawings, Section V *References*

17.2. References

2.2.1 Shoring – Section IV, *Design and Construction of Shoring Adjacent to and on Railroad Right-of-Way.*

2.2.2 Demolition – Section III, *Bridge Demolition and Removal Plan for Structure over Railroad.*

2.2.3 The recommendations of American Railway Engineering and Maintenance-of-Way Association (AREMA) Manual of Railway Engineering, latest edition.

3. Units

English units are preferred for all Grade Separation overhead structures. Structures requiring the use of metric units shall indicate all controlling dimensions in dual units. English units are to be shown in parenthesis.

Controlling dimensions or elevations refer to, but are not limited to, the following:

3.13. Horizontal and vertical clearances

3.14. Track spacing, Railroad ROW, track stationing

3.15. Span length, width and depth of superstructure elements

3.16. Size and limits for barrier rail or splashboards and fences

3.17. Location and elevation of underground or aerial utilities and their relocation adjustments, if required

3.18. Size, elevation and location of pier or abutment footings for spans adjacent to railroad tracks

3.19. Size of structure supports (pier or abutment walls, columns)

3.20. Size and elevations of pier protection walls, if required

3.21. Shoring location and their limit(s), if required

3.22. Top of rail elevation(s) under structure and grade profile. If the track(s) are in a curve, the top of rail elevations will be required at each rail as will the design elevations of the bottom most element of the bridge structure at each of those locations.

3.23. Size and location of drainage structures and ditches

3.24. Temporary construction vertical and horizontal clearances, if required

Plans will be rejected if required controlling dimensions are not shown or not shown properly.

4. New or Modified Structures

New overhead structures are defined as any structure being constructed over the Railroad tracks at a location where no crossing currently exists or replaces an existing at-grade crossing or a grade separation structure at a different location than the existing. All new structures shall be designed to provide for one or more future tracks as required for long-range planning or other Railroad operating requirements and for a ROW access roadway. Designer should consult with KCSR prior to laying out the bridge bents.

Modified existing structures are defined as those structures being modified to accommodate more travel lanes or upgrading an existing structure at its existing location.

All new or modified overhead structures shall comply with the applicable minimum requirements shown on the current issue of KCSR standard drawings. Following are the specific requirements that must be properly addressed when the project involves modifying an existing structure:

Table 5.1 Modification Requirements

STRUCTURE MODIFICATION	COMPLY WITH REQUIREMENTS FOR:
Total deck replacement	Protection walls, Fence, Splashboards, Lighting, if applicable
Total replacement of existing railing	Fence, Splashboards
Total replacement of superstructure	Protection walls, Vertical clearances, Fence, Splashboards, Lighting, if applicable
Total replacement of existing structure	Treat replacement structure as new structure
Widening deck of existing superstructure	Protection walls, Fence, Splashboards, Lighting, if applicable
Widening existing structure	Protection walls, or modify existing walls to comply with current AREMA requirements
Multiple parallel structures	Treat each structure as a new individual structure

5. Permanent Clearances

Permanent clearances shall comply with the current issue of KCSR standard drawings with provisions for future tracks, access roads and drainage ditches. It is required on all new overhead

bridge structures to have all piers, abutments and their foundations located and constructed outside the Railroad's ROW and parallel to the tracks. At locations where railroad yards, industry tracks, large swaths of land owned by the railroad, etc. exist near or at the proposed overhead structure, special consideration shall be given to major future improvements or expansions by the railroad. Prior to laying the overhead structure at these locations, input from KCSR on possible future expansions shall be obtained. KCSR will not be responsible if major changes to the design needs to be done if proposed design doesn't allow for future expansions of railroad facilities.

If the above requirements are not possible to be met due to structural depth, vertical clearances or design limitations, piers, abutments and their foundations may be located on Railroad's ROW after obtaining a written approval from KCSR prior to laying out the bridge bents.

The horizontal and vertical clearances as well as the existing clearances of structures to be rehabilitated or replaced shall be indicated on the General Plan and Elevation.

Any variation of horizontal or vertical clearances shall be treated as a special case and will require approval by KCSR.

5.1. Vertical Clearances

Minimum permanent vertical clearance shall be twenty-three feet six inches (23'-6") measured from above the top of the highest rail to the lowest part of the overhead structure at a distance of nine (9) feet from the centerline of the track. This clearance shall be provided for all existing and future tracks. Additional vertical clearances may be required for features beyond those shown in the standard drawings; such as correction of sag in the track, track raise, construction requirements and future track raises.

Design plans shall prominently display a note stating: **"The elevations of the existing top-of-rail profile shall be verified prior to beginning construction**." All discrepancies shall be brought to the attention of KCSR.

5.2. Horizontal Clearances

Layout of ALL overhead structures shall provide ample space for access road(s) along at least on one side of the track(s) or as required by KCSR. For an existing single track, design shall accommodate a second track and access road on the side as required by KCSR during plan review. For multiple tracks, space shall be provided for an access road on both sides of the tracks and between tracks if required by KCSR during plan review. Designer shall consult with the KCSR for the requirements and location of a second track and access road(s).

Minimum horizontal clearance on tracks without an access road shall be twenty-five (25) feet measured perpendicular from the centerline of the closest existing or future track to the near face of pier protection wall(s). If only an access road is required, then the design shall provide a minimum distance of eighteen (18) feet from the centerline of the access road to the near face of the pier protection.

The minimum horizontal clearance requirement mentioned above is for tangent track layout. Horizontal clearances shall be increased by one and one half (1.5) inches per degree or fraction thereof of curvature or per AREMA requirements, whichever is

greater, when any part of the structure is located within a horizontal curve in the track or within eighty (80) feet of a curve or turnout.

The layout of the proposed structure shall take the following into consideration:

5.2.1. Future tracks and their relative location.
5.2.2. Geometry of existing track
5.2.3. Spreading of track centers and direction of spread
5.2.4. Location of access road
5.2.5. Location and size of drainage ditches
5.2.6. Location of new, existing or relocated utilities
5.2.7. All signal equipment including signal masts, cabins, hot box detectors, high water detection equipment, high/wide detectors, etc.

6. Construction Clearances

6.1. Vertical Clearances

The minimum **temporary construction** clearance to any falsework, parked equipment, shoring walls, containments, etc. shall be twenty-two (22) feet vertically above the highest rail. Falsework designers must check the supporting members for deflection and allow for said deflection, with a factor of safety, during erection of the falsework, construction and the removal of falsework elements. **Dropping of falsework or any other construction material on the tracks is not permitted**.

6.2. Horizontal Clearances

The minimum **temporary construction** clearance to any falsework part shall be Fourteen (14) feet from the centerline of the nearest track measured perpendicular to the said track.

Temporary horizontal clearances shall be adjusted pursuant to AREMA recommendations when structures are located within eighty (80) feet of a turnout or curved track.

Greater clearances may be required for special cases to satisfy local operating conditions. Designer shall consult with the KCSR for locations where additional clearance is required.

Temporary vertical and horizontal clearances shall be shown on the plans for ANY construction planned within or adjacent to KCSR ROW.

No variation to any temporary clearance (vertical or horizontal) will be allowed without written authorization of KCSR.

7. Safety Barrier and Splashboards

Designers of overhead structures shall provide means of protecting Railroad facilities and to maintain the safety of employees below the structure from snow removal activities and errant vehicles.

All structures where snow removal is being performed shall have splashboards as indicated in KCSR standard drawing. Structures requiring snow protective devices shall have a high solid barrier railing of three feet-six inches (3'-6") minimum height or a combination of a lower solid barrier railing and splashboard on top for a total height of five (5) feet. For details see current issue of KCSR standard drawings.

A variance to the solid three (3) feet six (6) inch high barrier railing or splashboards which is based on not removing snow laterally from the bridge will require a clause to that effect in the agreement between the Agency and KCSR.

The limits of snow protective devices shall extend to the full length of Railroad's right-of-way or a minimum of twenty-five (25) feet beyond the centerline of exterior track or access road. Addition of future tracks shall require the lengthening of the snow protective devices at the expense of the Agency.

Standard solid barrier rail will be acceptable on structures where snow removal is not performed.

Types of barrier railing or combination of barrier railing and splashboards and their limits on the structure shall be clearly shown on the plans.

8. Safety Fences

Protection and safety of rail operations and the KCSR employees and its contractors who may be working on the ground beneath the bridge is absolutely paramount. Designers of overhead structures shall provide means of protecting Railroad facilities and the safety of their employees and contractors below from objects being thrown from above by pedestrians or passing motorists. Types of fences and their limits shall be shown on the plans. Aesthetics shall not be cause for not meeting the safety requirements.

Fence shall be provided on both sides of ALL overhead structures. For types of fences required, see current issue of KCSR standard drawings.

Designer shall provide an eight (8) feet high curved fence or a ten (10) feet high straight fence on the side of the walkway. A combination of barrier rail and fence for a total height of ten (10) feet is acceptable.

Any variance to the fence requirements above may be provided by KCSR after a careful review of the circumstances. If variance is granted, KCSR reserves the right to request the Agency to install the Safety Fence at its sole cost at a later date if circumstances change.

Ornamental fencing with a maximum gap of four (4) inches and meeting the minimum height requirements noted herein are acceptable.

9. Parallel Structures

Parallel structures which are up to two (2) feet apart shall not require safety fence or snow protective devices at their interface. Structures that are more than two (2) feet apart shall be treated as individual structures and the required safety protective devices (barrier, splashboards, and fences) shall be provided.

10. Piers

All piers and abutment, their foundations and slopes shall be located so that they do not interfere with the drainage ditches or the natural drainage features of the area. Where conditions make this impractical, an explanation of such conditions shall be submitted along with the drainage plans and supporting calculations to KCSR.

Piers located within twenty-five (25) feet of centerline of the nearest existing or future track shall be designed with pier protection wall(s). Excavations and shoring for foundations shall conform to Section IV, *Design and Construction of Shoring Adjacent to and on Railroad Right-of-Way.*

Pier footings within twenty-five (25) feet of the nearest track centerline shall be a minimum of six (6) feet below the base of rail.

Drilled shafts within the influence of track surcharge shall be designed with temporary casing to protect track 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.

Drilling of shafts or shoring construction for footings within the influence of track surcharge shall not proceed without KCSR approval. For limits of track surcharge influence refer to Section IV, *Design and Construction of Shoring Adjacent to and on Railroad Right-of-Way.*

11. Pier Protection Walls

Piers supporting bridges over a railroad with a clear distance of less than twenty-five (25) feet from centerline of nearest, or centerline of anticipated future track, shall be of heavy construction or shall be protected by a reinforced concrete protection wall.

AREMA defines pier of heavy construction as: *"Piers shall be considered of heavy construction if they have a 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 single column, the minimum cross-sectional area is thirty (30) square feet (12 feet in length x 2.5 feet in width = 30 square feet). Columns with thirty (30) square feet of area must have the larger dimension parallel to the track (such as a five (5) foot x six (6) foot column with the six (6) foot dimension parallel to the track is considered as heavy construction column). Round columns may not meet the heavy construction criteria.

Design of pier protection wall shall comply with the requirements of AREMA Chapter 8.

At locations where tracks are on both sides of a pier and are less than twenty-five (25) feet from centerline of an adjacent track(s), both sides of the pier shall be protected with protection walls.

On projects where existing overhead structures are being rehabilitated in which existing piers are proposed to remain, Agencies shall make necessary provisions in the project to install pier protection walls on the existing piers if they are within twenty five (25) feet from the centerline of the existing or future track.

If pier design requires column isolation, the pier protection wall shall be designed to resist the impact and redirection of railroad equipment in case of derailment to be supported on an independent footing.

All new, replacement or modified structures shall comply with the AREMA recommendations for pier protection walls.

At locations where pier columns and protection walls interfere with drainage, openings must be provided in the wall for the drainage to ditches or drainage facilities to allow for the collection and disposal of water to the drainage system. Openings in the pier protection wall must be lower than the track sub-grade elevation and must drain away from the track. In cases where such openings cannot be provided in the protection walls, the drainage shall be diverted to the back of the piers away from the tracks before connecting into existing drainage ditches beyond the construction limits of the project.

12. Adjustment to Utilities

Agency, its engineers or contractors shall be responsible for locating, protecting and relocating utilities located within the construction limits of the project. Existing underground or aerial facilities interfering with a new structure shall be placed underground and away from the bridge structure. Relocation of utilities shall be performed by the owners of the utility at the sole expense of the Agency.

Relocation of non-railroad owned utilities or communication lines shall be coordinated with the owners and submitted to KCSR for coordination. Relocation of utilities within KCSR ROW shall be done only under an executed permit obtained from KCSR. Agency's engineer shall begin the process of relocating utilities currently inside KCSR ROW as early in the design process as possible to avoid delays to the project schedule.

13. Abutment Slopes

To prevent embankment material from sloughing and drainage waters from undermining track sub-grade, end slopes of abutments adjacent to railroad tracks shall be protected with paved slopes.

Paved slopes shall extend two (2) feet past the face of abutment wall and terminate with a curb or gutter to divert runoff. Paving shall consist of a prepared sub-base and filter fabric with reinforced concrete slab or grouted rip-rap placed on prepared sub-base and filter fabric. Asphalt pavement for slope protection shall be considered only if proper design and method of installation is submitted or covered in the special provisions.

Toe of slopes shall terminate at the bottom of drainage ditches and must have a cut-off wall to protect slope from drainage erosion. If piers are located twenty-five (25) feet or closer from the centerline of the track, the paved slopes shall terminate behind the pier protection walls.

Slope layout shall provide for a minimum drainage ditch or ditches required by hydraulic analysis for the area. See KCSR standard drawings for details. At all times, the toe of slope shall be below the finished track or roadway sub-grade and provide a ditch for positive track or roadway drainage.

If layout of abutments, piers or columns with protection walls interfere with the drainage ditches, the designer shall provide other means to manage the longitudinal drainage.

Track drainage ditch limits shall be shown to scale on the project plans with the distance from centerline of nearest track. A typical cross-section detail shall be shown on the plans depicting the intersection of the embankment slope and drainage ditch.

14. Drainage and Erosion Control from Structure

Maintaining the existing drainage and providing for future drainage improvements is of the utmost importance in layout of the overhead structures.

Drainage from the structure shall be diverted away from the Railroad ROW at all times. Scuppers from the deck shall not be permitted to discharge water onto the track or roadway areas at any time. If drainage of the deck uses downspouts in the columns, the downspouts shall be connected to the storm drain system or allowed to drain into drainage ditches. Concrete splash block or aggregate ditch lining will be required at the discharge area of downspouts. Downspouts shall be placed behind the face of the piers and their outflows drained into drainage ditches.

If a structure's drainage is carried outside the Railroad right-of-way and does not change the drainage conditions within the Railroad ROW, then improvement of existing drainage will not be required.

If the proposed bridge structure will not change the quantity and/or characteristic of the flow in the railroad's ditches and/or drainage structures; the plans shall include a general note stating such.

Drainage plans shall be included with the plans submitted for review. These plans must include hydrologic computations indicating the rainfall intensity and duration of the design storm used as well as the method of analysis. Drainage structures shall be in such a manner that the water surface elevation of a one-hundred (100) year flood event does not exceed the track sub-grade elevation. Where project design calls for the drainage flow to increase through the railroad ROW, methods must be developed to accommodate the additional flow.

Lateral or side clearances must provide sufficient space for construction of the required standard ditches parallel to the standard roadbed section.

The size of ditches will vary depending upon the flow and terrain and should be designed accordingly.

To evaluate the impact of the structure relative to existing site drainage, cross sections perpendicular to the centerline of track shall be submitted along with the drainage plans. Cross sections should be submitted to adequately depict the site condition; however, a minimum of five (5) cross sections on each side of the structure will be required at fifty (50) foot intervals. The existing or proposed railroad ditch along with the proposed toe of slope shall be shown on the applicable cross sections.

When permanent revetment is placed on the embankment slopes (concrete, stone rip rap, etc.) or seed and sodding is being placed, they must not extend beyond the top of the back slope of the railroad drainage ditch. Revetment shall be keyed into the ground a minimum distance of three (3) feet to prevent sliding. If columns exist within twenty-five (25) feet of the existing or future tracks, revetment shall be stopped behind the row of columns and protection wall. Columns and protection walls shall not be placed within the flow lines of the drainage ditch. If it cannot be avoided, the drainage ditch shall be rerouted to the back of the row of columns and protection walls.

In cases where the work area is very close to the track for unavoidable reasons, proper erosion control, silt fences, sedimentation and check dams, etc. shall be installed to prevent foreign

materials from fouling the track structure. If track becomes fouled due to Agencies project, Agency will reimburse KCSR for the cleaning or removing and replacing of the fouled materials.

Approval of the drainage plan does not relieve the submitting Agency and/or designer of ultimate responsibility and liability for the adequacy of the drainage design.

15. Lights

Designer to provide lighting for ALL new overhead or modified structures exceeding eighty (80) feet of superstructure width, except if such structures are located in a rural area. Lighting shall be provided also for structures of less than eighty (80) feet in width in areas that railroad switching is performed or high vandalism or trespassing has been experienced.

Designer to provide temporary lighting for ALL falsework designs irrespective of the superstructure width in areas that railroad switching is performed or trespassing or vandalism has been experienced in the past.

The minimum design criteria shall be an average of one (1) foot-candle for the entire area under the structure at the KCSR tracks. Fixtures shall be installed on the column walls or caps of the overhead structure without adversely impacting the required vertical and horizontal clearances.

Maintenance of lights shall be the responsibility of the Agency. Access to perform any maintenance for lights shall be coordinated with KCSR.

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

16. Review Submittals

Submittals for design and construction of grade separation projects shall be coordinated and submitted through the KCSR Engineering Department. To expedite reviews, submittals must be complete, clearly explained and orderly. Design review for grade separation structures will be reviewed by KCSR and/or an outside consultant at the expense of the Agency. Prior to any review being performed, KCSR must receive authorization from the Agency agreeing to compensate KCSR for all review costs associated with the project including plan reviews, construction inspection and monitoring and construction support services, whether performed by KCSR's own forces or an outside consultant. If, during the review or construction process, the estimated costs are determined to be insufficient to complete the reviews, the Agency will be advised and provide additional funds to continue the review and construction process. The original estimated costs will not be the upper limit of the costs, but will provide a guideline for budgeting purposes. Regardless, all reasonable costs incurred during the plan review process and construction monitoring phase of the work will be fully recoverable from the Agency.

17. Preliminary Submittal

The following shall be the minimum contents of plan submittals:

17.1. Plans:

At a minimum, the Plan View shall include:

17.1.1 KCSR ROW

17.1.2 Footprint of proposed structure including existing structure, if applicable

17.1.3 Location of all railroad tracks and identify each track as mainline, siding, spur, etc.

17.1.4 Minimum horizontal clearances and track spacing of all existing and/or future tracks to the face of the pier or pier protection walls. Location of future tracks can be obtained by contacting KCSR.

17.1.5 Location of ALL access roadways

17.1.6 Footprint of footings with the minimum clearance from centerline of adjacent or future track.

17.1.7 Indicate the minimum clearance requirement for shoring.

17.1.8 Locate and show all existing facilities and utilities and their proposed relocation, if required.

17.1.9 Drainage ditches and direction of flow.

17.1.10 Minimum structure separation for parallel structures.

17.1.11 KCSR milepost, stations, and the direction of increasing mileposts.

17.1.12 Point of minimum vertical clearance and location from the nearest track.

17.1.13 If existing structure is modified, plans shall clearly show what portion of the structure will be demolished and what portions will remain.

17.2. Elevations:

At a minimum, the Elevation View shall include:

17.2.1 Minimum vertical track clearances taken from top of rail at distance of 9ft from the centerline of each tack. Minimum vertical clearances shall be measured from the top of rail. KCSR shall be contacted to verify if any track raises are planned with that data included in the drawings and documented in the design.

17.2.2 Top rail elevation for all tracks.

17.2.3 Pier footing within Railroad right-of-way shall be six (6) ft. below base of rail.

17.2.4 Top of wall elevation of all pier protection walls relative to top of rail elevation.

17.2.5 Elevation of existing or relocated utilities.

17.2.6 Specification of slope and of slope paving. Toe of slope shall be shown relative to drainage ditch and top of track of access roadway sub-grade.

17.2.7 Drainage ditches. Provide enlarged scaled detail showing the correlation of slope pavement, ditch, and track or roadway sub-grade.

17.2.8 Limits of safety fencing and protective railing or splashboards.

17.3. Typical Sections:

At a minimum, the Typical Section(s) shall include the following items:

17.3.1 Structural components of superstructure as represented on the plans.

17.3.2 Type of railing and safety fencing and their heights.

17.3.3 Pier outline and pier protection walls. Additional cross-section(s) may be required to properly represent the protection wall design.

17.4. Track Profiles:

The plans shall include a top of rail profile which extends at least one thousand (1000) feet beyond each side of the proposed structure. Top of rail elevations shall be collected at no less frequent than fifty (50) foot intervals. If a railroad bridge is encountered, the bridge shall be located using the railroad station at inside face of backwalls at both ends of the bridge along with elevations at each bent location. Data points at switch points, milepost, other railroad signage, structures, or equipment as well as at the center and each edge of all at-grade railroad crossings. Contact KCSR to obtain railroad stationing. All surveys shall be based on State Plane Coordinates and on NAVD88 vertical datum.

17.5. General Notes:

General notes specifying material requirements, design data, temporary clearance requirements, stages of construction, flagging, shoring requirements, right of entry permits, erosion control measures, demolition and removal, access roads, insurance requirements, emergency contacts of KCSR and the Agency, etc. shall be included in the plans

Agency shall complete include with both the preliminary and final plan submittal the attached “Overhead Submittal Checklist” and “Overhead Grade Separation Data Sheet” (see Appendix A). For any exception to the minimum requirements on the attached checklist, a detailed explanation/reason why the minimum requirements cannot be met must be provided.

Revised submittals of plans or documents shall follow the same procedure as the initial submittal until all issues are resolved.

17.6. Preliminary Submittal Procedure:

All submittals to KCSR shall be done electronically. Allow a minimum of three (3) weeks for review of each submittal.

18. Final Submittal

18.1. Final Plans

Final plans for overhead structures submitted to KCSR should include only pertinent drawings that impact the railroad. Complete sets are not required. As a minimum the following drawings should be submitted with the final plans.

18.1.1 General plan and elevation view

18.1.2 Structural details of columns, foundations, protection walls and framing plan of structure over KCSR ROW,

18.1.3 Typical roadbed section and drainage ditches

18.1.4 Track profiles

18.1.5 Drainage plans and deck drains

18.1.6 Railing and fencing details

18.1.7 Pier protection plans

18.1.8 Erosion control plans

18.2. Drainage Calculations

Drainage design criteria for ROW drainage ditches, drainage structures parallel to or under the track shall comply with the following:

18.2.1. The 100-year flood water surface elevation should not come into contact with the crown of a culvert or the low chord of the drainage structure, whichever is applicable.

18.2.2. The 100-year flood water surface elevation should not exceed the track sub-grade elevation.

If existing drainage facilities do not meet the design criteria above, an enlarged opening must be considered.

18.3. Special Provisions

Any and all special considerations which are not typical shall be referenced and included in the Special Provisions.

18.4. Final Submittal Procedure

Complete/revise and submit along with the final plan submission the attached “Overhead Submittal Checklist” and “Overhead Grade Separation Data Sheet” (see Appendix A). For any exception to the minimum requirements on the attached checklist, a detailed explanation/reason why the minimum requirements cannot be met must be provided.

Electronic copies of the one hundred (100) percent structural calculations, hydraulic calculations and special provisions shall all be sealed and ***signed*** by a professional/structural engineer currently licensed in the state where the work is being performed shall be submitted. A minimum of three (3) weeks shall be allowed for review. KCSR's Consultant and Agencies Design Engineer shall be free to communicate and resolve design issues keeping KCSR advised of the updated revisions. Once KCSR and its consultant are satisfied with the plans, KCSR will issue a written final approval of the plans. Agency shall draft the Construction and Maintenance Agreement for the project for review and approval by both the Agency and KCSR's Legal Department. Once approved by both parties, Construction and Maintenance Agreement will be executed releasing the project for bidding.

19. Construction Submittals

During construction of the overpass structure, the KCSR requires the review of the design of temporary structures such as falsework, shoring, demolition of existing structures, lifting plans, etc. Each submittal shall be approved by KCSR prior to any work covered by the submittal will be performed. It is required that all designs be submitted by the Agency or their representative to the KCSR for review following their own review and approval of the design and other submittals. All designs and submittals shall be **"sealed and signed by a Professional Engineer currently licensed in the state where the work is being performed"** and shall be forwarded to the KCSR for review and approval. The Agency approved submittal may be forwarded to an outside consultant for review and comment. The consultant may reply directly to the Agency or its representative following consultation with KCSR. During the review process, the consultant and design engineer shall be free to and are encouraged to communicate with each other directly to resolve any issues. Final approval of each submittal much be obtained directly from KCSR. All submittals shall be provided electronically unless otherwise requested by KCSR.

During construction of the bridge structure, KCSR requires the review of material data sheets to determine compliance with the specifications. It is required that product information for all material specified in the table below be submitted by the Agency or their representative to KCSR for review following their own review and approval of the material. The Agency approved submittal may be forwarded to an outside consultant for review and comment. The consultant may reply directly to the Agency or its representative following consultation with KCSR. During the review process, the consultant and design engineer shall be free to and is encouraged to communicate and resolve issues. Following is a list of some of the material submittals to be provided to KCSR by the Agency. KCSR reserves the right to request additional submittals.

The following table contains a list of typical submittals required for overhead structures and their minimum review time. Additional submittals may be required depending on the nature and complexity of the project.

Table 19.1 Submittal Review Time

SUBMITTAL	PLANS REQUIRED	CALCULATIONS REQUIRED	MINIMUM REVIEW TIME
Pre-Construction Meeting	N/A	N/A	4 week notice (to make travel plans)
Excavation/Shoring	Yes	Yes	4 weeks
Falsework	Yes	Yes	4 weeks
Drainage	Yes	Yes	4 weeks
Demolition	Yes	Yes	4 weeks
Special Provisions	Yes	N/A	4 weeks
Curfew Requests	N/A	N/A	3 weeks
Access Roads	Yes	Yes	4 weeks
Erection Plan	Yes	Yes	4 weeks
Utility Relocation	Yes	Yes	4 weeks
Right of Entry Permit	Yes	N/A	4-6 weeks

Appendix A

1. Overhead Grade Separation Data Sheet

2. Overhead Submittal Checklist

Overhead Grade Separation Data Sheet

1	*Location:*			
		City	*County/Parish*	*State*
2	*Distance from nearest Milepost to centerline of Bridge:*			
3	*Description of Project:*			
4	*Utilities on Railroad Property:*			
	Name	*Any Adjustments Required*	*Contact Person*	
5.	*List all the at-grade crossings that will be eliminated by the construction of this grade separation:*			
6.	*Minimum horizontal clearance from centerline of the nearest track to face of Pier:*			
	A. Proposed:		*B. Existing (if applicable):*	
7.	*Minimum vertical clearance from centerline of the nearest track to face of Pier:*			
	A. Proposed:		*B. Existing (if applicable)*	
8.	*List piers where protection walls are provided:*			
	Pier	*Distance from Centerline of Track:*		
9.	*Describe how Drainage from approach roadway is handled:*			
10.	*Describe how drainage from bridge is handled:*			
11.	*List piers where shoring is required to protect track:*			
12.	*Scheduled Letting Date:*			

ALL INFORMATION ON THIS DATA SHEET TO BE FURNISHED BY THE SUBMITTING AGENCY TO THE MANAGER OF CONTRACTS
PRELIMINARY PLAN & ELEVATION VIEWS SHALL BE SUBMITTED WITH THIS FORM
**** ATTACH SHEETS IF ADDITIONAL INFORMATION TO BE PROVIDED**

Overhead Submittal Checklist

Preliminary Plan Submittal Checklist	*Grade Separation:*			
	Hwy/Street Name:			
Project Name and Number:	*County/Parish:*			
	State:		*City*	
	Milepost :		*Sub:*	
Date:	*DOT No.:*			

Item	*Required Information*	*Min. Required*	*As Submitted*	*A/R*	*Railroad Remarks*	
					A=Approved	**R=Rejected**
	Abutment No. 1					
1	*Horizontal Clearance (Left) (CL to Face)*	*25'-0"*				
2	*Horizontal Clearance (Right) (CL to face)*	*25'-0"*				
3	*Vertical Clearance (From Top of Rail)*	*23'-6"*				
4	*Horizontal Clearance to footing from CL*	*25'-0'*				
5	*Depth top of footing below base of rail*	*6'-0"*				
6	*Pier Protection wall required*	** 25'-0"*				
7	*Shoring required (CL to nearest Pt.)*	*12'-0"*				
	Bent No. 2					
1	*Horizontal Clearance (Left) (CL to Face)*	*25'-0"*				
2	*Horizontal Clearance (Right) (CL to face)*	*25'-0"*				
3	*Vertical Clearance (From Top of Rail)*	*23'-6"*				
4	*Horizontal Clearance to footing from CL*	*25'-0'*				
5	*Depth top of footing below base of rail*	*6'-0"*				
6	*Pier Protection wall required*	** 25'-0"*				
7	*Shoring required (CL to nearest Pt.)*	*12'-0"*				
	Bent No. 3					
1	*Horizontal Clearance (Left) (CL to Face)*	*25'-0"*				
2	*Horizontal Clearance (Right) (CL to face)*	*25'-0"*				
3	*Vertical Clearance (From Top of Rail)*	*23'-6"*				
4	*Horizontal Clearance to footing from CL*	*25'-0'*				
5	*Depth top of footing below base of rail*	*6'-0"*				
6	*Pier Protection wall required*	** 25'-0"*				
7	*Shoring required (CL to nearest Pt.)*	*12'-0"*				
	Abutment No. 4					
1	*Horizontal Clearance (Left) (CL to Face)*	*25'-0"*				
2	*Horizontal Clearance (Right) (CL to face)*	*25'-0"*				
3	*Vertical Clearance (From Top of Rail)*	*23'-6"*				
4	*Horizontal Clearance to footing from CL*	*25'-0'*				
5	*Depth top of footing below base of rail*	*6'-0"*				
6	*Pier Protection wall required*	** 25'-0"*				
7	*Shoring required (CL to nearest Pt.)*	*12'-0"*				

**** Pier protection required within KCSRC Right-of-Way***

	Track Requirements					
1	*Existing track centers*	*Required*				
2	*Track spreading taken into consideration*	*Required*				
3	*Future track centers*	*20'-0"*				

Overhead Submittal Checklist

Preliminary Plan Submittal Checklist	*Grade Separation:*			
	Hwy/Street Name:			
Project Name and Number:	*County/Parish:*			
	State:		*City*	
	Milepost :		*Sub:*	
Date:	*DOT No.:*			

Item	***Required Information***	***Min. Required***	***As Submitted***	***A/R***	***Railroad Remarks***	
					A=Approved	**R=Rejected**
	Safety Requirements					
1	*Splashboards or barrier rail near Side NS*	*5'0" / 3'-6"*				
2	*Splashboards Far Side FS*	*5'0" / 3'-6"*				
3	*Splashboards limits adequate*	*R/W to R/W*				
4	*Fence w/pedestrian walkway, NS or FS*	*8'-0" / 10'-0"*				
5	*Fence w/o pedestrian walkway, NS or FS*	*10'-0"*				
6	*Fence limits adequate*	*R/W to R/W*				
	Drainage Requirements					
1	*Adequate Drainage (Left)*	*Required*				
2	*Adequate Drainage (Right)*	*Required*				
3	*Drain from Str. / Leaders at Bents*	*-*				
	General Requirements					
1	*Access road (25' from CL to face)*	*25'-0"*				
2	*RR R/W shown correctly*	*Required*				
3	*All tracks labeled correctly*	*Required*				
4	*Existing utilities aerial or underground*	*Required*				
5	*Maximum gap between structures*	*2'-0"*				
6	*Lights required for width of Str. Over 80'*	*80'-0"*				
7	*Track profile for 1000' on each side of Str.*	*1000'*				
8	*Demolition required*	*-*				
9	*Abutment slope protection*	*>2:1*				
10	*Temp. construction vertical clearance*	*21'-0"*				
11	*Temp. construction horizontal clearance*	*12'-0"*				
12	*Milepost number & direction of increase*	*Required*				

Instructions	
1	*Milepost and direction of Milepost must be shown in the plans. Left and Right is the orientation of structure elements facing in the direction of increasing milepost.*
2	*Fill all applicable parts of table above: In Column "As Submitted" insert all applicable values from plans.*
3	*For any exception to the minimum requirements on the checklist, a detailed explanation/reason why the minimum requirements cannot be provided must be given.*
4	*Preliminary Plan Review:* *If items on above table show deficiencies, acceptance of preliminary plans will not be granted until deficiencies are resolved.*
5	*Final Plan Review:* *Prior to structure construction signed final plans, special provisions and hydraulic calculations, if required, shall be submitted for final review. If all items are resolved and plans comply, will release structure for construction.*
6	*Units:* *Units for the above checklist to be in English*

Section III

Bridge Demolition and Removal Plan For Structures over Railroad

Section III
Bridge Demolition and Removal Plan for Structures over Railroad

Table of Contents

Subsection	Page No.
1. General	3
2. Bridge Removal Plans	4
3. Procedure	5
4. Track Protection	6
5. Cranes	6
6. Cutting Torches	7
7. Utilities	7
8. Hazardous Material	7

1. General

When the Agency contemplates demolition and removal of an existing structure within railroad right of way or when the planned demolition and removal of such structure affects the railroad right of way, whether such a structure is parallel or perpendicular to railroad right of way, provisions of this Section shall apply. Structures involved include overhead bridges, retaining walls, drainage structures, road embankments, etc.

1.1 When the project involves this type of work , the Agency shall provide its Contractors the requirements of this Section in the Bid Documents.

1.2 The Contractor shall develop a work plan such that its operations shall in no way impede the rail operations of the KCSR.

1.3 The Agency shall require its contractor to contact KCSR well in advance of when any demolition work is planned so KCSR can assess what type of track protection will be required.

1.4 Track curfews are to be requested from KCSR by the Contractor in accordance with KCSR current advance notification policy, which is typically at least four (4) weeks from the date of work. KCSR will subsequently inform the Contractor if such track curfews will be granted in the week prior to the week of work. It is advised that the curfew length each day be as short as possible to limit extended interruptions to rail operations. It shall be noted that approved curfews are not guaranteed and KCSR takes no liability or responsibility for any cancelled curfews if necessitated by rail operations.

1.5 The Contractor shall be responsible for planning and executing all procedures necessary to remove the structures in a safe and controlled manner.

1.6 KCSR’s tracks and property shall be protected at all times.

1.7 The Contractor shall ensure the area within KCSR ROW is free of any debris that could cause injury to railroad personnel or that could cause hazard to railroad personnel and operations.

1.8 All excavations shall be designed and constructed in accordance with KCSR requirements in these Guidelines.

1.9 All demolition debris shall be disposed of outside of KCSR ROW.

1.10 Phased demolition or removal of the portions of structures adjacent to any railroad facility shall not compromise the integrity of the remaining structure or pose any danger to the railroad facilities or operations.

1.11 A flagman is required when any work is performed on any portion of the KCSR ROW or the work, even if outside the KCSR ROW, affects KCSR’ facilities or rail operations.

1.12 No blasting will be permitted on KCSR ROW.

1.13 Proper placement and compaction of approved material to fill any voids created by contractor's work shall be done to the satisfaction of KCSR. Only those materials approved by KCSR may be used as backfill material.

1.14 Temporary clearances of fourteen (14) feet minimum horizontal from track centerline and twenty-two (22) feet minimum vertical from track top of rail shall be maintained at all times.

1.15 Agency or its contractor shall submit all information relating to demolition and removal to KCSR. Submittals must be complete, clearly explained and orderly. Submittals are to be in an acceptable electronic format. Reviews of submittals will be done by KCSR and/or through an outside consultant at the expense of the Agency.

2. Bridge Removal Plans

The Removal Plan shall include the following:

2.1 Bridge removal sequence and procedures for entire bridge including the staging for the removal of the superstructure and substructure. All demolition work shall be done in a safe and controlled manner. The sequencing procedure shall indicate the estimated time in days and hours per day for each task.

2.2 Plan, elevation and location of bridge component(s) to be removed, and the locations of any access roads required for movement of the equipment. The as-built drawings may be used for the submittals provided the removal steps are clearly marked and legible. Identify temporary minimum clearances to be maintained.

2.3 Indicate the position of all railroad tracks below the bridge and identify each track as mainline, siding, spur, etc.

2.4 Identify and list the types and numbers of equipment required and their locations during demolition operations. Include the horizontal clear distance from centerline of near track to nearest portion of equipment when in use and not in use.

2.5 Location, size and type of crane pads needed for the demolition of the structure.

2.6 Submit a crane lifting plan including the identification of the crane(s) capacity and weight of removed material each crane(s) is to lift. Crane lifting plan shall be designed and sealed by a Professional Engineer currently licensed in the state where the work is being performed. The Lifting plan shall satisfy the minimum requirements stated in these Guidelines.

2.7 Locations and types of temporary supports, shoring or bracing required for excavations associated with bridge demolition. These members shall be designed to meet the requirements of Part 28 *Temporary Structures for Construction* in the AREMA Manual for Railway Engineering, latest edition along with all shoring requirements of KCSR and applicable local and national building codes.

2.8 Locations and types of temporary supports or bracing required for demolition of superstructure.

2.9 The proposed vertical and horizontal clearance from railroad tracks to all temporary supports, shoring or bracing to be in accordance with KCSR requirements.

2.10 Temporary supports or equipment shall not interfere with the natural drainage along KCSR ROW.

2.11 Details, limits and locations of protective covers or other measures proposed to be used to protect the tracks. This includes any shields or other measures that will protect the tracks from falling debris during removal of the overhead structure and from any debris rolling down the side slopes or otherwise being deposited into the area adjacent to the track(s) that could affect rail operations, drainage ditches or safety of the KCSR' personnel involved in inspection and/or maintenance of railroad facilities. Design loads, including impact loads, shall be noted. In addition, identify the equipment to be on site that is capable of removing debris and the track shield from the track(s).

2.12 All overhead and underground utilities in the area affected by removal of the bridge shall be shown on the drawings, including any fiber optic, railroad signal and communication lines. Identify the method of protection of all the utilities during demolition operations.

2.13 No track crossings for equipment or vehicles will be permitted across the railroad tracks.

2.14 Limits of demolition of substructures.

2.15 Details of on-site fire suppression.

2.16 Bridge removal plans shall be signed and sealed by a Professional Engineer currently licensed in the state where the work is being performed.

2.17 Contractor must provide KCSR a copy of a letter from the Agency approving Contractor's bridge removal plan prior to any demolition activities being performed.

3. Procedure

3.1 Integrity of the remaining structure shall be maintained at all times during the entire duration of the demolition and removal of the structure.

3.2 Prior to proceeding with bridge removal, the Professional Engineer who sealed the demolition plans, or his authorized representative shall inspect all aspects of the project site as it relates to the demolition work and confirm that all elements and equipment conform to the approved demolition plans. The Engineer shall certify in writing to KCSR that all elements and equipment are in conformance with the demolition plans and that the materials and workmanship are satisfactory. A copy of this certification shall be submitted to the KCSR representative prior to beginning the demolition work. A copy of this certification shall be available at the work site at all times.

3.3 Coordinate the removal schedule with KCSR. All the removal work within KCSR ROW shall be performed during the work windows or curfews when the trains or equipment are not passing the work site.

3.4 No portion of the removed structure shall be suspended across the railroad track(s) as a train or railroad equipment pass through the work site.

3.5 All substructures shall be removed to at least three (3) feet below the final finished grade or at least two (2) feet below the railroad drainage ditch whichever is lower, unless otherwise specified by KCSR.

3.6 Final back slopes beneath the removed structure shall be stabilized with permanent turf, riprap or other stabilization products to prevent any siltation from entering the KCSR ROW ditches and track structure.

3.7 After the removal of the structure, the embankment slopes of the removed structure shall be graded to match the existing embankments on either side of the removed structure and shall also be graded in such a way as to prevent any slope failures.

3.8 All debris and refuse resulting from the work shall be removed from the KCSR ROW by the Contractor and the premises left in a neat and presentable condition acceptable to KCSR.

3.9 The work progress shall be reviewed and logged by the Contractor's Engineer. Should an unplanned event occur, the Contractor shall inform KCSR immediately and submit the procedure to correct or remedy the event or occurrence.

4. Track Protection

4.1 Unless otherwise approved by KCSR, a track protective cover shall be constructed before beginning bridge removal work. A decking supported by the bridge located above the track clearance envelope or a track shield that covers the track(s) constructed in accordance with KCSR standards may be utilized.

4.2 Construction equipment is not be allowed on the tracks.

5. Cranes

When cranes are operating near the tracks, the following is required:

5.1 Only cranes with the capacity to properly manage the loads will be used. Front-end loaders and backhoes cannot be used to lift materials over the track(s).

5.2 The Contractor shall verify that the foundations under the crane can properly support the crane and loads.

5.3 If crane mats are utilized, they shall be rigid and of sufficient size and capacity to adequately distribute the crane and expected loads and prevent tipping of the crane.

5.4 Equipment outriggers are not to be placed on the track(s) or ballast section.

5.5 The boom of a crane(s) when not in use or when a train or railroad equipment pass through the work site shall be turned away from the track centerline. When cranes are stationary while passing trains or equipment thru the work zone, the nearest part of the crane shall be a minimum distance of twenty-five (25) feet from the centerline of

the tracks. Cranes shall be moved outside the railroad ROW when parked overnight or for extended duration with their booms turned parallel to or away from the track(s).

6. Cutting Torches

When a cutting torch is used within the KCSR right-of-way, the following steps shall be taken:

6.1 Fire suppression equipment shall be readily available and on-site at all times cutting torches are utilized.

6.2 Do not use a cutting torch over, between or adjacent to a track(s) unless a protective steel cover plate is used. Care shall be taken to ensure the steel plate does not come in contact with any of the rails.

6.3 Contractor shall sufficiently wet the ties or timbers below and adjacent to the cutting area.

6.4 When torches are used near the railroad ROW, care shall be taken to not start a brush fire. All dry brush and grass shall be either completely removed or sufficiently wetted.

6.5 Contractor shall monitor the cutting site for a minimum of three (3) hours following all the cutting activity being on watch for a smoldering fire.

7. Utilities

The demolition operations shall be planned to accommodate the safe operations of all the utilities within the work limits at all times. The utility lines shall be protected if affected by demolition operations. Agency's contractor shall be solely responsible for location, protection, relocation, etc. of the utility lines and all coordination with the respective utility companies.

8. Hazardous Material

If any hazardous material(s) are found within KCSR ROW, provide protection to the workforce as required in the MSDS and immediately notify KCSR.

Section IV

Design and Construction of Shoring Adjacent to and on Railroad Right-of-Way

Section IV

Design and Construction of Shoring Adjacent to and on Railroad Right-of-Way

Table of Contents

Subsection Title **Page No.**

1. Scope 3
2. Responsibilities of Agency and Contractor 3
3. Survey and Investigation 4
4. Loads 5
5. Drainage 6
6. Construction of Shoring System 6
7. Types of Shoring 7
8. Computation of Applied Forces 8
9. Structural Integrity 10
10. Soil Characteristics 11
    - 10.1 Subsurface Exploration 11
    - 10.2 Backfill 11
    - 10.3 Computation of Backfill Pressure 12
    - 10.4 Loads Exclusive of Earth Pressure 12

Appendix A

Shoring Design Checklist 15

Appendix B

AREMA References for Shoring Design

- Table A 18
- Figure 8-20-1 19
- Figure 8-20-2 20
- Figure 8-20-3 20

1. Scope

The intent of this section is to inform Agencies, design engineers and contractors of KCSR's minimum standards and requirements concerning excavation made within KCSR right-of-way and the design and construction of any required temporary shoring supporting KCSR tracks and facilities.

Shoring design shall conform to AREMA Manual, Chapter 8 and this section of KCSR Guidelines.

This Section supplements the recommendations provided by AREMA in regard to shoring adjacent to and on KCSR ROW.

2. Responsibilities of Agency and Contractor

The Agency shall provide the following requirements to its Contractor in their Bid Documents. Agency and the Contractor must understand that these requirements may not be complete and KCSR reserves the right to request additional information including detailed survey of the work area, geotechnical investigation reports, boring logs, and continuous monitoring of the site by a licensed engineer or surveyor while the shoring is being installed and during the excavation behind the shoring.

2.1. KCSR requirements, construction submittal review times and review criteria should be discussed at the pre-construction meeting with the Contractor.

2.2. All shoring design, plans, and calculations shall be prepared, stamped, and signed by a professional engineer licensed in the state the work will be performed.

2.3. Agency shall submit all shoring submittal information to KCSR. Submittal(s) must be complete, clearly explained and orderly. All submittals to KCSR shall be done electronically. Review of submittals will be done by KCSR and/or through an outside consultant at the expense of the Agency.

2.4. Shoring system design plans and calculations shall be in English units. If Metric units are used, all controlling dimensions, elevations, design criteria assumptions and material stresses shall be expressed in dual units, with English units shown in parentheses. Information shall be obtained and provided concerning ROW boundary, clearances, proposed grades of tracks and roads, and all other factors that may influence the controlling dimensions of the proposed shoring system. All shoring plans, sections and details shall be drawn to scale with the scale shown.

2.5. The Contractor must not begin construction of any component of the shoring system affecting KCSR ROW until written approval by KCSR is obtained.

2.6. The Contractor shall be responsible for planning and executing all procedures necessary to construct the shoring in a safe and controlled manner. All structures that support or impact KCSR facilities shall be properly designed and constructed to provide safe and stable structure.

2.7. An RWIC (flagman) is required when any work is performed on KCSR ROW or when KCSR facilities are being affected by the excavation and shoring work.

2.8. All removed materials will become the responsibility of the Contractor and shall be disposed of outside KCSR ROW.

2.9. Appropriate measures for the installation, location, identification and protection of fiber optic cables and other utilities shall be addressed in the plans and contract documents and is the sole responsibility of the Agency and its Contractor.

2.10. The Contractor shall be solely responsible for the design, construction and performance of the temporary structure.

2.11. The Contactor's responsibility includes compliance with all Federal, State, County/Parish and local laws or municipal ordinances and regulations, which in any manner affect the work.

2.12. The Contractor shall use only those materials stated in the plans and specifications and install them as specified in those plans and specifications.

2.13. The Contractor must establish, monitor on a regular basis and record top of rail elevations and track alignment for the duration of the project. Any changes in any of the elevations or alignment measurement must be reported immediately to the KCSR.

2.14. The Contractor shall develop a work plan assuming rail operations will not be interfered with and no dedicated work windows will be available. If such a work plan cannot be developed, the Contractor shall discuss with KCSR other alternatives to install the shoring, including obtaining track curfews. If such a request is acceptable to KCSR, the Contractor shall develop a work plan which, at a minimum, shall include the following and submit it to KCSR for review and approval.

2.14.1. Preferred date(s) and time(s) to install and remove the shoring

2.14.2. Length of time required to install and remove the shoring

2.14.3. Duration of shoring to be in place

2.14.4. Anticipated date to remove shoring.

3. Survey and Investigation

The Agency or its contractor shall perform a detailed field survey and geotechnical investigation to properly design and construct the shoring system.

3.1. Field Survey

Sufficient information shall be submitted to KCSR in the form of a profile, cross-sections and topographical maps to determine general design and structural requirements. Existing and proposed grades and alignment of tracks and roads shall be indicated together with a record of controlling elevation of water surfaces or ground water. Indicate location of existing/proposed utilities and construction history of the area which may hamper proper installation of soldier beams, ground anchors, depth of scour or allowance for over-dredging.

3.2. Geotechnical Information

The Agency or its contractor shall provide to KCSR the following minimum geotechnical information used in the analysis and design of the shoring system.

3.2.1. Boring Logs

3.2.2. Location of groundwater level, at least to the extent that it is within the zone of influence, beneath the proposed bridge footing or bottom of shoring

3.2.3. Bearing capacity of the soil

3.2.4. Data on soil and/or rock properties relative to proposed shallow and deep bridge foundations

3.2.5. Settlement predictions

3.2.6. Selection of alternative types and/or depth of proposed bridge foundations

3.2.7. In seismic areas, evaluation of liquefaction potential of existing or placed soil

3.2.8. Global site stability (massive earth movements)

3.2.9. Any backfill material required shall be specified and the method and amount of compaction or consolidation shall be shown on the drawings. All backfill shall be, at a minimum, suitable for the construction of a railroad embankment. Refer to KCS Standard Technical Specifications for embankment material requirements. Detailed soil properties of the backfill material shall be submitted along the shoring design.

4. Loads

4.1. Loads on the shoring systems shall be designed for loads as stated in this document, AREMA, OSHA and the Agency's bid documents. The most conservative loads from the above shall be used for the design. All design criteria, temporary and permanent loading, boring and laboratory test results and properties of construction materials, including yield stress, should be clearly stated in the design calculations and on the contract and record plans.

Temporary loads include, but are not limited to:

- Construction equipment
- Construction materials
- Lower water levels adjoining the bulkhead causing unbalanced hydrostatic pressure
- Material storage piles

Permanent loads include, but are not limited to:

- Railroads – E-80 loading with impact
- Adjacent structures
- Future grading and paving
- Highway

- Snow
- Earthquake or seismic activity

4.2. The allowable live load after construction should be clearly shown in the plans.

4.3. The “loads” listed above are external to the total shoring system. There are also internal effects that are treated as loads in the design of individual members of the shoring system. These internal loads are active and passive soil pressures, acting separately or combined algebraically, saturated or dry as appropriate, for granular or cohesive soil or a combination thereof.

5. Drainage

The drainage pattern of the site before and after construction should be analyzed and adequate drainage provisions incorporated into the plans and specifications. Consideration should be given to underdrainage as well as surface drainage.

Drainage design shall include provisions for backfill that is compatible with the assumed water conditions.

6. Construction of Shoring System

For general shoring requirements and specific applications of the following items refer to Section V, *References*.

6.1. Evaluate existing slope and stability conditions to ensure the railroad embankment and/or structures will not be adversely affected.

6.2. Lateral or side clearances must provide sufficient space for construction and maintenance of the required standard ditches parallel to the standard roadbed section. The size of ditches will vary depending upon the flow and terrain and should be designed accordingly.

6.3. If existing conditions preclude the installation of shoring at the required minimum distance, the shifting of tracks or temporary removal of tracks may be investigated and presented to KCSR for consideration.

6.4. Vertical overhead clearance from the top of the rail to temporary shoring shall be a minimum of twenty-two (22) feet. Horizontal clearance from track centerline to temporary shoring shall be a minimum of fourteen (14) feet.

6.5. All shoring within the limits of Zone A or Zone B must be placed prior to the start of any excavation (Refer to KCSR Standards for definitions of various zones).

6.6. The top of the shoring wall must have an elevation equal to or greater than the elevation required to meet the limits of Zone B.

6.7. Shoring types that include the placement of lagging elements as the excavation proceeds are not permitted within the limits of Zone A.

6.8. Standard handrails, fence, or other barrier methods meeting OSHA and FRA requirements must be used around open excavations on or near KCSR ROW.

6.9. The most stringent project specifications of the Public Utilities Commission Orders, Department of Industrial Safety, OSHA, FRA, AREMA, KCSR or other governmental agencies shall be used.

6.10. Second-hand shoring material is not acceptable unless engineer on record who designed the shoring system or his designated representative submits a full inspection report verifying the acceptability of the second hand material. The report must be signed and sealed by that licensed professional engineer.

6.11. If cantilever sheet pile is used for shoring adjacent to any track, the shoring system must be at least fifteen (15) feet away from the centerline of the track and its maximum height shall not exceed the top of rail elevation. .

6.12. Cantilever sheet pile walls shall be used only in granular soils or stiff clays. Material at the excavation line, near the shoring system, shall be kept free of water and shall not be disturbed by men or equipment. If the above conditions cannot be met, cantilevered sheet pile shoring will not be accepted.

6.13. After work has been completed, all components of the shoring system are to be removed and all soil voids filled and properly compacted with materials approved by KCSR.

6.14. Slurry type materials are not acceptable for soldier beams in drilled holes.

6.15. KCSR prefers that all temporary shoring system be removed once all work that required the shoring is complete. In instances where removal of the installed temporary shoring system causes detrimental effects to KCSR facilities, the Contractor can abandon the temporary system in place with a written approval of KCSR. Shoring systems abandoned in-place shall not at any time, now or in future, interfere with maintenance or expansion of KCSR facilities or right-of-way.

7. Types of Shoring

The following shoring systems are acceptable to KCSR. Any variance requested to use other shoring systems will require written approval from KCSR.

7.1. A cantilever sheet pile wall. A structure designed to provide lateral support for a soil mass and derives stability from passive resistance of the soil in which the sheet pile is embedded.

7.2. An anchored sheet pile wall. A structure designed to provide lateral support for a soil mass and derives stability from passive resistance of the soil in which the sheet pile is embedded AND the tensile resistance of ground anchors.

7.3. A cantilever soldier beam with lagging wall. A structure designed to provide lateral support for a soil mass and derives stability from passive resistance of the soil in which the soldier beam is embedded.

7.4. An anchored soldier beam with lagging wall. A structure designed to provide lateral support for a soil mass and derives stability from passive resistance of the soil in which the soldier beam is embedded AND the tensile resistance of ground anchors.

7.5. Cantilevered soldier beams with lagging walls. Are generally designed as flexible structures, which have sufficient lateral movement to mobilize active earth pressures and a portion of the passive pressure.

7.6. A braced excavation is a structure designed to provide lateral support for a soil mass and derives stability from passive resistance of the soil in which the vertical members are embedded and from the structural capacity of the bracing members.

7.7. A cofferdam is an enclosed temporary structure used to keep water and soil out of an excavation for a permanent structure such as a bridge pier or abutment or similar structure. Cofferdams may be constructed of timber, steel, concrete or a combination of these. These specifications consider cofferdams primarily constructed with steel sheet piles.

7.8. A shoring box is a prefabricated shoring system, which is installed as the excavation progresses. Soil is typically removed from the inside of the shoring box. The shoring box is moved down into the excavation by gravity or by applying vertical loading from excavation equipment. This shoring system is not preferred by KCSR. The shoring is allowed in special applications only where Railroad live load surcharge is not present.

For purposes of these Guidelines:

- Soldier beams include steel H-piles, wide flange sections or other fabricated or rolled sections that are driven or set in concrete in drilled holes. Lagging refers to the members spanning between soldier beams.

- Ground anchors shall be cement-grouted tiebacks designed, furnished, installed, tested and stressed in accordance with these specifications.

- The vertical members of the braced excavation system include steel sheet piling or soldier beams comprised of steel H-piles, wide flange sections, or other fabricated sections that are driven or installed in drilled holes. Wales are horizontal structural members designed to transfer lateral loads from the vertical members to the struts. Struts are structural compression members that support the lateral loads from the wales.

8. Computation of Applied Forces

The following variables are used in this section:

q = intensity of strip load (Live load) (in units of pounds per square foot)
5 feet = Axle spacing
8.5 feet = Typical tie length (to be field verified)
γ = unit weight of soil
ϕ = angle of internal friction in degrees
α and β are angles measured in radians

$$q = \frac{80{,}000 \text{ lbs.}}{(5 \text{ feet})\ (8.5 \text{ feet})}$$

$$K_A = \tan^2 \left(45 - \frac{\phi}{2}\right)$$

$$K_P = \tan^2 (45 + \frac{\phi}{2})$$

8.1. Live load pressure due to Cooper E80 loading for track parallel to shoring system. Strip Load q.

A continuous strip of surcharge load q (pounds per square foot) parallel to the bulkhead is shown in the AREMA Manual, Chapter 8, Figure 8-20-2 "*Pressure Distribution for Strip Load*" (See Section V, *References*). The intensity of pressure at a given point may be computed by:

$$P_s = \frac{2q}{\pi} (\beta + \sin \beta \sin^2 \alpha - \sin \beta \cos^2 \alpha)$$

Document provided in Section V, *References* shows the results of this equation for Cooper E80 live load. Overlapping surcharge live loads from the adjacent tracks are not cumulative.

8.2. Live load pressure due to Cooper E80 loading for tracks at right angle to the shoring system use the following equation to determine the applied loading:

$$P_s = K_A q$$

The entire load shall be taken as distributed uniformly on the surface of the ballast immediately below the tie, over a width equal to the length of the tie, typically eight and one half (8.5) feet, to be field verified.

8.3. Active Earth Pressure Due to Weight of Backfill:

The active earth pressure due to the weight of the backfill may be computed by the Coulomb Theory and is represented in the loading diagram by "***area 1***" in the AREMA Manual, Chapter 8, Figure 8-20-1 *Lateral Pressure Diagrams* (see Section V, *References*).

The active earth pressure at depth "z" is:

$$p_A = K_A \gamma z$$

z = depth of soil influencing the passive pressure

8.4. Active Earth Pressure Due to Unbalanced Water Pressure

When bulkheads are used for waterfront construction, the bulkhead is subjected to a maximum earth pressure at the low water stage. During a rainstorm or rapidly receding high water, the water level behind the bulkhead may be several feet higher than in front, as shown in AREMA Manual, Chapter 8, Figure 8-20-5. The unbalanced water pressure is represented by area III in AREMA Manual, Chapter 8, Figure 8-20-1 (See Section V, *References*).

Drained conditions in backfill apply when clean sand or clean sand and gravel, as defined in AREMA Manual, Chapter 8, Article 20.2.5 are used and adequate permanent drainage outlets are provided. Where drained conditions exist, the design water level may be assumed at the drainage outlet elevation.

8.5. Active earth pressure due to a uniform surcharge load q (pounds per square foot) which is represented by "***area II***", AREMA Manual, Chapter 8, Figure 8-20-1 (See Section V, *References*) is:

$$p_u = K_A q$$

8.6. Passive earth pressure, p_ρ, in front of the bulkhead may also be computed by the Coulomb Theory. This pressure is also shown in AREMA Manual, Chapter 8, Figure 8-20-1 (See Section V, *References*).

$$P_\rho - K_\rho \gamma z$$

z = vertical distance not to exceed embedment depth.

8.7. Include and compute other loading that is impacting the shoring system.

8.8. Structural Design Calculations

8.8.1. Computerized calculations and programs must clearly indicate the input and output data. List all equations used in determining the output.

8.8.2. Handwritten calculations must be provided to support computerized output.

8.8.3. A simple free body diagram showing all applied loads on a temporary shoring system shall be included.

8.8.4. Documents and manufacturer's recommendations that support the design assumptions must be included with the calculations.

9. Structural Integrity

Structures and structural members shall be designed to have design strengths at all sections at least equal to the required strengths calculated for the factored loads and forces in such combinations as stipulated in AREMA Manual, Chapter 8, Article 2.2.4, which represents various combinations of loads and forces to which a structure may be subjected. Each part of the structure shall be proportioned for the group loads that are applicable, and the maximum design required shall be used.

9.1. The stability requirements of AREMA Manual, Chapter 8, Section 20.4 *Stability* shall be met and shown in the submitted calculations. For well-defined loading conditions and thoroughly determined soil parameters, the minimum factor of safety for temporary installations is one point three (1.3) (AREMA Manual, Chapter 8, Article 8.20.4.1.c.). Geotechnical investigations shall consider global stability and massive earth movements as shown in AREMA Manual, Chapter 8, Figure 8-20-6.

9.2. The total depth of embedment is equal to one point five (1.5), for temporary installations, times the minimum calculated depth of embedment. (AREMA Manual, Chapter 8, Article 8.20.5.1.a.).

9.3. The allowable stresses shall be determined on the following basis:

9.3.1. Sheet pile sections – two thirds (2/3) tensile yield strength for steel

9.3.2. Concrete – One third (1/3) compressive strength

9.3.3. Structural Steel – zero point fifty five (0.55) Fy compression in extreme fiber (AREMA Manual, Chapter 15, Table 15-1-11 *Summary of Percentage of Allowable Stresses for Combinations of Loads or Forces*)

9.3.4. Anchor Rods – one half (1/2) tensile yield strength for steel

9.4. AISC allowances for overstressing due to temporary loading conditions are not acceptable.

9.5. Proposed deflections of temporary shoring system and top of rail elevation shall not exceed the deflection criteria as shown in the following table:

Table 9.5 Deflection Criteria

HORIZONTAL DISTANCE FROM SHORING TO TRACK CL	MAXIMUM HORIZONTAL MOVEMENT OF SHORING SYSTEM	MAXIMUM ACCEPTABLE HORIZONTAL OR VERTICAL MOVEMENT OF RAIL
12’ < X < 18’	3/8”	3/16”
18’ < X < 24’	1/2"	1/4"

10. Soil Characteristics

10.1. Subsurface Exploration

Sufficient borings shall be made along the length of the structure to determine, with a reasonable degree of certainty, the subsurface conditions. Irregularities found during the initial soil boring program may dictate the need to perform additional borings.

The subsurface investigation shall be made in accordance with the provisions of AREMA Manual, Chapter 8, Part 22, *Geotechnical Subsurface Investigation*.

10.2. Backfill

10.2.1. Backfill is defined as all material behind the wall, whether undisturbed ground or fill, that contributes to the pressure against the wall.

10.2.2. The backfill shall be investigated and classified with reference to the soil types described in the following table.

10.2.3. Types 4 and 5 backfill shall be used only with approval of KCSR. In all cases the wall design shall be based on the type of backfill used.

Table 10.2 Types of Backfill for Retaining Walls

BACKFILL TYPE	BACKFILL DESCRIPTION
1	Coarse-grained soil without admixture of fine soil particles, very free-draining (clean sand, gravel or broken stone).
2	Coarse-grained soil of low permeability due to admixture of particles of silt size.
3	Fine silty sand; granular materials with conspicuous clay content; or residual soil with stones
4	Soft or very soft clay, organic silt; or soft silty clay.
5	Medium or stiff clay that may be placed in such a way that a negligible amount of water will enter the spaces between the chunks during floods or heavy rains

10.3. Computation of Backfill Pressure

Values of the unit weight, cohesion, and angle of internal friction of the backfill material shall be determined directly by means of soil tests or, if the expense of such tests is not justifiable, by means of the following table, referencing the soil types defined in the previous table. Unless the minimum cohesive strength of the backfill material can be evaluated reliably, the cohesion shall be neglected and only the internal friction considered. (Review AREMA Manual, Chapter 8, Part 20, *Flexible Sheet Pile Bulkheads*, Table 8-20-3).

Table 10.3 Properties of Backfill Materials

TYPE OF BACKFILL	UNIT WEIGHT LBS. PER CU.FT. "W"	COHESION "C"	ANGLE OF INTERNAL FRICTION
1	105	0	33º 42' (38º for broken stone)
2	110	0	30º
3	125	0	28º
4	100	0	0º
5	120	240	0º

10.4. Loads Exclusive of Earth Pressure

10.4.1. In the analysis of a shoring design, due account shall be taken of all superimposed loads carried directly on them, such as building walls, columns, or bridge structures; and of all loads from surcharges caused by railroad

tracks, highways, building foundations, or other loads supported on the backfill. Shoring must also be designed for stream flow pressures as well as ice flow pressures and collision forces where applicable.

10.4.2. In calculating the surcharge due to track loading adjacent to a shoring structure, the entire load shall be taken as distributed uniformly on the surface of the ballast immediately below the tie, over a width equal to the length of the tie. With increased depth, the width for distribution can be increased on slopes of one (1) horizontal to two (2) vertical with surcharge loads from the adjacent tracks not being permitted to overlap.

10.4.3. To account for variability in backfilling and the dynamic effects of axle loads, shoring shall be designed for earth pressures and live load surcharge increased by one hundred (100) percent.

10.4.4. The stability of the shoring as a whole unit, regardless of the distribution of the loads and surcharges, shall always be checked.

10.4.5. For shoring adjacent to piers and abutments, consideration must be given to all forces transmitted from the superstructure to the substructure, depending on the bearing fixity conditions.

Appendix A

Shoring Design Checklist

Appendix A
Shoring Design Checklist

The checklist is intended to act as a reminder to design or check for specific important aspects of the shoring system. It is not a substitute for the design plan and/or design criteria or specification requirements.

Instructions:

Respond to every question on the checklist. Submit the checklist with the design plans and calculations to KCSR. Attach to this checklist a detailed explanation of all negative response(s).

	QUESTIONS	YES	NO	N/A
1.	Are the steps for method of installation and removal of shoring system given?			
2.	Are the shoring design plans and calculations prepared by and sealed by a licensed professional engineer registered to practice engineering in the jurisdiction in which the project is being constructed?			
3.	Are shoring plans in compliance with the requirements of the construction plans, project specifications and general notes?			
4.	Are all existing, adjusted and new utilities in proximity with the proposed shoring shown on the shoring plans and is protection of these utilities addressed?			
5.	Are minimum construction clearance requirements of fourteen (14) feet horizontal at right angle to centerline of track and twenty two (22) feet vertical from top of rail satisfied and shown on the shoring plans?			
6.	Has Cooper E80 loading been used to design the shoring system?			
7.	Has the pressure of Cooper E80 live load from continuous strip of surcharge load q (psf) parallel to shoring been computed using the equation shown below? $\mathbf{P}_S = \frac{2q}{\pi} (\beta + \sin\beta \sin^2\alpha - \sin\beta \cos^2\alpha)$ where $q = \frac{80{,}000 \text{ lbs.}}{(5 \text{ feet})(8.5 \text{ feet})}$			
8.	Are the magnitude and location of all loads incorporated into the design plans and calculations?			
9.	Are the material properties used to determine design stresses for each different shoring member shown on the shoring plans?			
10.	Are all components of shoring system designed pursuant to AREMA and KCSR requirements?			
11.	Are the allowable stress and the calculated stress listed in the summary for each different shoring member?			
12.	If “finished’ lumber is specified for shoring by the shoring designer, are the actual lumber dimensions used in calculation shown?			
13.	Has ground water elevation and seepage into the excavation been addressed?			
14.	Are steel structural shapes and plates identified by ASTM specification number on the shoring plan and in the calculations?			

	QUESTIONS	YES	NO	N/A
15.	Have steel beams been checked for bending, shear, web crippling and buckling of the compression flange and any other potential failure mode?	`		
16.	Has buckling been evaluated for all compression members?			
17.	Has bracing been provided at all points of assumed support for compression members?			
18.	Are bracing strength and stiffness sufficient for the intended purpose?			
19.	Has the deflection of the shoring system been calculated and found to meet the requirements of these Guidelines?			
20.	Do the shoring plans indicate the Contractor will obtain and monitor top-of-rail elevation and track alignment?			
21.	Have seismic concerns been considered and addressed?			
22.	Are all construction components clearly shown on the plans?			
23.	Do the drawings show all controlling dimensions and elevations of shoring system?			
24.	If second-hand material will be utilized, is the inspection report included?			
25.	Are protective fencing height and limits shown on the plans? If a fence is not practical, is an alternative closure system provided?			
26.	Do the plans and specifications identify the backfill material and the compaction requirements?			
27.	Are two (2) copies of the shoring design plans and two (2) copies of the complete design calculations included in the submittal package to KCSR?			
28.	For excavations in Zone A, are drawings and calculations signed and sealed by a registered professional engineer?			

Appendix B

AREMA References for Shoring Design

INDEX		
	AREMA Reference Title	**Table/Figure No.**
1	Boussinesq Surcharge Pressure Due to E80 Live Load (psf) for Shoring Parallel to the Track	Table A
2	Lateral Pressure Diagram	AREMA Figure 8-20-1
3.	Pressure Distribution for Strip Load	AREMA Figure 8-20-2
4	Pressure Distribution for Line Load	AREMA Figure 8-20-3

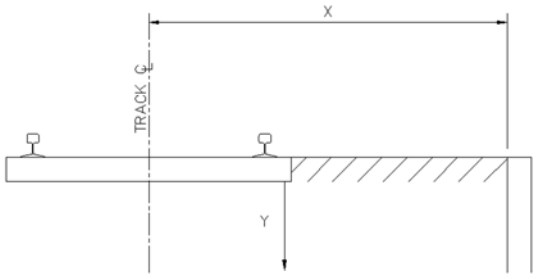
Table A

Boussinesq Surcharge Pressure Due to E80 Live Load (psf) For Shoring Parallel to the Track

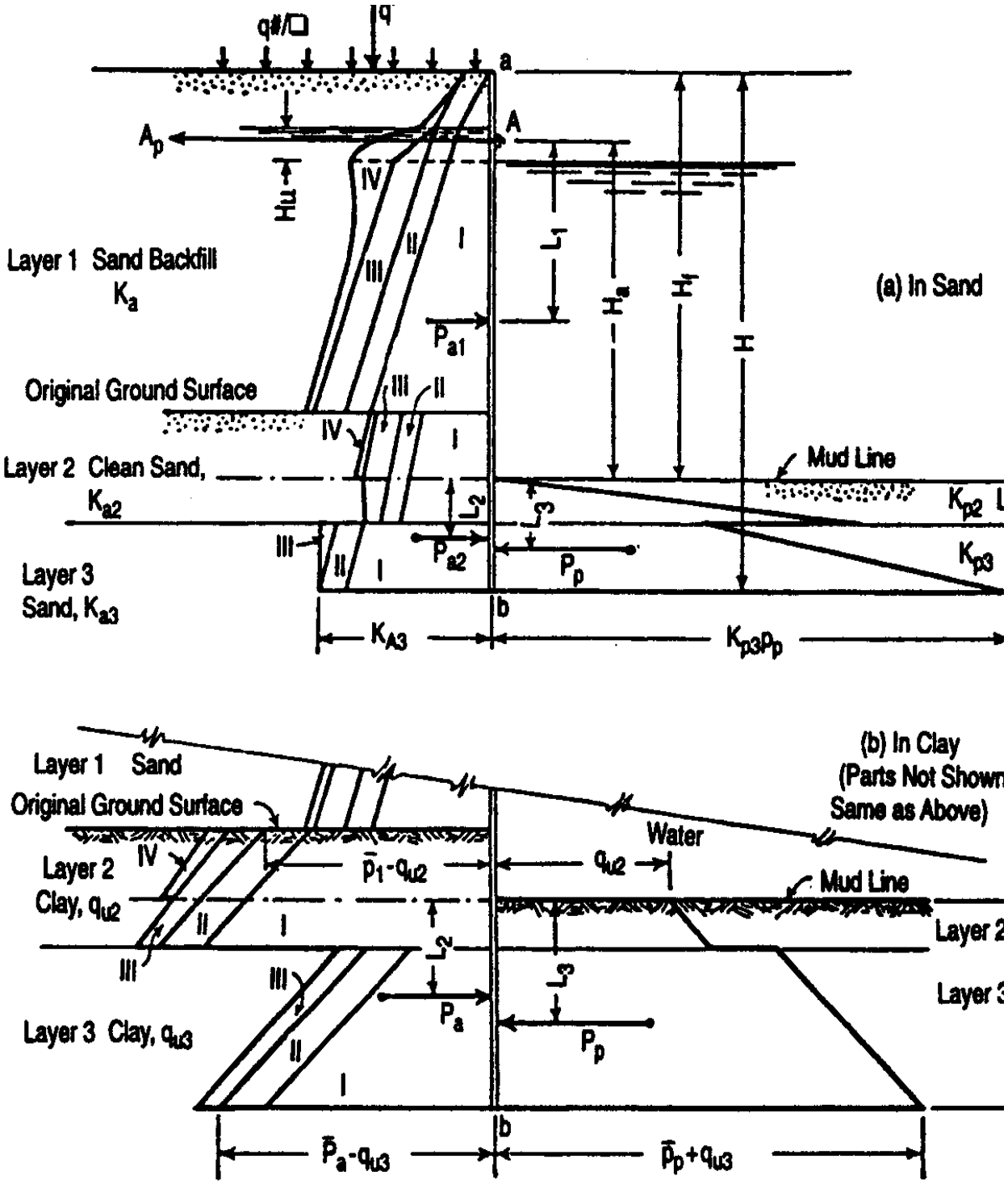
Depth (y) Below Base of Rail (ft.)	Distance (x) from Track Side of Shoring System to Track Centerline (ft.)																	
	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
1	157	131	112	97	84	74	66	59	53	48	43	40	36	33	31	28	26	25
2	299	252	216	188	164	145	129	115	104	94	86	78	72	66	61	57	52	49
3	415	355	307	268	236	210	187	168	152	138	126	115	106	97	90	84	78	72
4	499	434	380	335	298	266	239	215	195	178	163	149	137	127	118	109	102	95
5	552	489	434	387	347	312	282	256	233	214	196	180	167	154	143	133	124	116
6	577	520	469	424	384	348	317	290	266	244	225	208	193	179	166	155	145	136
7	579	532	487	446	408	374	344	316	291	269	249	231	215	200	187	175	164	154
8	565	527	491	455	422	390	362	335	311	289	269	251	234	219	205	192	181	170
9	539	512	483	454	426	398	372	348	325	304	284	266	249	234	220	207	195	184
10	506	488	468	445	422	399	376	354	333	313	295	278	261	246	232	219	207	196
11	469	460	447	430	412	394	374	355	337	319	302	285	270	256	242	229	218	206
12	432	429	422	411	398	384	368	352	336	320	305	290	276	262	249	237	225	215
13	395	398	396	390	381	371	359	346	332	319	305	292	279	266	254	242	231	221
14	360	367	369	367	362	355	346	336	326	314	302	291	279	268	257	246	235	225
15	327	337	342	343	342	338	332	325	317	307	298	288	277	267	257	247	238	228
16	297	308	316	320	322	320	317	312	306	299	291	283	274	265	256	247	239	230
17	269	282	291	298	301	302	301	299	295	289	283	276	269	261	254	246	238	230
18	244	258	268	276	281	284	285	284	282	279	274	269	263	257	250	243	236	229
19	221	235	247	256	262	267	269	270	269	267	264	260	256	251	245	239	233	227
20	201	215	227	237	244	250	254	256	256	256	254	251	248	244	239	235	229	224
21	182	196	209	219	227	234	238	242	243	244	243	242	240	237	233	229	225	220
22	166	180	192	202	211	218	224	228	231	232	233	232	231	229	226	223	220	216
23	151	164	176	187	196	204	210	215	218	221	222	223	222	221	219	217	214	211
24	138	151	162	173	182	190	197	202	206	209	212	213	213	213	212	210	208	206
25	126	138	150	160	169	177	184	190	195	199	201	203	204	205	204	203	202	200
26	115	127	138	148	157	165	173	179	184	188	191	194	195	196	197	196	196	194
27	106	117	127	137	146	154	162	168	173	178	182	185	187	188	189	189	189	188
28	97	108	118	127	136	144	151	158	163	168	172	176	178	180	182	182	183	182
29	89	99	109	118	127	135	142	148	154	159	163	167	170	172	174	175	176	176
30	82	92	101	110	118	126	133	139	145	150	155	159	162	165	167	168	169	170

Notes:

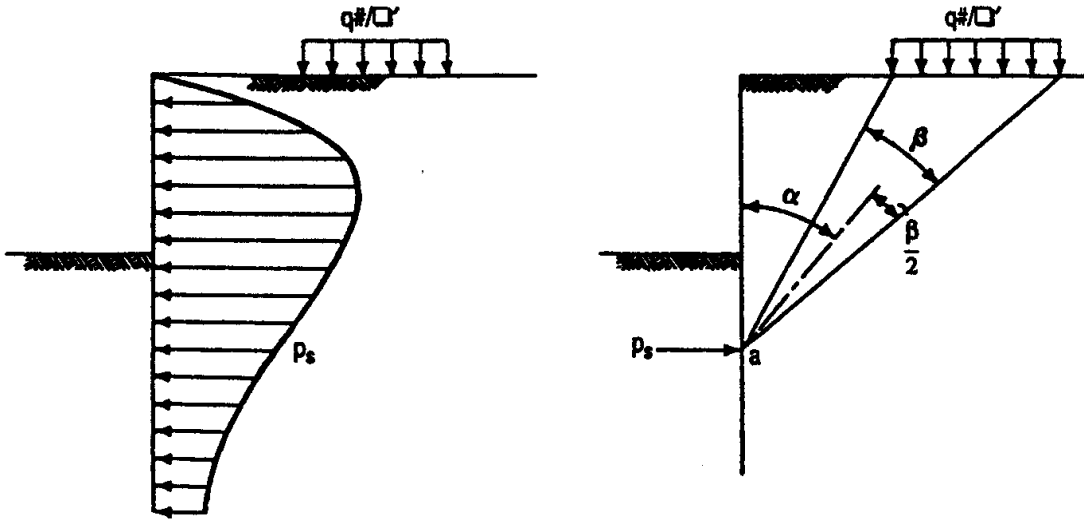
1. This chart assumes the top of shoring elevation is equal to the base of rail elevation. If this assumption is incorrect, additional surcharge due to the earth load above top of shoring must be added.
2. Use the Boussinesq equation to calculate pressures past twenty nine (29) feet or deeper than thirty (30) feet (see KCSR Railroad Guidelines, Section IV, *Design and Construction of Shoring Adjacent to and on Railroad Right-of-Way,* Item 8.1)
3. No shoring is allowed within twelve (12) feet of track centerline.



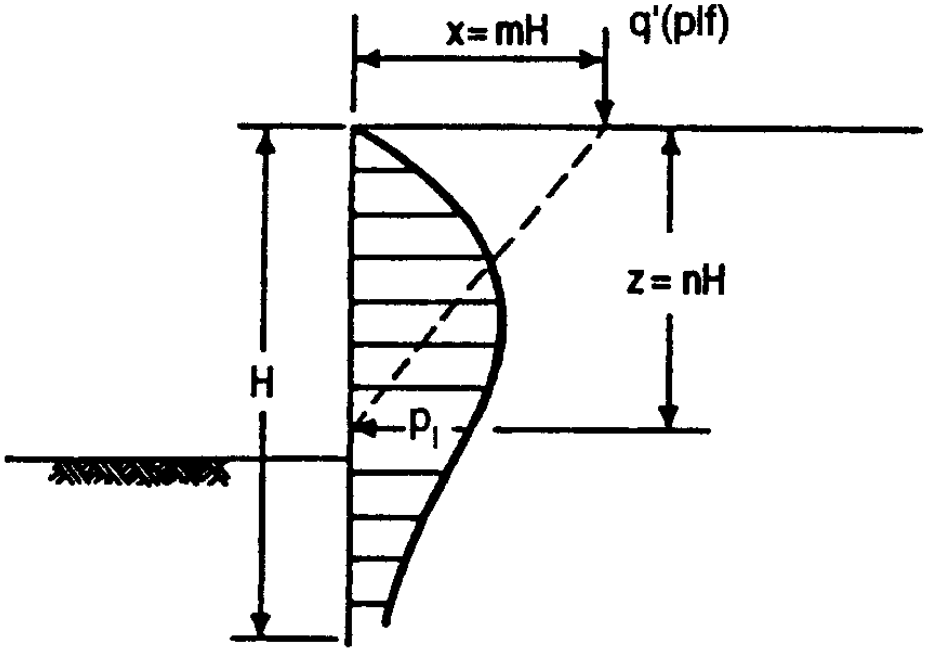
AREMA Figure 8-20-1 - Lateral Pressure Diagrams



AREMA Figure 8-20-2 - Pressure Distribution for Strip Load



AREMA Figure 8-20-3 - Pressure Distribution for Line Load



Section V

References

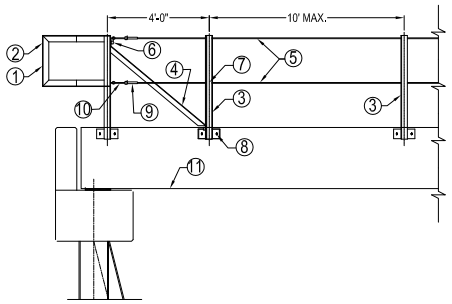
1	**KCSR Standard Drawings – Most frequently used**	
2	**KCSR Standard Technical Specifications – By Reference ONLY**	
3	**KCSR Industrial Track Standards – By Reference ONLY**	
4	**American Railway Engineering and Maintenance of Way Association – By Reference ONLY**	

References - Table of Contents

1. Frequently used KCSR Standard Drawings

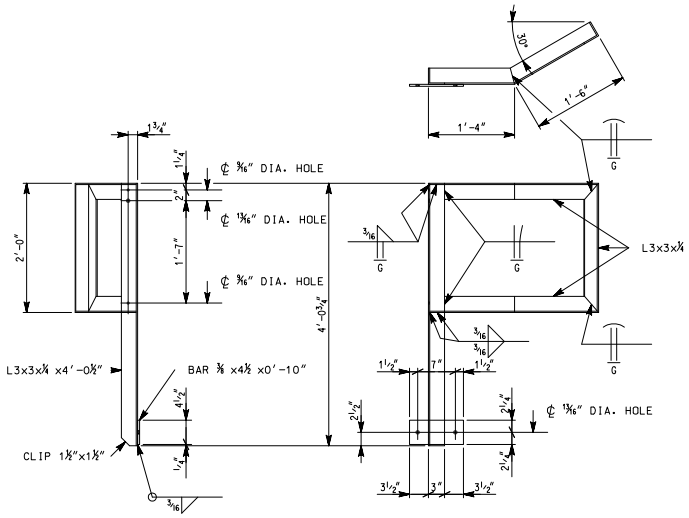
No.	Description	Drawing No.	Year Released
GENERAL			
1	English to Metric Conversion Chart	G-101	2007
2	Speeds Thru Turnouts	G-102	2007
3	Temporary Track Around Obstructions (Shoofly Geometry)	G-105	2007
4	Turnout Applications	G-107	2007
	General Shoring Requirements	BR-122	2007
RAILROAD BRIDGE			
	Steel Deck Plate Girder Span	BR-101	2020
	Steel Beam Span Girder – Steel Ballast Deck	BR-102	2020
	Steel Beam Span Girder – Open Deck	BR-102A	
	Pre-Stressed Pre-Cast Concrete Single Cell Box Girder Span	BR-103	2020
	Pre-Stressed Pre-Cast AASHTO-Type Beam Span	BR-104	2020
	Concrete Multi-Cell Box Girder Span	BR-105	2020
	Steel Through Plate Girder Span – Steel Ballast Deck	BR-108	2020
	Steel Through Plate Girder Span – Open Deck	BR-108A	2020
	Pre-Stressed Pre-Cast Concrete Box Girder Span	Br-??	2020
	Deck Drains	BR-113	
	Water Proofing – Concrete Deck	BR-115	
	Water Proofing – Steel Deck	BR-115	
	Collision Impact Devices and Sacrificial Beam	BR-116	2020
	Double Inside Guardrail	BR-123	
	Standard Timber Pile Trestle – 6-Pile Bents	BR-125	
	Standard Timber Pile Trestle – Open Deck Timber	BR-127	
	Standard Timber Pile Trestle – Typical Components	BR-128	
OVERPASS PROJECTS			
	Chain Link Railing Details	BR-110	
	Tubular Hand Railing Details	BR-111	
	Picket Hand Railing Details	BR-112	
	Track Shield (Protection) Detail	BR-117	2020
	Temporary Construction Clearances	BR-118	
	Typical Permanent Clearances	BR-120	
	Pedestrian Fencing on Overpasses	BR-121	
RAILROAD TRACK			
	Speeds Thru Turnouts		
	Superelevation of Curves – 1 inch Unbalanced	RB-802	
	Superelevation of Curves – 1-1/2 inch Unbalanced	RB-803	
	Superelevation of Curves – 2 inch Unbalanced	RB-804	
	Superelevation of Curves – 3 inch Unbalanced	RB-805	
	Vertical Curve Design	RB-806	
	Other Track Materials - Washer	RA-111	

	Other Track Materials - Spike	RA-112	
	Other Track Materials – Screw Spike – At Road Crossings	RA-113	
	Other Track Materials – Screw Spike – All other Locations	OTM-109	
	Other Track Materials – Track Bolts and Nuts	RA-114	
	Other Track Materials – Rail Plate		
	Other Track Materials – Rail Plate - Pandrol	OTM-104	
	Other Track Materials – Rail Plate – Victor		
	Other Track Materials – Rail Bolts and Nuts		
	Other Track Materials – e-Clip –E-2055	OTM-106	
	Other Track Materials – e-Clip – RP601A	OTM-107	
	Other Track Materials – Rail Anchor – Drive On	OTM110	
	Other Track Materials – Curve Block Assembly	OTM-111	
	Anchor Pattern – CWR – Equal to or Greater than 10 MGT	OTM-115	
	Anchor Pattern – CWR – Equal to or Greater than 10 MGT	OTM-116	
	Spike Patten for Tangent and Curved Track	RB-501	
	Tie - Concrete		
	Tie – Concrete – Tie Pad		
	Tie – Concrete – Plate Anchor		
	Track Ballast – Gradation Properties	RB-100	
	Track Ballast – Gradation Table	RB-101	
	Track Subballast – Gradation	RB-101	
	Track Bed – Typical Grading and Ballast Section	RB-201	
	Track Bed – 12 inch Ballast Section for Main Track	RB-202	
	Track Bed – 12 inch Ballast Section for Main Track	RB-207	
	Utility Crossings – Typical - 1	RB-203	
	Utility Crossings – Typical - 2	RB-203	
	At-Grade Crossing – Prefabricated Timber Crossing	RB-602	
	Design Clearances for Highway Overpasses	RB-603	
	Permanent Crossing Closure – Signage Details	S-124	



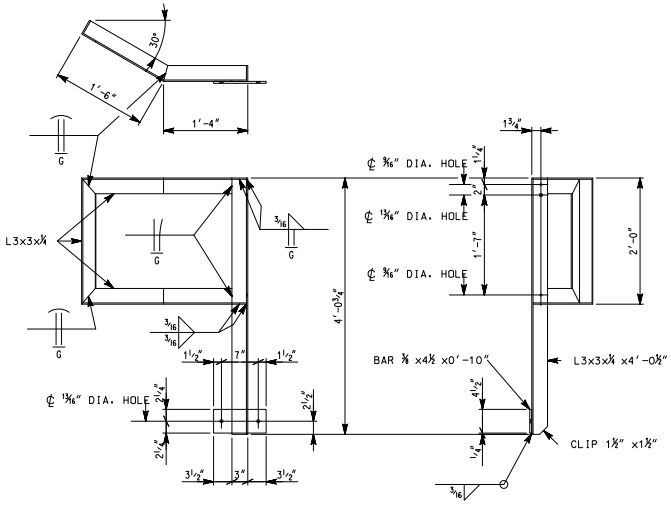
TYPICAL HANDRAIL LAYOUT

① END HANDRAIL POST MK. HP2 (TYP.)
② END HANDRAIL POST MK. HP2 (TYP.)
③ INTERM. HANDRAIL POST MK. HP3 (TYP.)
④ HANDRAIL BRACE MK. B2 (TYP.)
⑤ 3/8" DIA. WIRE ROPE, 7 STRAND, GALVANIZED
⑥ 3/4" DIA. X 1 3/4" A325 HIGH STRENGTH BOLT W/ NUT & WASHER FOR BOLTING BRACE TO HANDRAIL POSTS
⑦ GALVANIZED MALLEABLE IRON U-BOLT FOR 3/8" DIA. WIRE ROPE W/ ELASTIC NUTS FOR ATTACHING WIRE ROPE TO END HANDRAIL
⑧ 3/4" DIA. X 10" A307 MACHINE BOLT W/ HEAVY HEX ELASTIC NUT & 2 FLAT WASHERS FOR ATTACHING POSTS TO GIRDER
⑨ 1/2" DIA. EYEBOLT W/ 3" LONG SHANK W/ LOCK NUT & FLAT WASHER FOR ATTACHING WIRE ROPE TO END HANDRAIL
⑩ 3/8" EYE TYPE STRANDVISE FOR ATTACHING WIRE ROPE TO END HANDRAIL
⑪ CONCRETE OR TIMBER SPAN (TYP.)



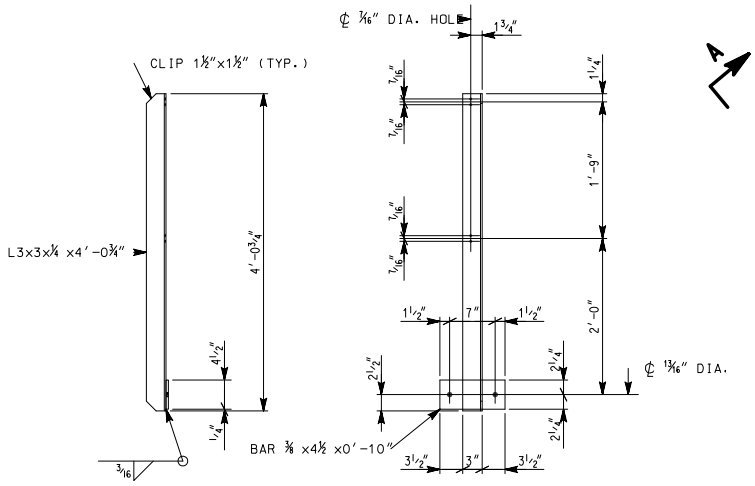
HANDRAIL POST MK. HP1
SCALE: 1"=1'-0"

ESTIMATED WEIGHT = 62.2 LBS.



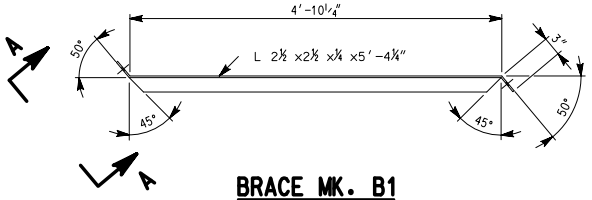
HANDRAIL POST MK. HP2
SCALE: 1"=1'-0"

ESTIMATED WEIGHT = 62.2 LBS.



HANDRAIL POST MK. HP3
SCALE: 1"=1'-0"

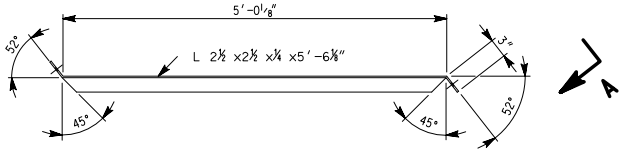
ESTIMATED WEIGHT = 24.7 LBS.



BRACE MK. B1
SCALE: 1"=1'-0"

ESTIMATED WEIGHT = 22.0 LBS.

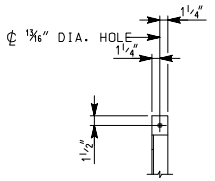
NOTE: USE WITH HANDRAIL POSTS MK. HP1 AND HP4.



BRACE MK. B2
SCALE: 1"=1'-0"

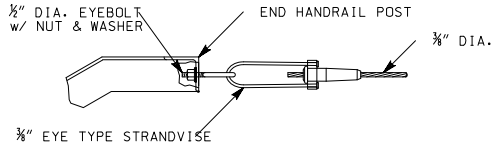
ESTIMATED WEIGHT = 22.6 LBS.

NOTE: USE WITH HANDRAIL POSTS MK. HP2 AND HP5.



SECTION A-A
SCALE: 3/4"=1'-0"

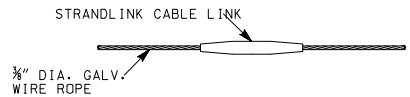
HANDRAIL POSTS IN THIS SHEET ARE FOR TANGENT TRACK ONLY. FOR CURVED TRACK, HANDRAIL POST MARKS HP3, HP4 AND HP5 SHALL BE USED. CONTACT KCSR FOR THOSE DETAILS.



VIEW C-C
SCALE: 1 1/2"=1'-0"

STEEL FABRICATION NOTES FOR HANDRAIL POST AND BRACES

DESIGN AND WORKMANSHIP - PER CURRENT AREMA MANUAL FOR RAILWAY ENGINEERING.
MISCELLANEOUS STEEL - PER CURRENT ASTM A36 SPECIFICATIONS UNLESS OTHERWISE NOTED.
STEEL COATING - PICKLE PER SSPC NO. 8 AND HOT-DIPPED GALV. PER CURRENT ASTM A123. COATING WEIGHT 2.3 OZ. PER SQ. FT. BOLTS AND NUTS TO BE ZINC PLATED.
WELDING - ARC PROCESS PER CURRENT AREMA MANUAL FOR RAILWAY ENGINEERING AND AWS D1.1 STRUCTURAL WELDING CODE.



WIRE ROPE SPLICE DETAIL
SCALE: NONE

K.C.S. STANDARDS	REVISIONS NO.	DESCRIPTION:	BY:	DATE:	DRAWN BY:	APPROVED BY:	DATE:	HAND RAIL STANDARDS CONCRETE OR TIMBER BRIDGES	DRAWING NO.
					XX	XXX	2020		BR-??

	MULTIPLY	BY	TO OBTAIN		MULTIPLY	BY	TO OBTAIN
LENGTH	INCHES (IN)	25.4000	MILLIMETERS (MM)	MOMENT	KIP FEET (KIP FT)	1.35582	KILONEWTON METER (KNM)
	FEET (FT)	0.3048	METERS (M)		POUND INCHES (LB IN)	0.11298	NEWTON METER (N M)
	YARDS (YD)	0.9144	METERS (M)	FORCE	POUND (LB) (FORCE)	4.44820	NEWTON (N)
	MILES (MI)	1.6093	KILOMETERS (KM)		KIP (K)	4.44820	KILONEWTON (KN)
AREA	SQUARE INCHES (IN^2)	645.1600	SQUARE MILLIMETERS (MM^2)		NEWTON (N)	1.00000	KG M/SEC^2
	SQUARE FEET (FT^2)	0.0929	SQUARE METERS (M^2)	STRESS	POUND/SQUARE IN (PSI)	6.89480	KILOPASCAL (KPA)
	SQUARE YARDS (YD^2)	0.8361	SQUARE METERS (M^2)		KIP/SQUARE IN (KSI)	6.89480	MEGAPASCAL (MPA)
	ACRES (AC)	0.4046	HECTARES (HA)		KIP/SQUARE FOOT (KSF)	47.88030	KILOPASCAL (KPA)
	SQUARE MILES (MI^2)	2.5900	SQUARE KILOMETERS (KM^2)		PASCAL (PA)	1.00000	N/M^2
WEIGHT	OUNCES (OZ)	28.3495	GRAMS (G)	VOLUME	CUBIC INCHES (IN^3)	16387.06400	CUBIC MILLIMETERS (MM^3)
	POUNDS (LB)	0.4536	KILOGRAMS (KG)		CUBIC FEET (FT^3)	0.02832	CUBIC METERS (M^3)
	KIPS (K)	0.4536	TONNES (METRIC TON)		CUBIC YARDS (YD^3)	0.76456	CUBIC METERS (M^3)
	TONS (TN)	0.9072	TONNES (METRIC TON)	MOMENT OF INERTIA	IN^4	416231.40000	MM^4
	TONNES (METRIC TON)	1000.0000	KILOGRAMS (KG)		FT^4	0.00863	M^4

PREFIXES: $U=10^{-6}$, $M=10^{-3}$, $K=10^{3}$, $M=10^{6}$

TURNOUT SPEEDS THROUGH TURNOUTS

TURNOUT SIZE	SWITCH POINT LENGTH	POINT TYPE	RECOMMENDED SPEED (MPH)*	RECOMMENDED SPEED (KMPH)*
LESS THAN 7	11'-0"	STRAIGHT	5	5
7 to 8 $\frac{1}{2}$	15'-0" OR 16'-6"	STRAIGHT	10	15
9 TO 10	16' -6"	STRAIGHT	10	15
11	19' -6"	CURVED	20	30
11 TO 12	22'-0"	STRAIGHT	20	30
14	24'-0"	STRAIGHT	25	40
15	26'-0"	CURVED	30	45
15	30'-0"	STRAIGHT	30	45
16	30'-0"	STRAIGHT	30	45
20	30'-0"	STRAIGHT	40	60
** 20	39'-0"	CURVED	40	60
30	115'-6"	CURVED	60	95

* THE RECOMMENDATIONS IN THIS TABLE ARE FOR GENERAL INFORMATIONAL PURPOSES ONLY. THE GEOMETRY AND ULTIMATELY THE SPEED THROUGH IDENTICAL SIZE TURNOUTS CAN VARY BETWEEN MANUFACTURER'S DESIGNS. IF YOU HAVE ANY QUESTIONS CONCERNING THE ALLOWABLE SPEED THROUGH A TURNOUT, CONSULT WITH THE CHIEF ENGINEER BEFORE MAKING ANY CHANGES.

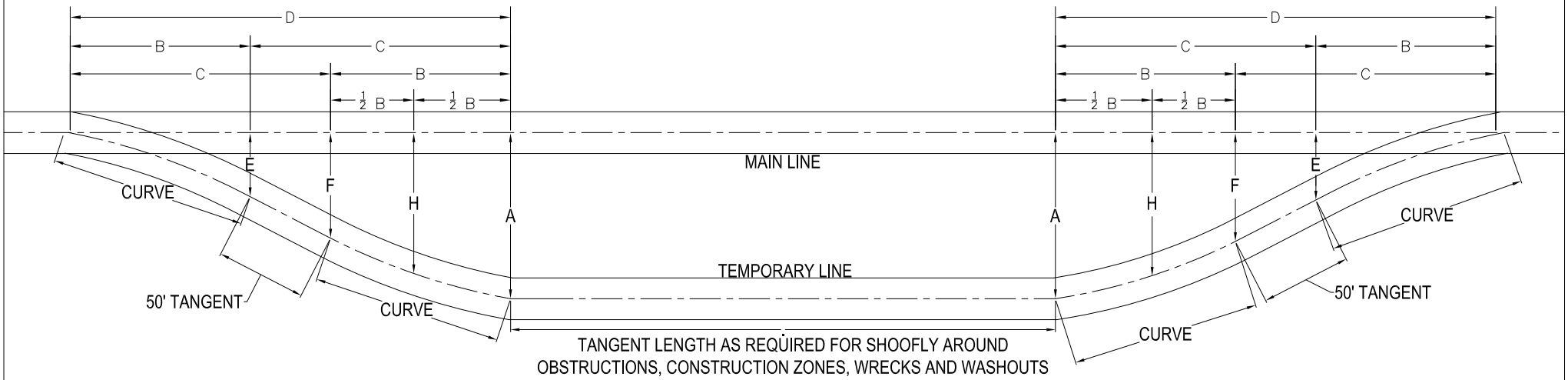
** PREFERED TURNOUT

8 DEGREE CURVE						
A	B	C	D	E	F	H
10.0	63.2	113.0	176.2	2.8	7.2	9.3
20.0	97.1	146.6	243.7	6.6	13.4	18.4
30.0	123.3	172.6	295.9	10.7	19.3	27.3
40.0	145.5	194.4	339.9	14.9	25.1	36.3
50.0	164.9	213.6	378.5	19.2	30.8	45.2
60.0	182.5	230.8	413.3	23.6	36.4	54.2
70.0	198.6	246.6	445.2	28.1	41.9	63.1
80.0	213.5	261.2	474.7	32.5	47.5	72.0
90.0	227.4	274.9	502.3	37.1	52.9	80.9
100.0	240.6	287.6	528.2	41.6	58.4	89.8

ALL DIMENSIONS IN TABLES ARE IN FEET

10 DEGREE CURVE						
A	B	C	D	E	F	H
10.0	54.7	104.5	159.1	2.6	7.4	9.3
20.0	84.8	134.2	219.0	6.3	13.7	18.4
30.0	108.1	157.2	265.3	10.3	19.7	27.4
40.0	127.8	176.5	304.3	14.4	25.6	36.4
50.0	145.1	193.5	338.6	18.7	31.3	45.3
60.0	160.7	208.7	369.4	23.0	37.0	54.2
70.0	175.0	222.6	397.6	27.4	42.6	63.0
80.0	188.2	235.5	423.7	31.8	48.2	71.9
90.0	200.6	247.4	448.0	36.3	53.7	80.7
100.0	212.2	258.7	470.9	40.7	59.3	89.5

12 DEGREE CURVE						
A	B	C	D	E	F	H
10.0	48.5	98.2	146.7	2.5	7.5	9.4
20.0	75.7	125.1	200.8	6.0	14.0	18.5
30.0	96.9	145.8	242.7	9.9	20.1	27.5
40.0	114.8	163.3	278.1	14.0	26.0	36.5
50.0	130.5	178.6	309.1	18.2	31.8	45.4
60.0	144.7	192.3	337.0	22.4	37.6	54.3
70.0	157.6	204.8	362.4	26.8	43.2	63.2
80.0	169.6	216.3	386.0	31.1	48.9	72.0
90.0	180.8	227.1	407.9	35.5	54.5	80.9
100.0	191.3	237.1	428.5	40.0	60.0	89.7



K.C.S. STANDARDS

REVISIONS			
NO.:	DESCRIPTION:	BY:	DATE:

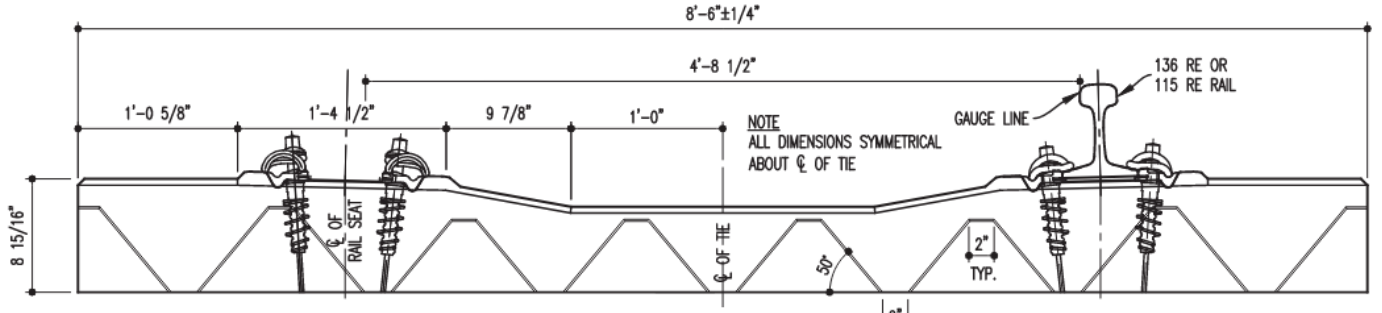
DRAWN BY:	APPROVED BY:	DATE:
XX	XXX	2007

TEMPORARY TRACK AROUND OBSTRUCTIONS (SHOOFLY TRACK GEOMETRY)

DRAWING NO. **G-105**

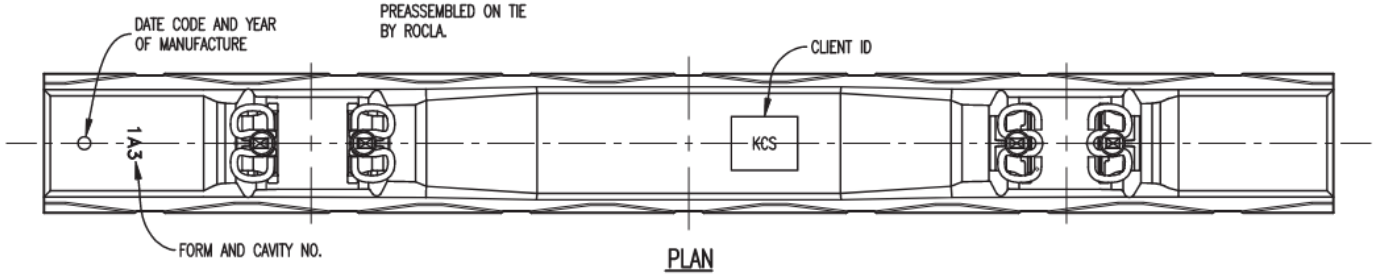
FROM A TO A	BRANCH, SECONDARY MAIN OR INDUSTRY LEAD	YARD LEADS	SIDINGS	WOOD TIE MAIN TRACK LESS THAN 10 MGT	WOOD TIE MAIN TRACK GREATER THAN 10 MGT	CONCRETE TIE MAIN TRACK LESS THAN 20 MGT	CONCRETE TIE MAIN TRACK GREATER THAN 20 MGT
INDUSTRY TRACK	#9 STD SPRING FROG (10 MPH/15 KMPH)	#9 STD SELF GUARDED FROG (10 MPH/15 KMPH)	#9 STD SPRING FROG (10 MPH/15 KMPH)	#11 STD SPRING FROG (20 MPH/30 KMPH)	#11 STD PREMIUM SPRING FROG (20 MPH/30 KMPH)	#11 PREMIUM WOOD SPRING FROG (20 MPH/30 KMPH)	#11 PREMIUM CONCRETE SPRING FROG (20 MPH/30 KMPH)
INDUSTRY TRACK USED BY UNIT TRAINS OR HEAVY AXLE LOADS	#9 STD RBM (10 MPH/15 KMPH)	#9 STD (10 MPH/15 KMPH)	#11 STD SPRING FROG (20 MPH/30 KMPH)	#11 STD SPRING FROG (20 MPH/30 KMPH)	#11 STD PREMIUM SPRING FROG (20 MPH/30 KMPH)	#11 PREMIUM SPRING FROG (20 MPH/30 KMPH)	#11 PREMIUM CONCRETE SPRING FROG (20 MPH/30 KMPH)
SUPPORT YARDS		#9 STD SELF GUARDED FROG (10 MPH/15 KMPH)					
PRODUCTION YARDS AND SWITCHING LEADS	#9 STD SPRING FROG (10 MPH/15 KMPH)	#11 STD SELF GUARDED FROG (10 MPH/15 KMPH)	#11 STD SELF GUARDED FROG (10 MPH/15 KMPH)	#11 PREMIUM SPRING FROG (20 MPH/30 KMPH)	#11 PREMIUM SPRING FROG (20 MPH/30 KMPH)	#11 PREMIUM SPRING FROG (20 MPH/30 KMPH)	#11 PREMIUM CONCRET SPRING FROG (20 MPH/30 KMPH)
SIDING	#9 STD SPRING FROG (10 MPH/15 KMPH)	#9 STD RBM (10 MPH/15 KMPH)		#15 PREMIUM RBM FROG (30 MPH/45 KMPH)	#15 PREMIUM RBM FROG (30 MPH/45 KMPH)	#15 PREMIUM WOOD RBM FROG (30 MPH/45 KMPH)	#15 PREMIUM CONCRETE RBM FROG (30 MPH/45 KMPH)
MULTIPLE MAIN				#20 PREMIUM RBM FROG (40 MPH/60 KMPH)	#20 PREMIUM RBM FROG (40 MPH/60 KMPH)	#20 PREMIUM WOOD RBM FROG (40 MPH/60 KMPH)	#20 PREMIUM CONCRETE RBM FROG (40 MPH/60 KMPH)
HAND THROW CROSSOVERS	#9 STD SPRING FROG (10 MPH/15 KMPH)	#9 STD SPRING FROG (10 MPH/15 KMPH)		#11 STD SPRING FROG (10 MPH/15 KMPH)	#11 STD PREMIUM SPRING FROG (10 MPH/15 KMPH)	#11 PREMIUM WOOD SPRING FROG (10 MPH/15 KMPH)	#11 PREMIUM WOOD SPRING FROG (10 MPH/15 KMPH)
POWER CROSSOVERS				#15 STD RBM FROG (30 MPH/45 KMPH)	#15 PREMIUM RBM FROG (30 MPH/45 KMPH)	#15 PREMIUM WOOD RBM FROG (30 MPH/45 KMPH)	#15 PREMIUM CONCRETE RBM FROG (30 MPH/45 KMPH)

1. WHEN TONNAGE THROUGH THE DIVERGENT SIDE OF THE TURNOUT EXCEEDS 40% OF THE TOTAL TONNAGE, USE SELF GUARDED OR RAILBOUND MANGANESE FROGS.
2. SITUATIONS MAY ARISE WHERE THESE RECOMMEDATIONS MAY REQUIRE MODIFICATION - APPLY TO THE CHIEF ENGINEER FOR AUTHORITY TO DEVIATE FROM THESE STANDARDS.
3. WHEN RAIL SIZES OR TRACK TYPES DIFFER BETWEEN TWO TRACKS, THE HIGHER TRACK TYPE OR LARGER RAIL SECTION WILL BE USED THROUGHOUT THE CROSSOVER.

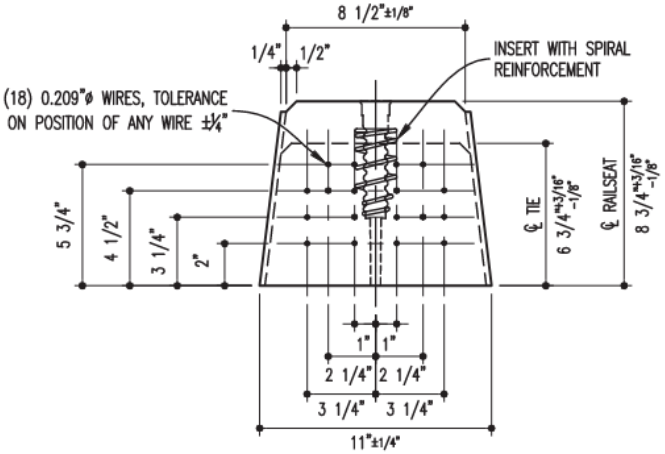


ELEVATION

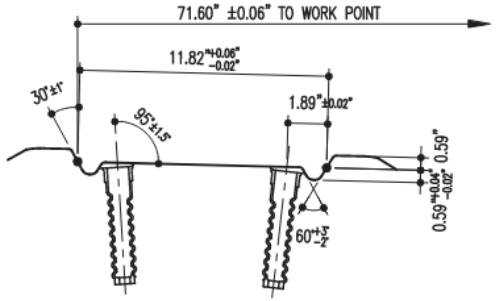
NOTE
VOSSLOH COMPONENTS
PREASSEMBLED ON TIE
BY ROCLA.



PLAN



TIE SECTION



RAILSEAT SLOPE @ 1:40 ±5

RAIL SEAT DETAIL

GENERAL NOTES

TIE
THIS TIE IS DESIGNED AND MANUFACTURED IN ACCORDANCE WITH THE TECHNICAL SPECIFICATIONS OF AREMA CHAPTER 30, PART 4, FOR PRESTRESSED CONCRETE TIES. APPROXIMATE WEIGHT OF TIE 720 LBS.

CONCRETE
STRENGTH: f'ci = 4,500 PSI AT TRANSFER, f'c = 7,500 PSI AT 28 DAYS.
CEMENT: MEETING ASTM C150, TYPE III, LOW ALKALI (LESS THAN 0.60%)
AGGREGATES: MEETING ASTM C33, CLASS 4S
FLYASH: CLASS F MEETING ASTM C618
WATER REDUCING ADMIXTURES: MEETING ASTM C494
AIR ENTRAINING ADMIXTURES: MEETING ASTM C260.
FINISH: STEEL FORM FINISH EXCEPT ON BOTTOM OF CROSS TIE, WHICH WILL HAVE ROUGH FINISH.

PRESTRESSING
PRESTRESSING WIRE IS NOMINAL 0.209"ø, GRADE 260 KSI, LOW RELAXATION AND CONFORMING TO ASTM A881. EACH WIRE SHALL BE STRESSED TO 6,750 LBS.

RAIL FASTENERS
PAD: AS PROVIDED BY KCSM
TENSION CLAMP: AS PROVIDED BY KCSM
GUIDE PLATE: AS PROVIDED BY KCSM
LAG SCREW: AS PROVIDED BY KCSM
INSERT: VOSSLOH, PROVIDED BY KCSM

COPYRIGHT RESERVED (2016)
This drawing is the property of Rocla Concrete Tie, Inc. and is subject to return upon demand. It is submitted for the use only in connection with proposals or contracts of this organization upon the express condition that it is not to be used directly or indirectly in any way detrimental to the interests of Rocla Concrete Tie, Inc. This drawing may not be copied or given to other parties without the expressed written approval of Rocla Concrete Tie, Inc.

NO.	DATE	REVISED ITEMS	BY	APRV

DESIGNED BY: PLL
DRAWN BY: PLL
CHECKED BY: RC
APPROVED BY: RC

Rocla Concrete Tie, Inc.
1819 Denver West Dr., Lakewood, CO 80401
TEL.: 303-296-3500 FAX.: 303-297-2255

ISSUE DATE: 02/24/16
ROCLA CODE: 101LV
REVISION NO: 00
DRAWING NO: 15-03E

KCS/KCSM 101L
18-WIRE VOSSLOH TIE

K.C.S. STANDARDS

REVISIONS NO.:	DESCRIPTION:	BY:	DATE:

DRAWN BY:	APPROVED BY:	DATE:
XX	XXX	2016

KCS/KCSM 101L 18-WIRE VOSSLOH TIE

DRAWING NO.
OTM-??

FROM A TO A	BRANCH, SECONDARY MAIN OR INDUSTRY LEAD	YARD LEADS	SIDINGS	WOOD TIE MAIN TRACK LESS THAN 10 MGT	WOOD TIE MAIN TRACK GREATER THAN 10 MGT	CONCRETE TIE MAIN TRACK LESS THAN 20 MGT	CONCRETE TIE MAIN TRACK GREATER THAN 20 MGT
INDUSTRY TRACK	#9 STD SPRING FROG (10 MPH/15 KMPH)	#9 STD SELF GUARDED FROG (10 MPH/15 KMPH)	#9 STD SPRING FROG (10 MPH/15 KMPH)	#11 STD SPRING FROG (20 MPH/30 KMPH)	#11 STD PREMIUM SPRING FROG (20 MPH/30 KMPH)	#11 PREMIUM WOOD SPRING FROG (20 MPH/30 KMPH)	#11 PREMIUM CONCRETE SPRING FROG (20 MPH/30 KMPH)
INDUSTRY TRACK USED BY UNIT TRAINS OR HEAVY AXLE LOADS	#9 STD RBM (10 MPH/15 KMPH)	#9 STD (10 MPH/15 KMPH)	#11 STD SPRING FROG (20 MPH/30 KMPH)	#11 STD SPRING FROG (20 MPH/30 KMPH)	#11 STD PREMIUM SPRING FROG (20 MPH/30 KMPH)	#11 PREMIUM SPRING FROG (20 MPH/30 KMPH)	#11 PREMIUM CONCRETE SPRING FROG (20 MPH/30 KMPH)
SUPPORT YARDS		#9 STD SELF GUARDED FROG (10 MPH/15 KMPH)					
PRODUCTION YARDS AND SWITCHING LEADS	#9 STD SPRING FROG (10 MPH/15 KMPH)	#11 STD SELF GUARDED FROG (10 MPH/15 KMPH)	#11 STD SELF GUARDED FROG (10 MPH/15 KMPH)	#11 PREMIUM SPRING FROG (20 MPH/30 KMPH)	#11 PREMIUM SPRING FROG (20 MPH/30 KMPH)	#11 PREMIUM SPRING FROG (20 MPH/30 KMPH)	#11 PREMIUM CONCRET SPRING FROG (20 MPH/30 KMPH)
SIDING	#9 STD SPRING FROG (10 MPH/15 KMPH)	#9 STD RBM (10 MPH/15 KMPH)		#15 PREMIUM RBM FROG (30 MPH/45 KMPH)	#15 PREMIUM RBM FROG (30 MPH/45 KMPH)	#15 PREMIUM WOOD RBM FROG (30 MPH/45 KMPH)	#15 PREMIUM CONCRETE RBM FROG (30 MPH/45 KMPH)
MULTIPLE MAIN				#20 PREMIUM RBM FROG (40 MPH/60 KMPH)	#20 PREMIUM RBM FROG (40 MPH/60 KMPH)	#20 PREMIUM WOOD RBM FROG (40 MPH/60 KMPH)	#20 PREMIUM CONCRETE RBM FROG (40 MPH/60 KMPH)
HAND THROW CROSSOVERS	#9 STD SPRING FROG (10 MPH/15 KMPH)	#9 STD SPRING FROG (10 MPH/15 KMPH)		#11 STD SPRING FROG (10 MPH/15 KMPH)	#11 STD PREMIUM SPRING FROG (10 MPH/15 KMPH)	#11 PREMIUM WOOD SPRING FROG (10 MPH/15 KMPH)	#11 PREMIUM WOOD SPRING FROG (10 MPH/15 KMPH)
POWER CROSSOVERS				#15 STD RBM FROG (30 MPH/45 KMPH)	#15 PREMIUM RBM FROG (30 MPH/45 KMPH)	#15 PREMIUM WOOD RBM FROG (30 MPH/45 KMPH)	#15 PREMIUM CONCRETE RBM FROG (30 MPH/45 KMPH)

1. WHEN TONNAGE THROUGH THE DIVERGENT SIDE OF THE TURNOUT EXCEEDS 40% OF THE TOTAL TONNAGE, USE SELF GUARDED OR RAILBOUND MANGANESE FROGS.
2. SITUATIONS MAY ARISE WHERE THESE RECOMMEDATIONS MAY REQUIRE MODIFICATION - APPLY TO THE CHIEF ENGINEER FOR AUTHORITY TO DEVIATE FROM THESE STANDARDS.
3. WHEN RAIL SIZES OR TRACK TYPES DIFFER BETWEEN TWO TRACKS, THE HIGHER TRACK TYPE OR LARGER RAIL SECTION WILL BE USED THROUGHOUT THE CROSSOVER.

BALLAST PROPERTIES

PROPERTY	GRANITE	LIMESTONE	QUARTZITE	CRUSHED GRAVEL	BLAST FURNACE SLAG	ASTM TEST
PERCENT MATERIAL PASSING NO. 200 SIEVE	1.0%	1.0%	1.0%	1.0%	1.0%	C 117
BULK SPECIFIC GRAVITY (SEE NOTE # 2)	2.60	2.6	2.60	2.3	2.90	C 127
ABSORPTION PERCENT	1.0	2.0	1.0	2.0	2.0	C 127
CLAY LUMPS 8 FRIABLE 5 CYCLES	0.5%	0.5%	0.5%	0.5%	0.5%	C 142
DEGRADATION	35%	35%	30%	40%	30%	>C535 <C131
SOUNDNESS (SODIUM SULFATE)	5.0%	5.0%	5.0%	5.0%	5.0%	C 88
FLAT AND/OR ELONGATED PARTICLES	5.0%	5.0%	5.0%	5.0%	5.0%	USACE CRD – C 119

BALLAST GRADATION

DESCRIPTION	NOMINAL SIZE SQUARE OPENING	PERCENT PASSING								
		2 ½"	2"	1 ½"	1"	¾	½"	⅜	NO. 4	NO. 8
MAIN TRACK LARGE (AREMA # 24)	2–½" – ¾"	90–100		25–60		0–10	0–5			
MAIN TRACK (AREMA # 4A)	2" – ¾"	100	90–100	60–90	10–35	0–10			0–3	
* SIDING SECONDARY MAIN (AREMA # 5)	1" – ⅜"	100	100	100	90–100	40–75	15–35	0–15	0–5	
* YARD & INDUSTRIAL TRACKS (AREMA # 57)	1" – NO. 4	100	100	100	95–100			25–60	0–10	5

* UNLESS OTHERWISE SPECIFIED BY CHIEF ENGINEER, USE AREMA #4A OR 24

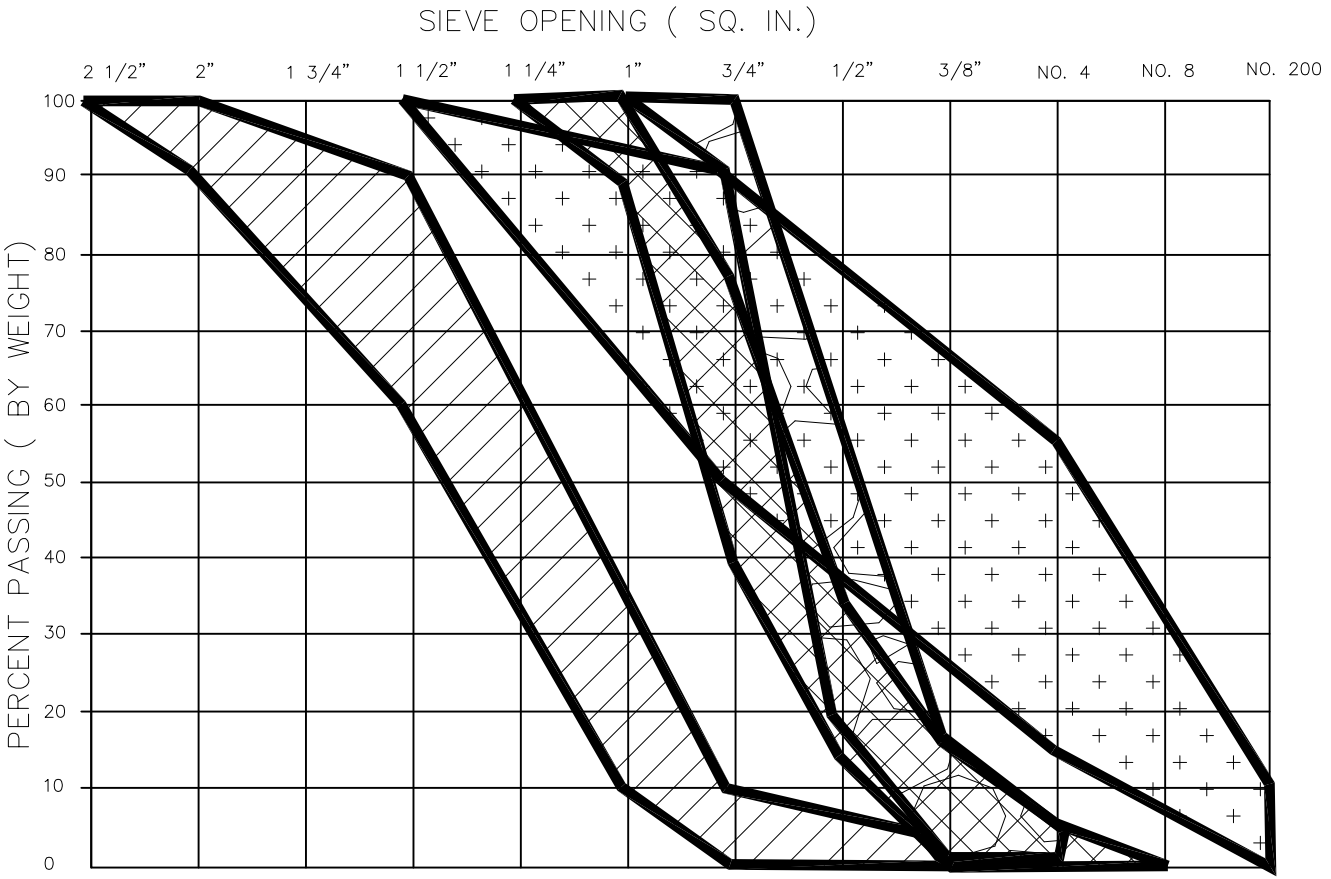
K.C.S. STANDARDS

REVISIONS NO.:	DESCRIPTION:	BY:	DATE:

DRAWN BY:	APPROVED BY:	DATE:
XX	XXX	2007

BALLAST AND GRADATION PROPERTIES

DRAWING NO. **RB-100**



PERCENT PASSING BY WEIGHT

(ALL AGGREGATE SAMPLING AND TESTING PER ASTM LATEST REVISIONS.)

SQUARE OPENING	KCS BALLAST CLASS			
	A	B	C	D
	2"–3/4"	1"–3/8"	3/4"–0"	1 1/2"–0"
2 1/2"	100			
2"	90–100			
1 3/4"				
1 1/2"	60–90			100
1 1/4"		100		
1"	10–35	90–100	100	
3/4"	0–10	40–75	90–100	50–90
1/2"		15–35	20–55	
3/8"	0–3	0–15	0–10	
NO. 4		0–5	0–5	25–55
NO. 8			0–1	
NO. 200	0–.5	0–.5	0–1	3–10

ITEM DESCRIPTION		ITEM NUMBER
A	MAIN TRACK BALLAST – AREMA #4A OR 24	–
B	BRANCH AND YARD TRACK BALLAST – AREMA #57	–
C	SUBBALLAST & WALKWAY MATERIAL	–
D	BASE MATERIAL	–

NOTES:

1. BASE MATERIAL TO BE USED AS SUB BALLAST IN POOR NATIVE SOIL AND IN CONDITIONS WHERE SPECIFIED BY CHIEF ENGINEER.

2. A AND B BALLAST MATERIALS ARE REQUIRED TO BE WASHED PRIOR TO LOADING.

Kansas City Southern Lines | Kansas City Southern de México | Panama Canal Railway Company

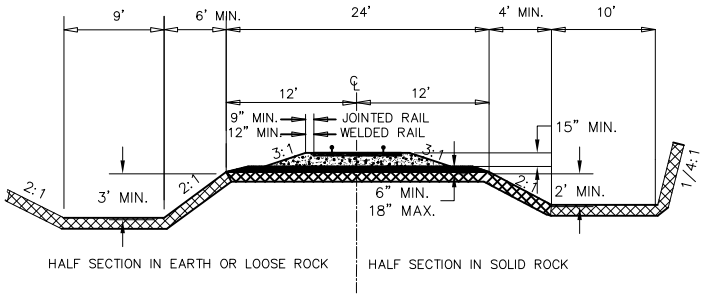
K.C.S. STANDARDS

REVISIONS NO.:	DESCRIPTION:	BY:	DATE:

DRAWN BY:	APPROVED BY:	DATE:
XX	XXX	2007

BALLAST AND GRADATION TABLE

DRAWING NO. **RB-101**



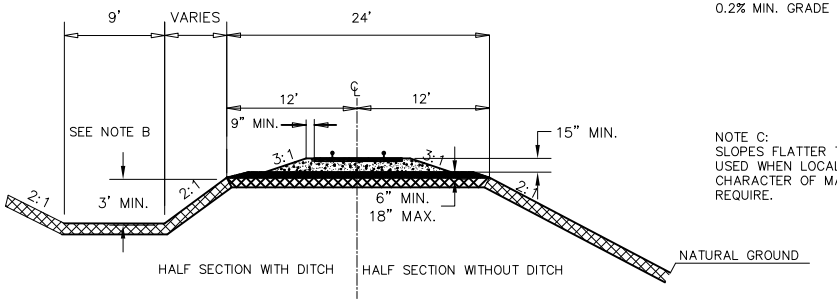
ROADBED SECTION IN CUTS

NOTE A:
ALL VERTICAL FACES IN SOUND ROCK CUTS SHALL BE PRE SPLIT WHERE PRACTICABLE

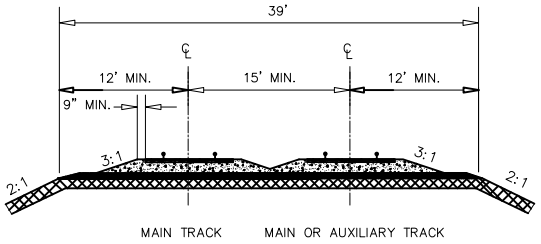
SOLID ROCK	1/4:1
FRACTURED ROCK	1:1
COMMON MATERIAL	2:1
SAND	3:1

NOTE B:
DITCH FLOW LINE ON 0.2% MIN. GRADE

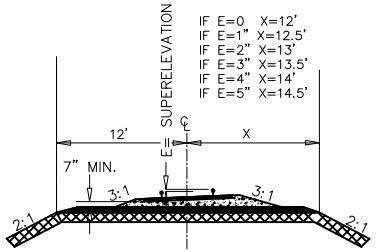
NOTE C:
SLOPES FLATTER THAN 2:1 SHALL BE USED WHEN LOCAL CONDITIONS AND CHARACTER OF MATERIAL SO REQUIRE.



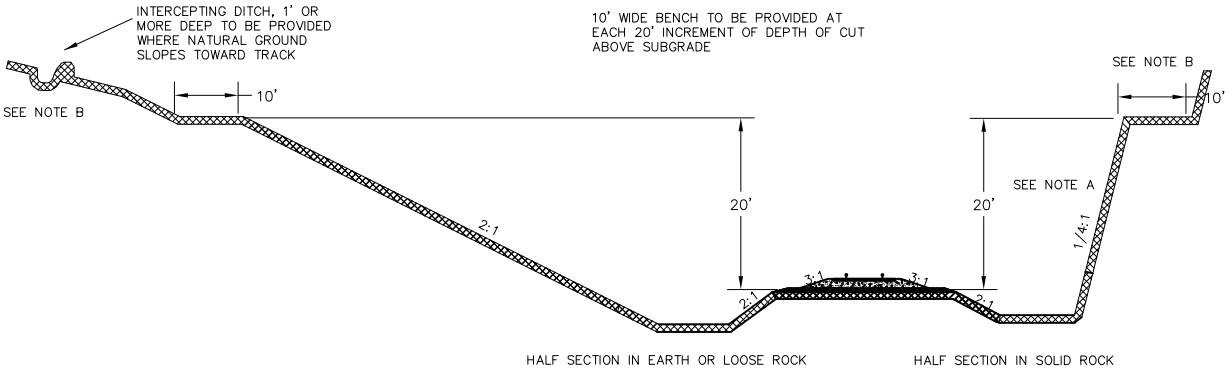
ROADBED SECTION IN FILLS



BALLAST SECTION FOR TWO TRACKS



ROADBED SECTION AT CURVED TRACK



DEEP CUT SECTIONS

GENERAL NOTES:

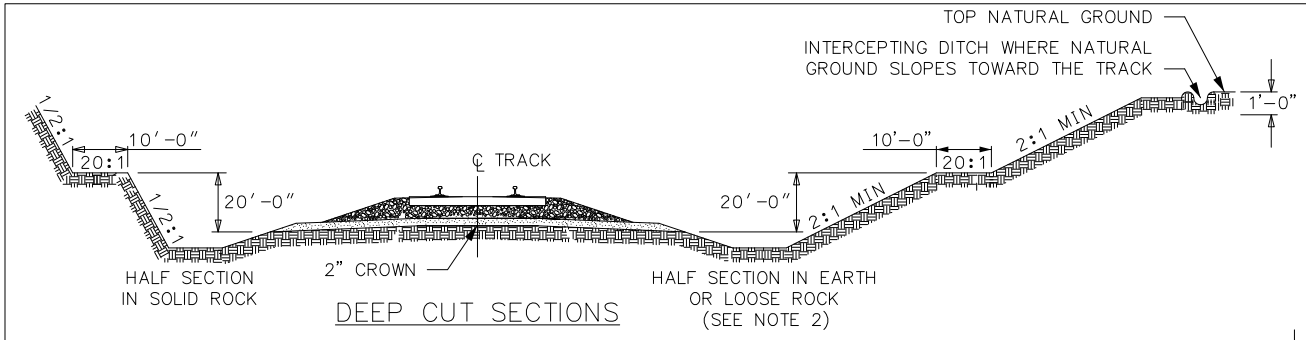
1) THE DEPTH OF BALLAST AND DEPTH OF SELECTED MATERIAL SHALL BE DECIDED ON THE BASIS OF VOLUME OF TRAFFIC AND THE QUALITY OF SELECTED MATERIAL AND SUBGRADE AS DETERMINED BY THE ENGINEER
2) SLOPES SHOWN FOR BANKS IN CUTS AND ON FILLS SHALL BE CONSIDERED STANDARD AND GENERALLY USED, BUT MAY BE MODIFIED AS REQUIRED BY LOCAL CONDITIONS AND CHARACTER OF MATERIAL.
3) BALLAST MUST BE EQUALIZED IN ADVANCE OF DRESSING SO THAT FINAL SECTION WILL CLOSELY CONFORM TO THESE PLANS.
4) WHERE PRACTICABLE, SERVICE ROADS SHALL BE CONSTRUCTED ON ONE SIDE OF THE TRACK.
5) ALL FILL SLOPES SHALL BE FACED WITH COVER OF MATERIAL SUITABLE FOR GROWING GRASS AND HAVING A THICKNESS OF APPROXIMATELY SIX INCHES. THE OUTER SURFACE OF THIS COVER SHALL COINCIDE WITH THE DESIGN SLOPE OF THE EMBANKMENT. MATERIAL FOR THIS COVER MAY BE OBTAINED FROM STRIPPINGS.

K.C.S. STANDARDS

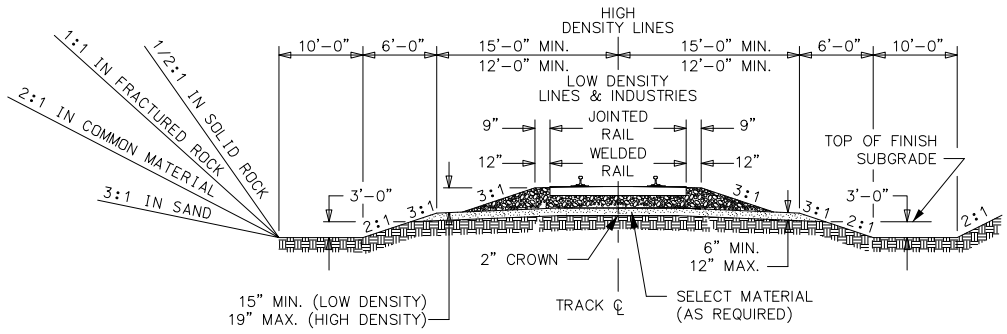
REVISIONS				DRAWN BY:	APPROVED BY:	DATE:
NO.:	DESCRIPTION:	BY:	DATE:			
1	UPDATED DETAILS	SVH	APR. 2020			
				XX	XXX	2007

TYPICAL FINISHED GRADING AND BALLAST SECTION

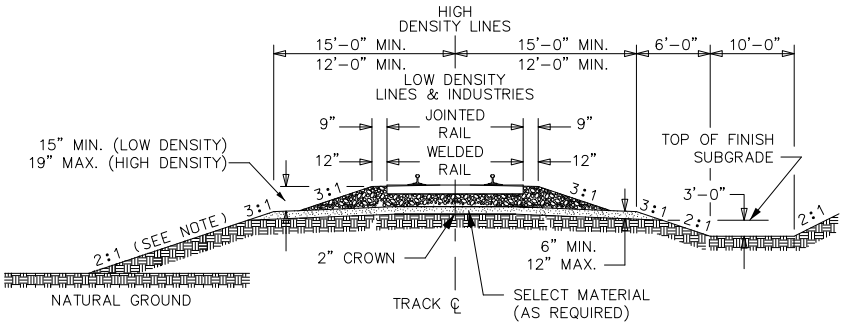
DRAWING NO. **RB-201**



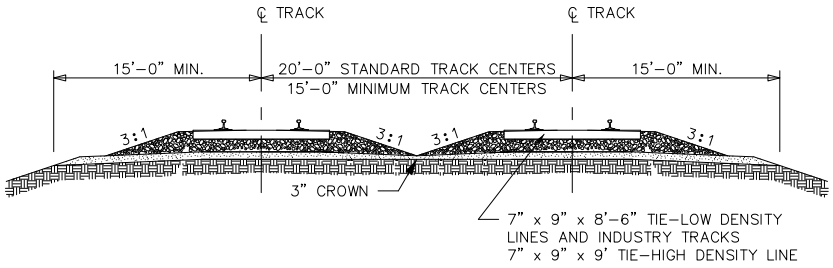
DEEP CUT SECTIONS



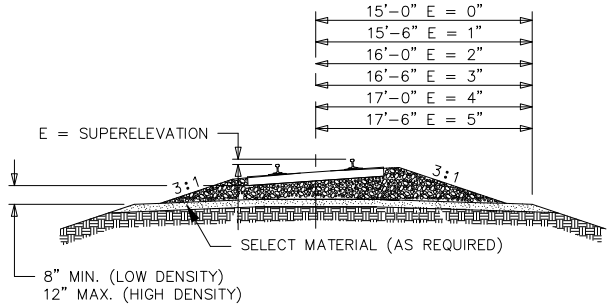
ROADBED SECTIONS IN CUTS



ROADBED SECTIONS AT FILLS



BALLAST SECTION FOR TWO TRACKS



ROADBED SECTION AT CURVED TRACK

FOR DETAILS NOT SHOWN, SEE CUT AND FILL SECTIONS ELSEWHERE ON THIS SHEET

MATERIAL REQUIRED FOR 1000 FEET OF SINGLE TRACK				
DEPTH	SHOULDER	CUBIC YARDS	DEPTH ABOVE TOP SUBGRADE	CUBIC YARDS
15"	9"	625	6"	700
	12"	650		
19"	9"	925	12"	1385
	12"	960		

ABOVE QUANTITIES ARE FOR TANGENT TRACK AND INCLUDE 15% ALLOWANCE FOR SHRINKAGE.

NOTES:

THE DEPTH OF BALLAST AND DEPTH OF SELECTED MATERIAL SHALL BE DECIDED ON THE BASIS OF VOLUME OF TRAFFIC AND THE QUALITY OF SELECTED MATERIAL AND SUBGRADE DETERMINED BY THE RAILROAD'S ENGINEER SUBJECT TO THE APPROVAL OF THE CHIEF ENGINEER.

SLOPES SHOWN FOR BANKS IN CUTS AND ON FILLS SHALL BE CONSIDERED STANDARD AND GENERALLY USED, BUT MAY BE MODIFIED AS REQUIRED BY LOCAL CONDITIONS AND CHARACTER OF MATERIAL.

BALLAST MUST BE EQUALIZED IN ADVANCE OF DRESSING SO THAT FINAL SECTION WILL CONFORM TO SLOPE REQUIREMENTS AND CHARACTER OF MATERIAL.

WHERE OFF-TRACK ROADWAY IS TO BE PROVIDED, ADD 8'-0" ADDITIONAL WIDTH TO THE ROADBED SECTION AT TOP OF SUBGRADE ELEVATION.

ALL FILL SLOPES SHALL BE FACED WITH COVER OF MATERIAL SUITABLE FOR GROWING GRASS AND HAVING A THICKNESS OF APPROXIMATELY 6 INCHES. THE OUTER SURFACE OF THIS COVER SHALL COINCIDE WITH THE DESIGN SLOPE OF THE EMBANKMENT. MATERIAL FOR THIS COVER MAY BE OBTAINED FROM STRIPPING.

FLOW LINE ON 0.2% MINIMUM GRADE DITCHES AND BENCHES.

FLAT BOTTOM DITCHES ARE REQUIRED FOR HIGH DENSITY LINES, HOWEVER A "V" DITCH IS ACCEPTABLE FOR INDUSTRY TRACKS WHEN RIGHT-OF-WAY IS LIMITED AND WHERE LOCAL CONDITIONS AND CHARACTER OF MATERIAL SO REQUIRE.

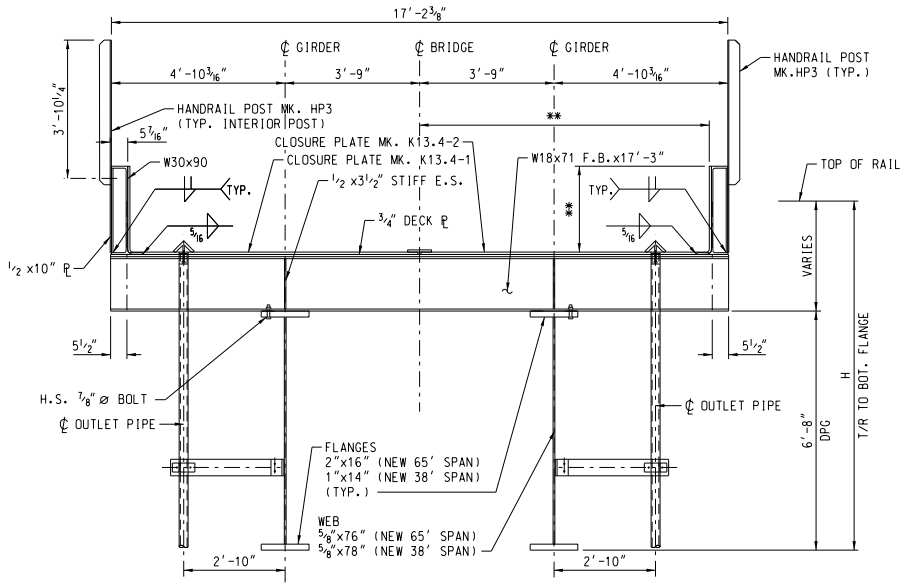
K.C.S. STANDARDS

REVISIONS			
NO.:	DESCRIPTION:	BY:	DATE:
1	UPDATED DETAILS	SVH	APR. 2020

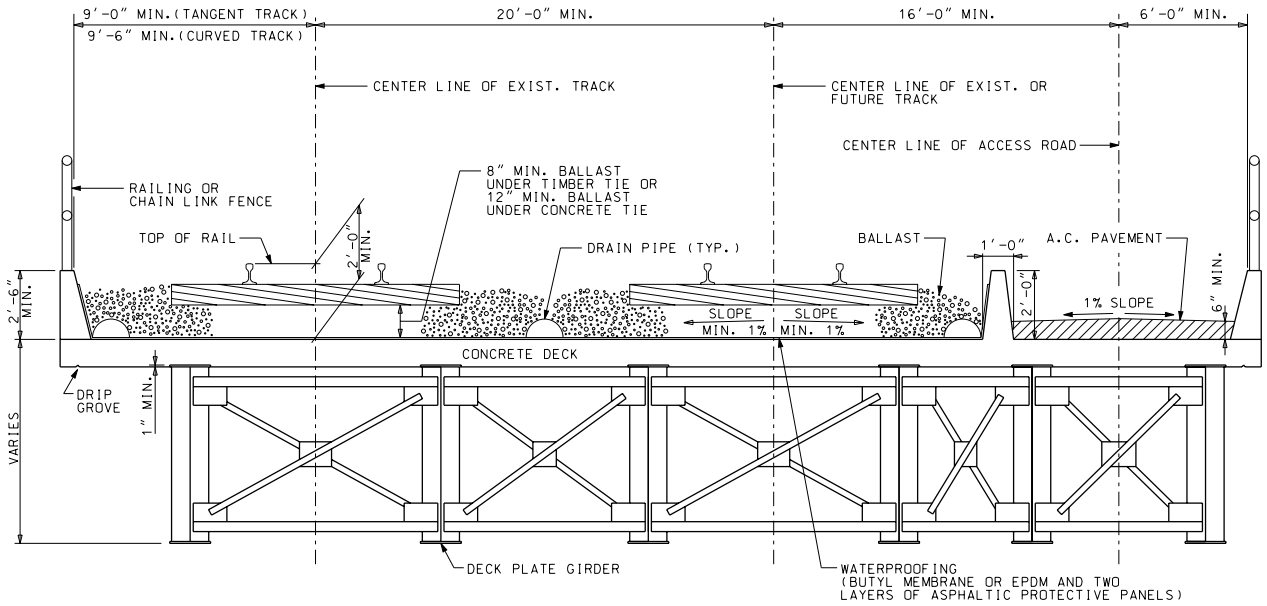
DRAWN BY:	APPROVED BY:	DATE:
XX	XXX	2007

TYPICAL ROADBED SECTION FOR WOOD TIE CONSTRUCTION

DRAWING NO. **RB-207**



ALTERNATE 1



ALTERNATE 2

FOR SINGLE TRACK BRIDGE STRUCTURE ON TANGENT ALIGNMENT, THE DECK WIDTH SHALL BE NOT LESS THAN SEVENTEEN (17) FEET. IN CURVED TRACK THE DECK WIDTH SHALL BE INCREASED BY AN ADDITIONAL ONE AND ONE HALF (1.5) INCHES FOR EVERY DEGREE OR FRACTION THEREOF OF CURVE. THE TRACK SHALL BE CENTERED ON THE BRIDGE WITH A CLEARANCE OF NOT LESS THAN EIGHT (8) FEET SIX (6) INCHES OR MINIMUM REQUIRED BY A STATE, WHICHEVER IS GREATER.

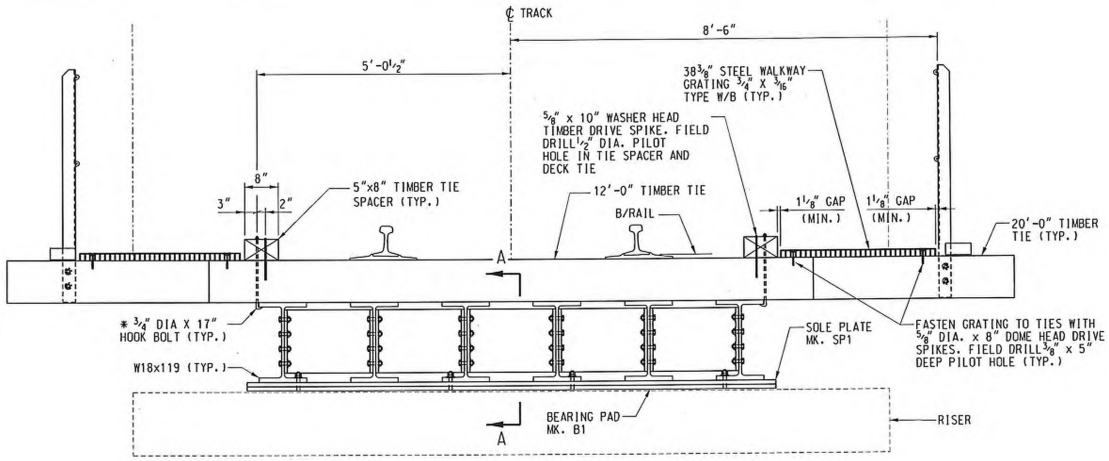
K.C.S. STANDARDS

REVISIONS NO.:	DESCRIPTION:	BY:	DATE:

DRAWN BY:	APPROVED BY:	DATE:
XX	XXX	2020

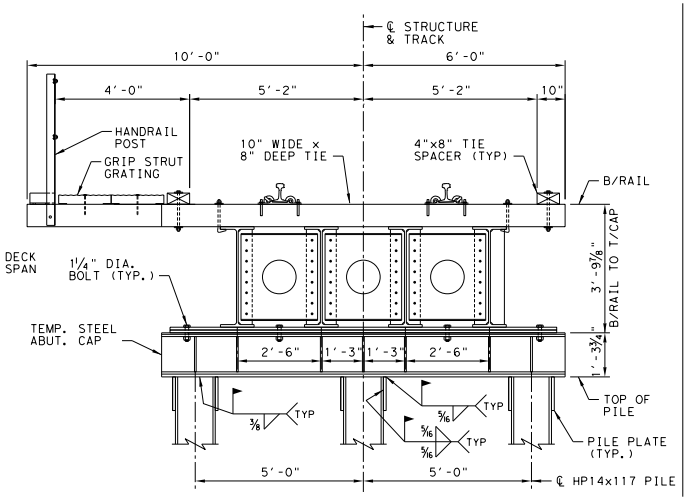
STEEL DECK PLATE GIRDER SPAN

DRAWING NO. **BR-101**



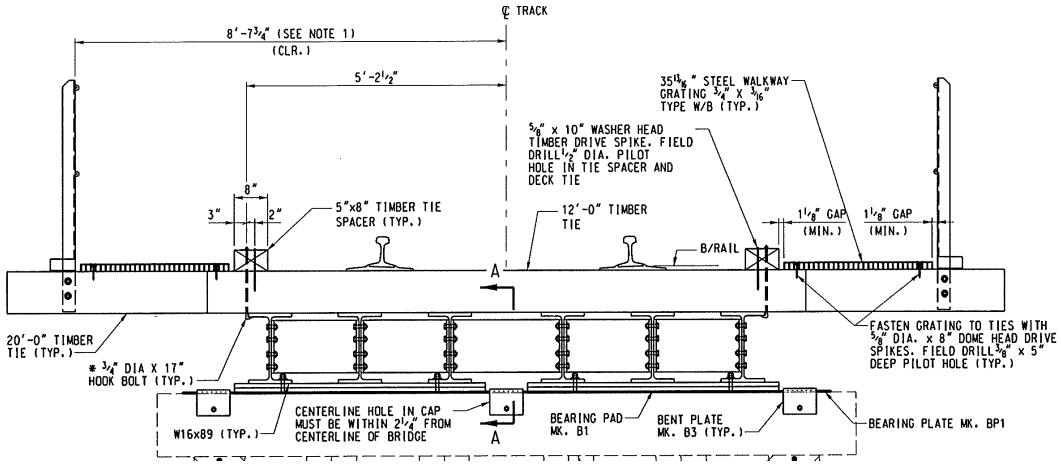
STEEL BEAM OPEN DECK SPAN - ALTERNATE 1

DOUBLE WALKWAY - MAX SPAN LENGTH 21FT



STEEL BEAM OPEN DECK SPAN

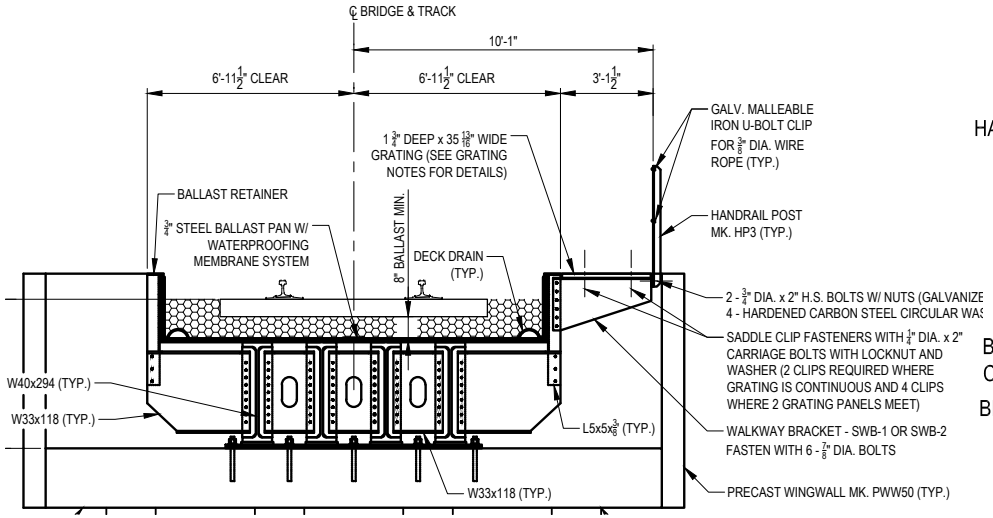
SINGLE WALKWAY - MAX SPAN LENGTH = 60FT

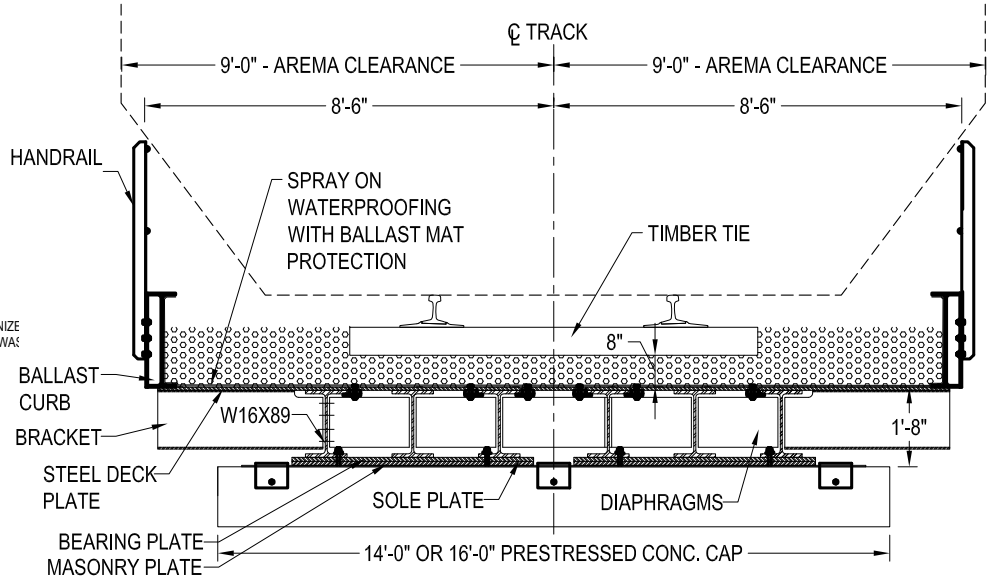


STEEL BEAM OPEN DECK SPAN - ALTERNATE 2

DOUBLE WALKWAY - MAX SPAN LENGTH = 15FT
MAXIMUM ECCENTRITY = 1"

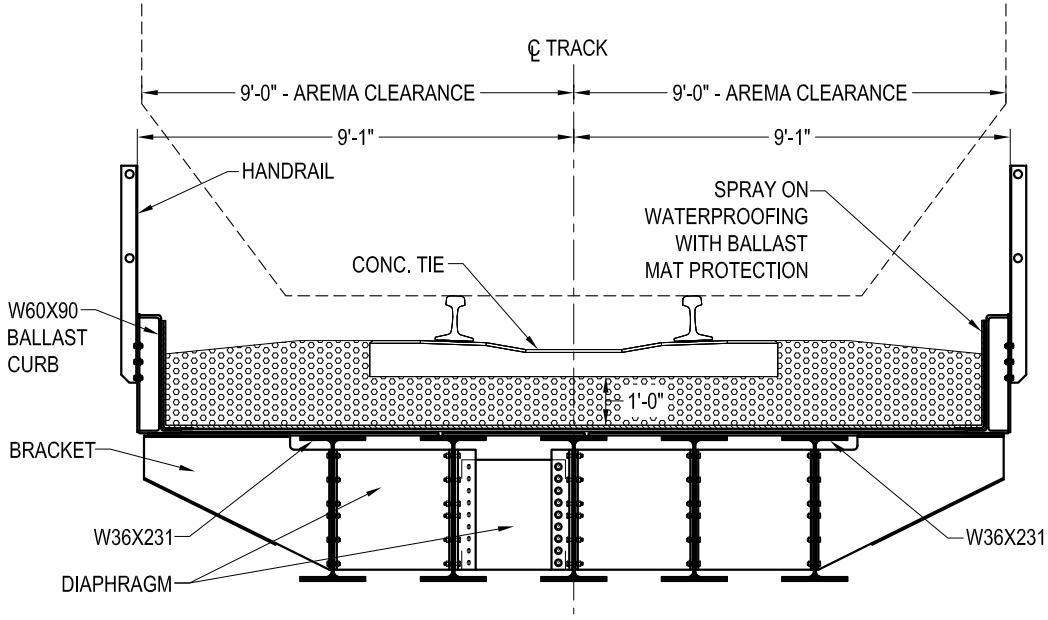
K.C.S. STANDARDS	REVISIONS NO.:	DESCRIPTION:	BY:	DATE:	DRAWN BY:	APPROVED BY:	DATE:	STEEL BEAM SPAN OPEN DECK	DRAWING NO. BR-102A
					XX	XXX	2020		





STEEL BEAM SPAN - ALTERNATE 2

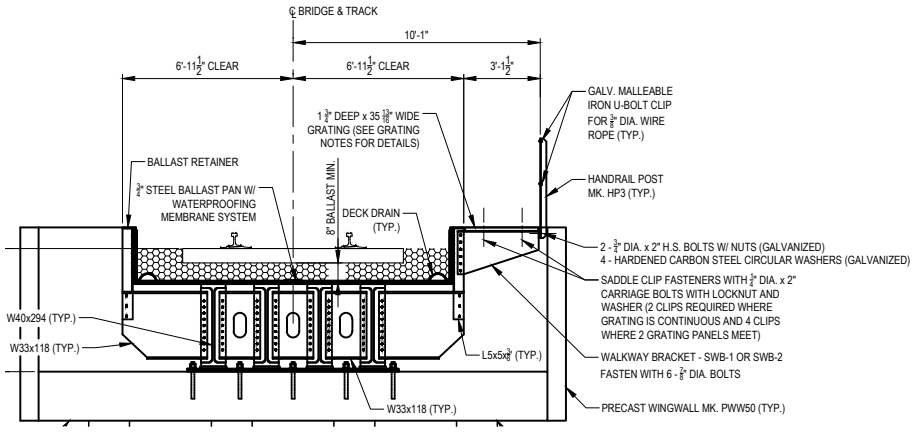
MAX. SPAN=14FT, ECC=6"



STEEL BEAM SPAN - ALTERNATE 3

MAX. SPAN=14FT, ECC=6"

K.C.S. STANDARDS	REVISIONS				DRAWN BY:	APPROVED BY:	DATE:	STEEL BEAM SPAN STEEL BALLAST DECK	DRAWING NO.
	NO.:	DESCRIPTION:	BY:	DATE:					
					XX	XXX	2020		BR-102

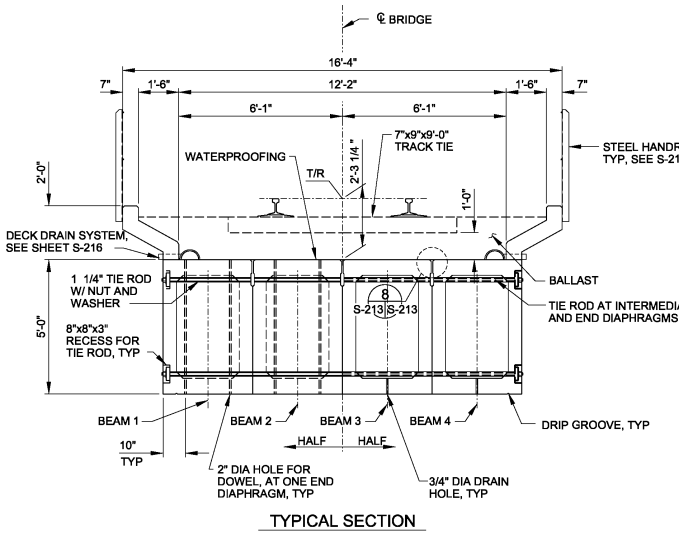


STEEL BEAM SPAN - ALTERNATE 1

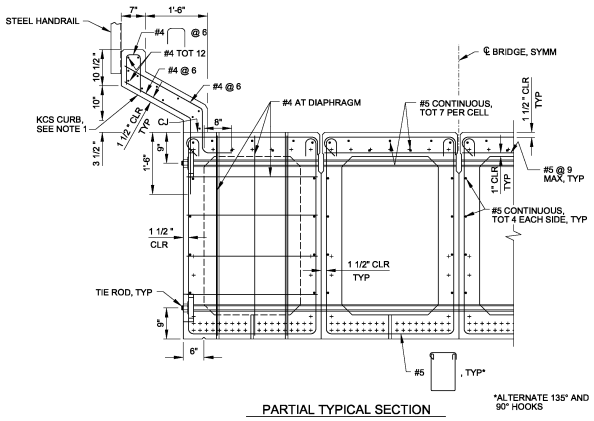
MAX: SPAN = 65FT, ECC=6"

FOR SINGLE TRACK BRIDGE STRUCTURE ON TANGENT ALIGNMENT, THE DECK WIDTH SHALL BE NOT LESS THAN SEVENTEEN (17) FEET. IN CURVED TRACK THE DECK WIDTH SHALL BE INCREASED BY AN ADDITIONAL ONE AND ONE HALF (1.5) INCHES FOR EVERY DEGREE OR FRACTION THEREOF OF CURVE. THE TRACK SHALL BE CENTERED ON THE BRIDGE WITH A CLEARANCE OF NOT LESS THAN EIGHT (8) FEET SIX (6) INCHES OR MINIMUM REQUIRED BY A STATE, WHICHEVER IS GREATER.

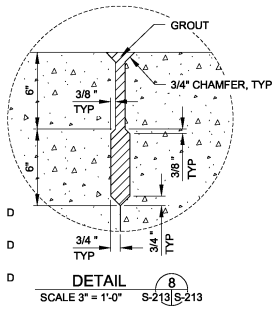
Kansas City Southern Lines / Kansas City Southern de México / Panama Canal Railway Company	**K.C.S. STANDARDS**	REVISIONS NO.:	DESCRIPTION:	BY:	DATE:	DRAWN BY:	APPROVED BY:	DATE:	**STEEL BEAM SPAN STEEL BALLAST DECK**	DRAWING NO. **BR-102**
						XX	XXX	2020		



TYPICAL SECTION

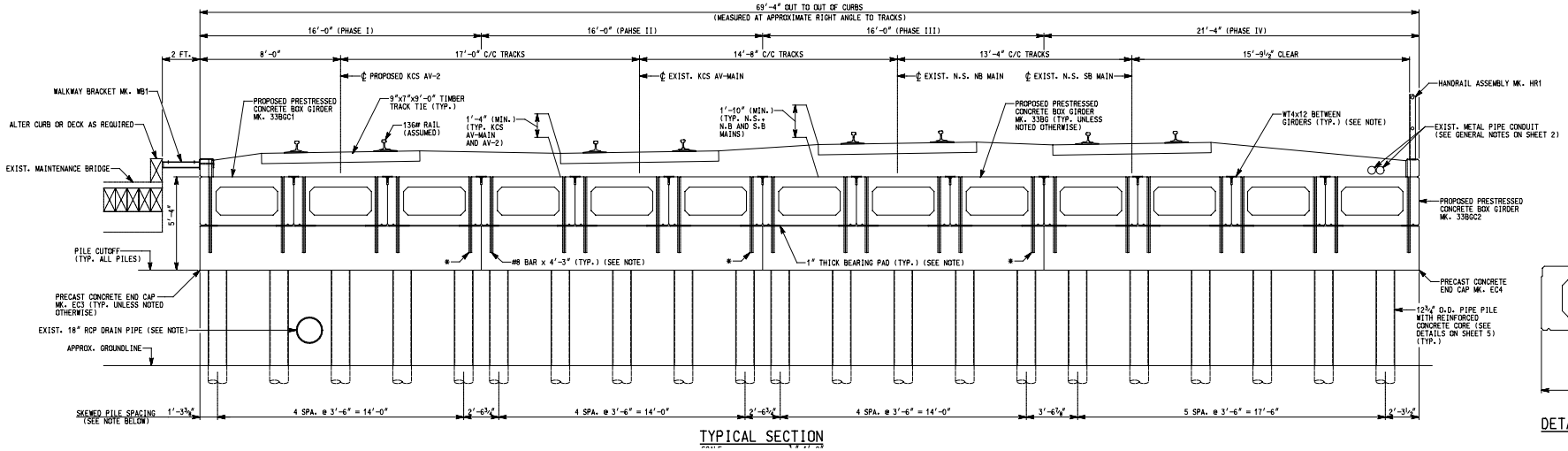


PARTIAL TYPICAL SECTION

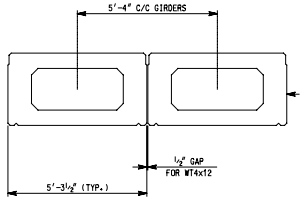


DETAIL 8 S-213 S-213
SCALE 3" = 1'-0"

ALTERNATIVE DESIGN 1



TYPICAL SECTION



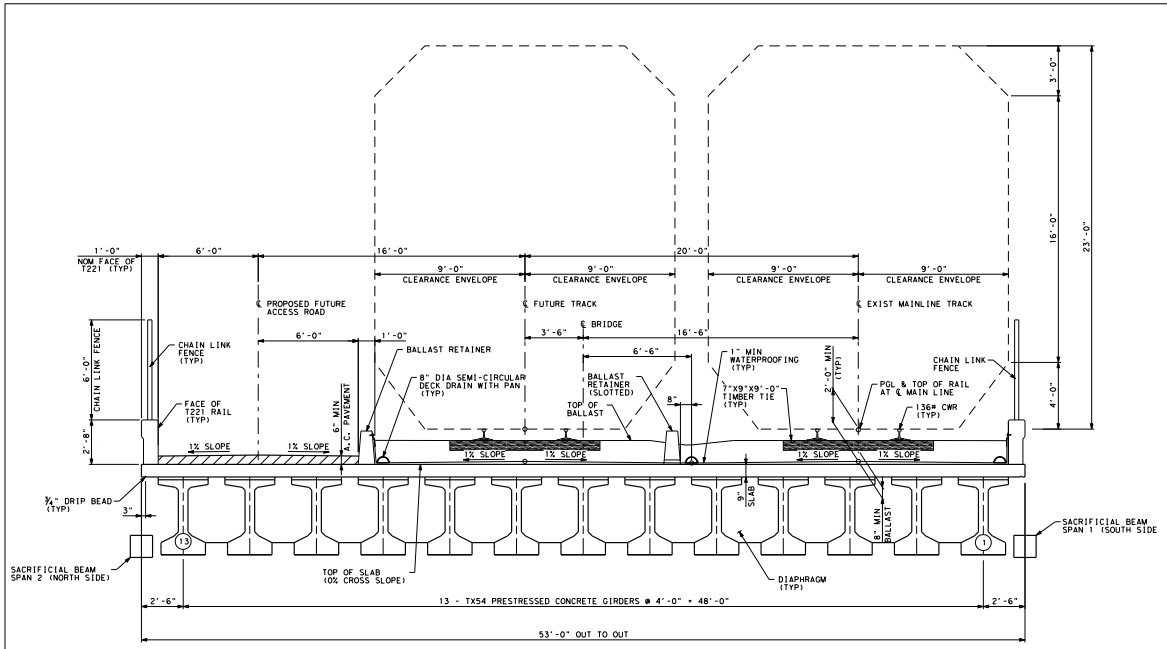
DETAILS OF GIRDER INSTALLATION

FOR SINGLE TRACK BRIDGE STRUCTURE ON TANGENT ALIGNMENT, THE DECK WIDTH SHALL BE NOT LESS THAN SEVENTEEN (17) FEET. IN CURVED TRACK THE DECK WIDTH SHALL BE INCREASED BY AN ADDITIONAL ONE AND ONE HALF (1.5) INCHES FOR EVERY DEGREE OR FRACTION THEREOF OF CURVE. THE TRACK SHALL BE CENTERED ON THE BRIDGE WITH A CLEARANCE OF NOT LESS THAN EIGHT (8) FEET SIX (6) INCHES OR MINIMUM REQUIRED BY A STATE, WHICHEVER IS GREATER.

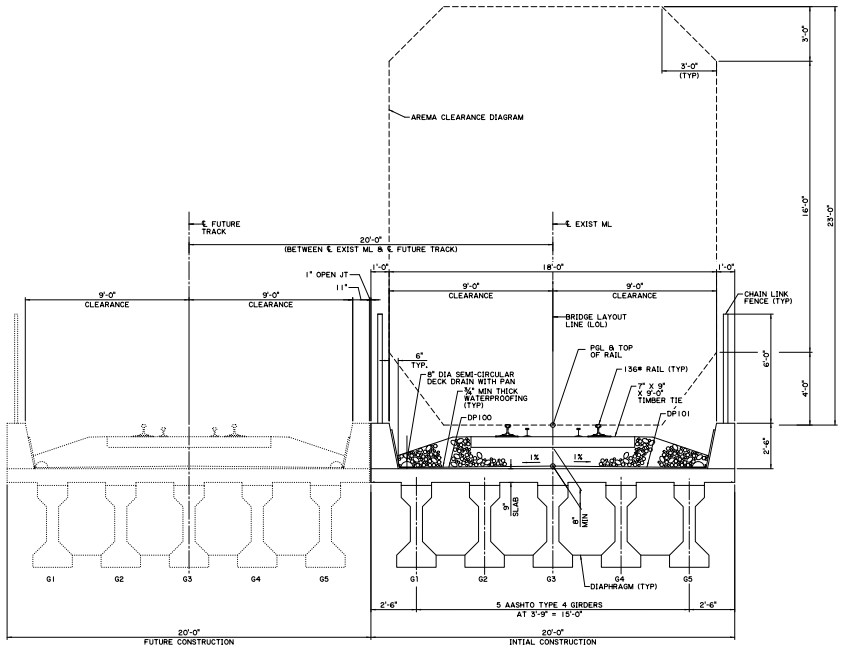
ALTERNATIVE DESIGN 2

ALTERNATIVE DESIGNS CAN BE PROPOSED FOR KCSR REVIEW AND APPROVAL

K.C.S. STANDARDS	REVISIONS NO.:	DESCRIPTION:	BY:	DATE:	DRAWN BY:	APPROVED BY:	DATE:	PRE-STRESSED PRE-CAST CONCRETE SINGLE CELL BOX GIRDER SPANS	DRAWING NO. BR-103
					XX	XXX	2020		



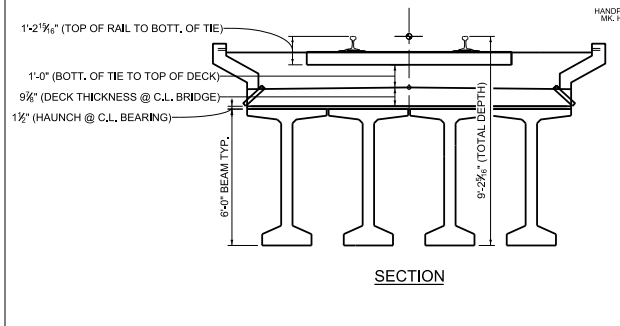
SPAN ALTERNATIVE 1



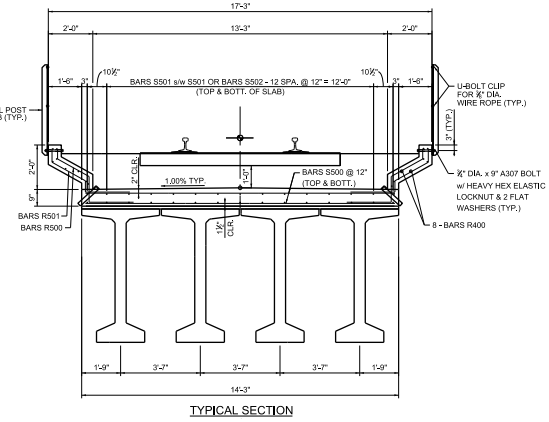
SPAN ALTERNATIVE 2

ALTERNATIVE DESIGNS CAN BE PROPOSED FOR KCSR REVIEW AND APPROVAL

FOR SINGLE TRACK BRIDGE STRUCTURE ON TANGENT ALIGNMENT, THE DECK WIDTH SHALL BE NOT LESS THAN SEVENTEEN (17) FEET. IN CURVED TRACK THE DECK WIDTH SHALL BE INCREASED BY AN ADDITIONAL ONE AND ONE HALF (1.5) INCHES FOR EVERY DEGREE OR FRACTION THEREOF OF CURVE. THE TRACK SHALL BE CENTERED ON THE BRIDGE WITH A CLEARANCE OF NOT LESS THAN EIGHT (8) FEET SIX (6) INCHES OR MINIMUM REQUIRED BY A STATE, WHICHEVER IS GREATER.

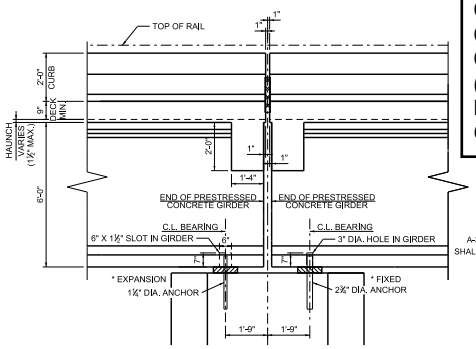


SECTION

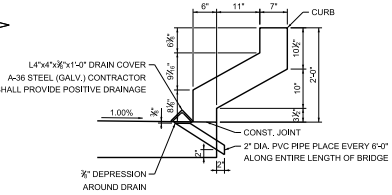


TYPICAL SECTION

SPAN ALTERNATIVE 3

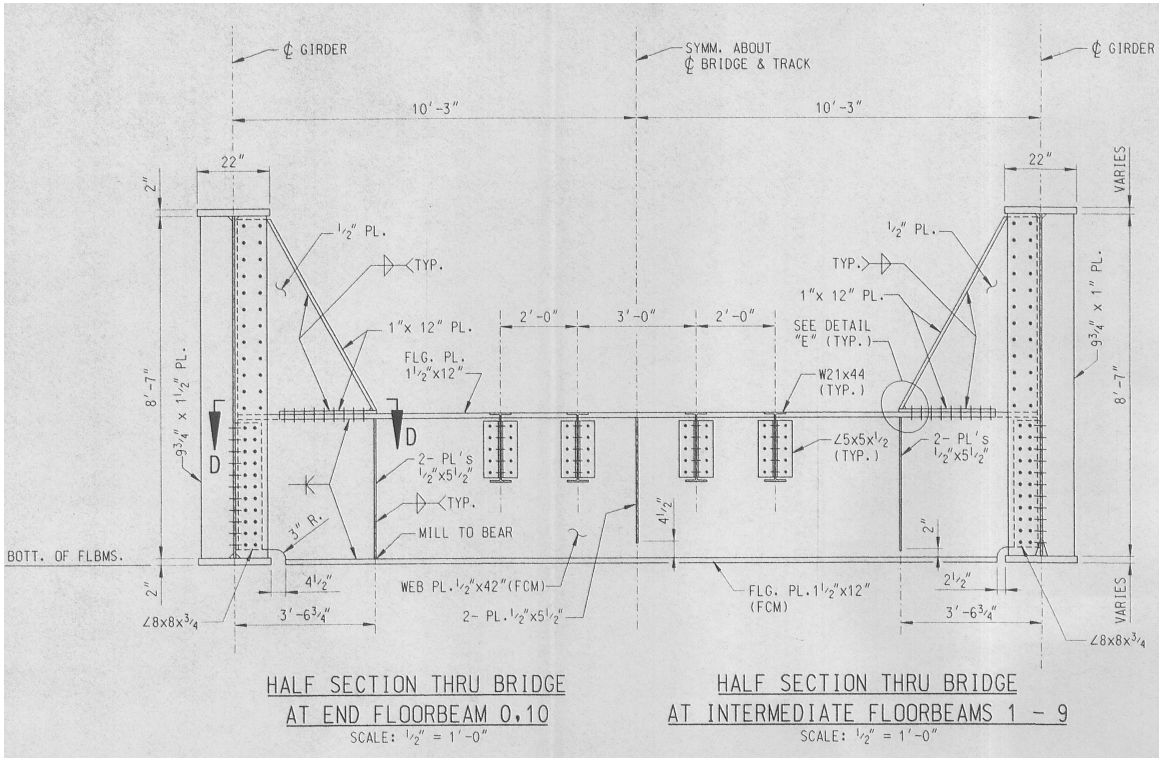


TYPICAL EXPANSION DETAIL



TYPICAL DRAINAGE DETAIL

K.C.S. STANDARDS	REVISIONS NO.:	DESCRIPTION:	BY:	DATE:	DRAWN BY:	APPROVED BY:	DATE:	PRE-STRESSED PRE-CAST AASHTO TYPE GIRDER SPANS	DRAWING NO. BR-104
					XX	XXX	2020		



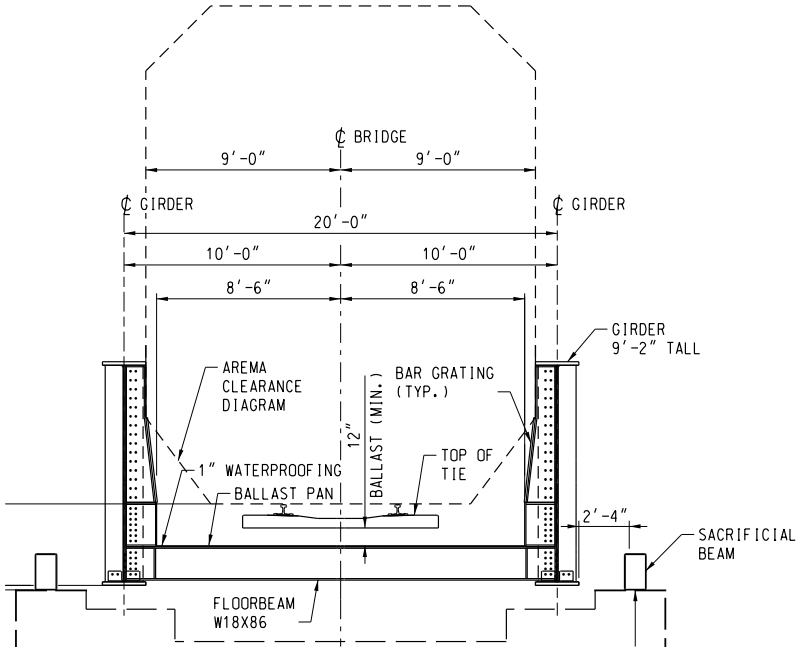
HALF SECTION THRU BRIDGE AT END FLOORBEAM 0,10

SCALE: ½″ = 1′-0″

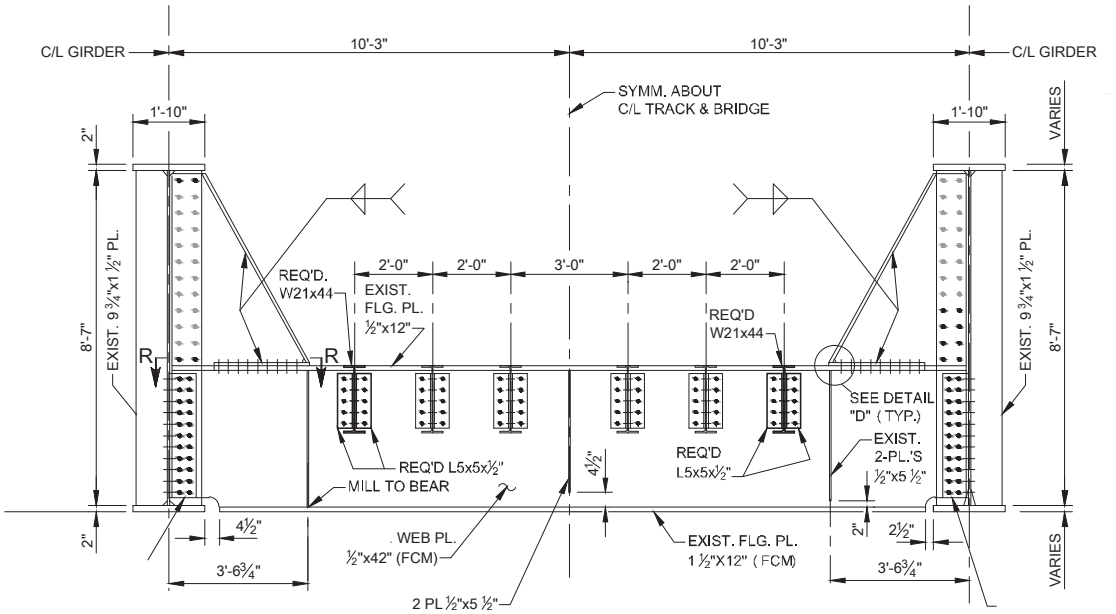
HALF SECTION THRU BRIDGE AT INTERMEDIATE FLOORBEAMS 1 – 9

SCALE: ½″ = 1′-0″

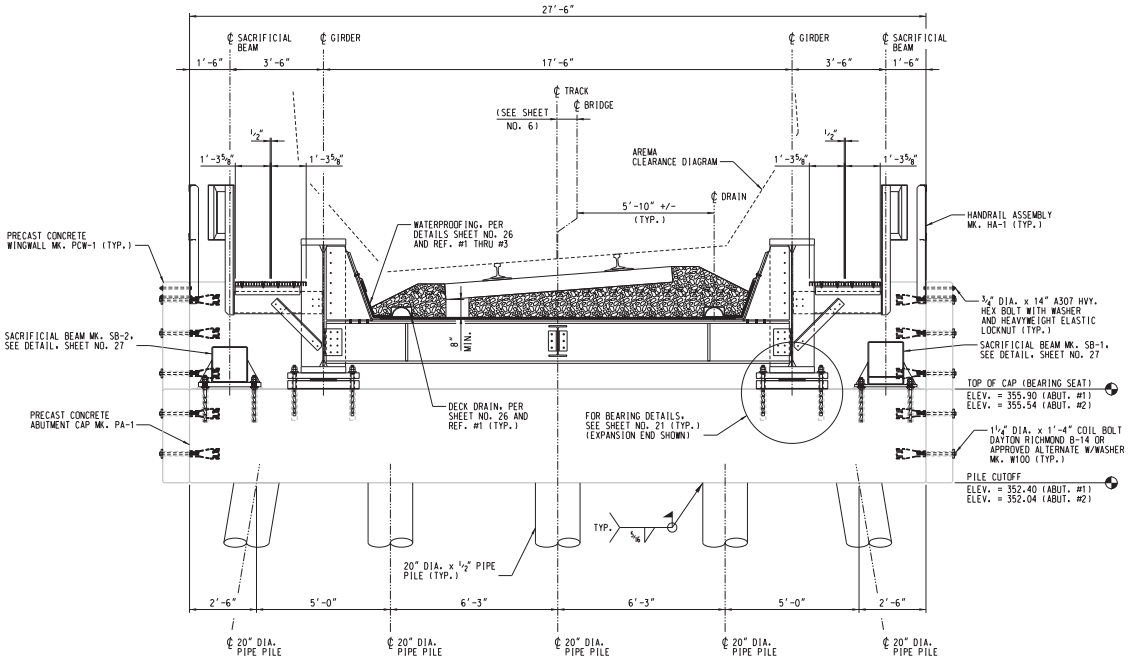
K.C.S. STANDARDS	REVISIONS			DRAWN BY:	APPROVED BY:	DATE:	STEEL THROUGH PLATE GIRDER SPAN OPEN DECK	DRAWING NO.
	NO.:	DESCRIPTION:	BY: DATE:					
				XX	XXX	2020		BR-108A



ALTERNATIVE 1 - SHALLOW PROFILE

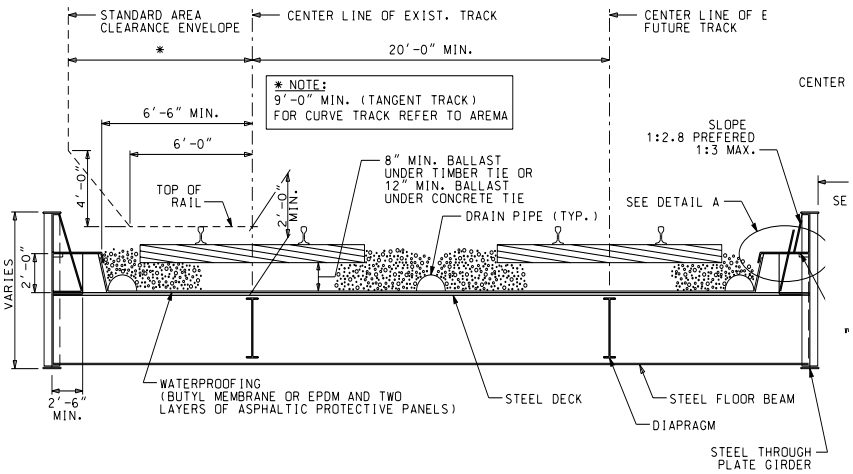


ALTERNATIVE 2 - FLOOR BEAM/STRINGER DESIGN



ALTERNATIVE 3 - SHALLOW PROFILE

FOR SINGLE TRACK BRIDGE STRUCTURE ON TANGENT ALIGNMENT, THE DECK WIDTH SHALL BE NOT LESS THAN SEVENTEEN (17) FEET. IN CURVED TRACK THE DECK WIDTH SHALL BE INCREASED BY AN ADDITIONAL ONE AND ONE HALF (1.5) INCHES FOR EVERY DEGREE OR FRACTION THEREOF OF CURVE. THE TRACK SHALL BE CENTERED ON THE BRIDGE WITH A CLEARANCE OF NOT LESS THAN EIGHT (8) FEET SIX (6) INCHES OR MINIMUM REQUIRED BY A STATE, WHICHEVER IS GREATER.

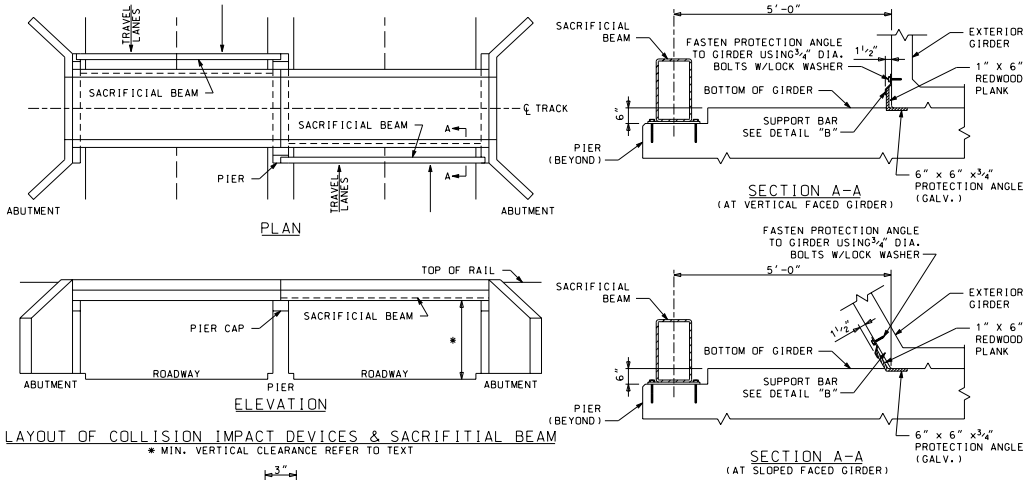


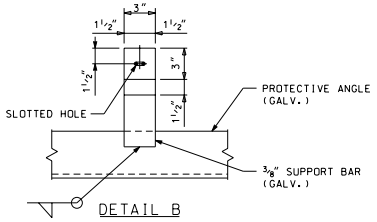
ALTERNATIVE 4 - SHALLOW PROFILE

REVISIONS							
NO.:	DESCRIPTION:	BY:	DATE:	DRAWN BY:	APPROVED BY:	DATE:	DRAWING NO.
				XX	XXX	2020	BR-108

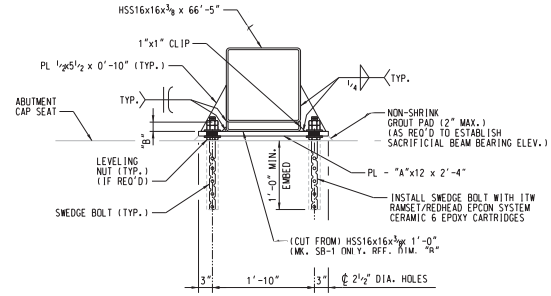
K.C.S. STANDARDS

STEEL THROUGH PLATE GIRDER
STEEL BALLAST DECK

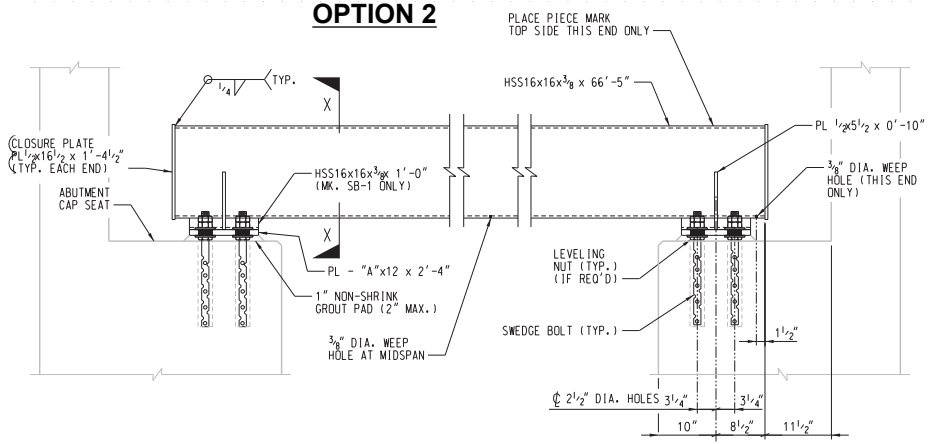




OPTION 1



OPTION 2



TYPICAL CRASH BEAM DETAILS

AREMA 2006 CHAPTER 8 ARTICLE 2.1.5.1 ADJACENT TO RAILROAD TRACKS:

1. TO LIMIT DAMAGE BY THE REDIRECTION AND DEFLECTION OF RAILROAD EQUIPMENT, PIERS SUPPORTING BRIDGES OVER RAILWAYS AND WITH A CLEAR DISTANCE OF 25 FEET (7600 MM) OR LESS FROM THE CENTERLINE OF A RAILROAD TRACK SHALL BE OF HEAVY CONSTRUCTION (DEFINED BELOW) OR SHALL BE PROTECTED BY A REINFORCED CONCRETE CRASH WALL.

2. CRASH WALLS FOR PIERS FROM 12 TO 25 FEET (3600 TO 7600 MM) CLEAR FROM THE CENTERLINE OF TRACK SHALL HAVE A MINIMUM HEIGHT OF 6 FEET (1800 MM) ABOVE THE TOP OF RAIL. PIERS LESS THAN 12 FEET (3600 MM) CLEAR FROM THE CENTERLINE OF TRACK SHALL HAVE A MINIMUM CRASH WALL HEIGHT OF 12 FEET (3600 MM) ABOVE THE TOP OF RAIL.

3. THE CRASH WALL SHALL BE AT LEAST 2'-6" (760 MM) THICK AND AT LEAST 12 FEET (3600 MM) LONG. WHEN TWO OR MORE COLUMNS COMPOSE A PIER, THE CRASH WALL SHALL CONNECT THE COLUMNS AND EXTEND AT LEAST 1 FOOT (300 MM) BEYOND THE OUTERMOST COLUMNS PARALLEL TO THE TRACK. THE CRASH WALL SHALL BE ANCHORED TO THE FOOTINGS AND COLUMNS, IF APPLICABLE, WITH ADEQUATE REINFORCING STEEL AND SHALL EXTEND TO AT LEAST 4 FEET (1200 MM) BELOW THE LOWEST SURROUNDING GRADE.

4. PIERS SHALL BE CONSIDERED OF HEAVY CONSTRUCTION IF THEY HAVE A CROSS-SECTIONAL AREA EQUAL TO OR GREATER THAN THAT REQUIRED FOR THE CRASH WALL AND THE LARGER OF ITS DIMENSIONS IS PARALLEL TO THE TRACK.

5. CONSIDERATION MAY BE GIVEN TO PROVIDING PROTECTION FOR BRIDGE PIERS OVER 25 FEET (7600 MM) FROM THE CENTERLINE OF TRACK AS CONDITIONS WARRANT. IN MAKING THIS DETERMINATION, ACCOUNT SHALL BE TAKEN OF SUCH FACTORS AS HORIZONTAL AND VERTICAL ALIGNMENT OF THE TRACK, EMBANKMENT HEIGHT, AND AN ASSESSMENT OF THE CONSEQUENCES OF SERIOUS DAMAGE IN THE CASE OF A COLLISION.

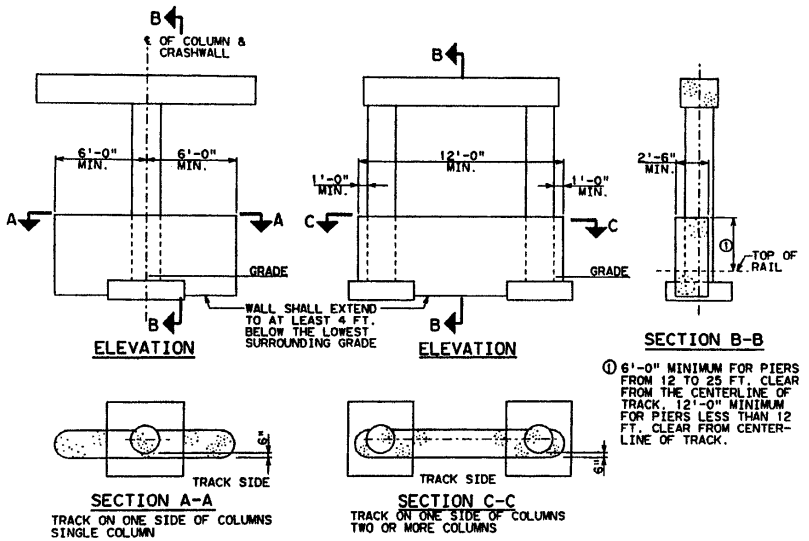
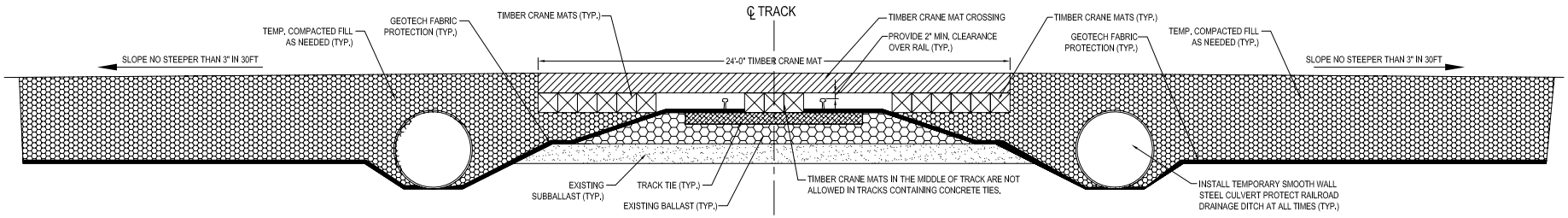


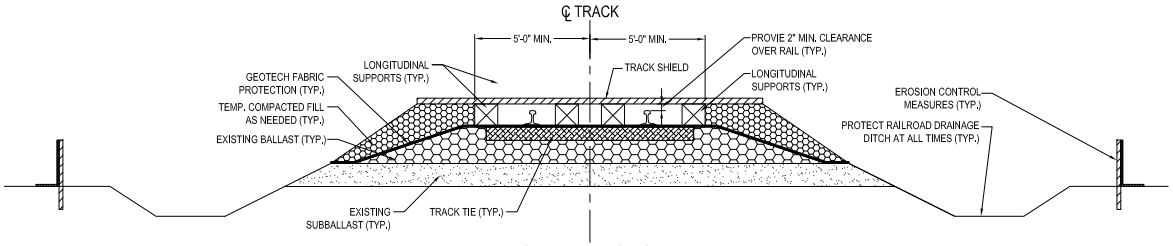
Figure 8-C-2-1. Pier Protection: Minimum Crash Wall Requirements (Not To Scale)

K.C.S. STANDARDS	REVISIONS NO.:	DESCRIPTION:	BY:	DATE:	DRAWN BY:	APPROVED BY:	DATE:	COLLISION IMPACT DEVICES CRASH BEAMS AND PIER PROTECTION WALL	DRAWING NO. BR-116
					XX	XXX	2020		



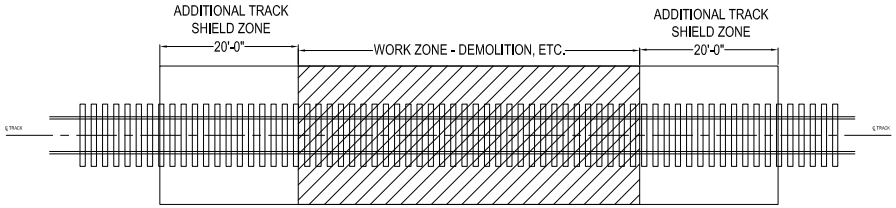
TEMPORARY CONSTRUCTION CROSSING

FOR TEMPORARY CROSSING OF CONSTRUCTION EQUIPMENT DURING:
BRIDGE CONSTRUCTION, DEMOLITION OF HEAVY OVERHEAD STRUCTURES, ETC.
USE ONLY UNDER A TRACK WINDOW



TEMPORARY TRACK SHIELD

FOR DEBRIS FALLING FROM OVERHEAD DURING:
DEMOLITION OF OH STRUCTURE, LIFTING CONSTRUCTION MATERIALS (DIRT OR SIMILAR, BEAMS, ETC.) OVER TRACK, ETC.
USE ONLY UNDER A TRACK WINDOW



TEMPORARY TRACK SHIELD - PLAN VIEW

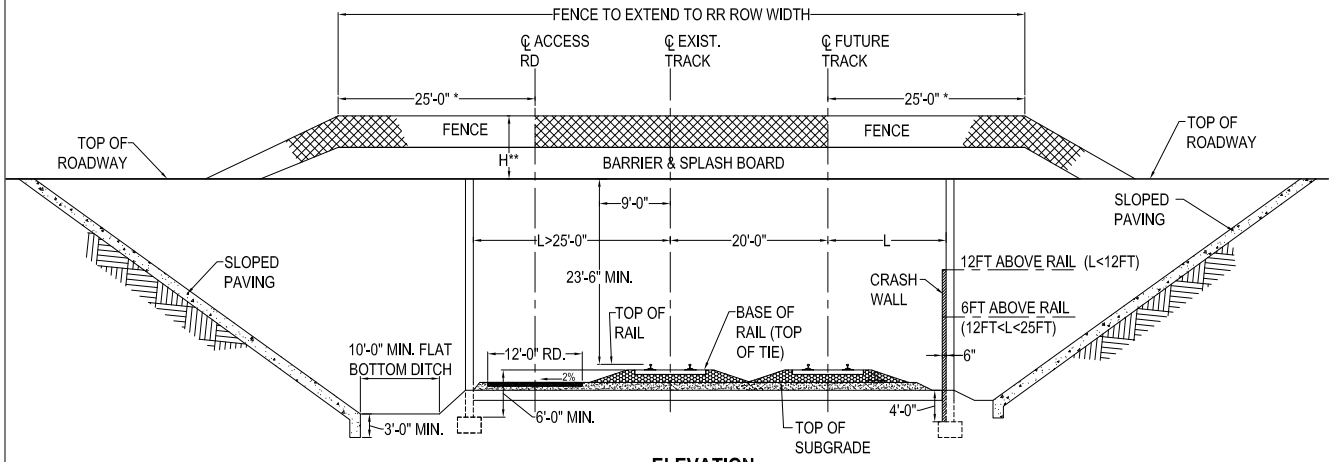
TEMPORARY TRACK SHIELD - NOTES

1. A FLAGMAN IS REQUIRED AT ALL TIMES DURING THE USE OF A TRACK SHIELD.
2. TRACK SHIELD SHALL BE DESIGNED BY THE CONTRACTOR AND SHALL BE OF SUFFICIENT STRENGTH TO SUPPORT THE ANTICIPATED LOADS, INCLUDING IMPACT. THE SHIELD SHALL PREVENT ANY MATERIALS, EQUIPMENT OR DEBRIS FROM FALLING ONTO THE RAILROAD TRACK. ADDITIONAL LAYERS OF MATERIAL SHALL BE FURNISHED AS NECESSARY TO PREVENT FINE MATERIALS OR DEBRIS FROM SIFTING DOWN UPON THE TRACK.
3. THE SHIELD SHOULD PREFERABLY BE PRE-FABRICATED AND FURNISHED WITH LIFTING HOOKS TO SIMPLIFY REMOVAL.
4. THE SHIELD SHALL BE OF SUFFICIENT STRENGTH TO SPAN BETWEEN IT'S SUPPORT WITHOUT BEARING UPON THE RAILS AND TO WITHSTAND THE FALL OF DEBRIS. A MINIMUM CLEARANCE OF 2" (TWO INCHES) ABOVE THE TOP OF RAIL SHALL BE PROVIDED.
5. BEFORE REMOVAL, THE SHIELD SHALL BE CLEANED OF ALL DEBRIS AND FINE MATERIAL.
6. THE TRACK SHIELD SHALL EXTEND AT LEAST 20'-0" (20 FEET) BEYOND THE LIMITS OF DEMOLITION TRANSVERSE TO THE EDGE OF THE BRIDGE AND ALONG THE TRACK.
7. LONGITUDINAL SUPPORT TIMBERS FOR THE SHIELD SHALL NOT EXTEND ABOVE THE TOP OF RAIL WHEN THE SHIELD IS REMOVED.
8. FOR TRAIN PASSAGE, TRACK SHIELD SHALL BE REMOVED AND FOREIGN DEBRIS SHALL BE REMOVED TO A MINIMUM DISTANCE OF 8'-6" (EIGHT FEET SIX INCHES)FROM THE NEAREST RAIL AND TO AN ELEVATION NO HIGHER THAN THE TOP OF RAIL.
9. AT THE END OF THE DAY, THE RUBBLE SHALL BE REMOVED COMPLETELY TO A MINIMUM OF 10'-0" FROM THE NEAREST RAIL AND DOWN TO ORIGINAL GRADE.
10. CARE SHALL BE TAKEN TO NOT PLACE METAL ACROSS THE TRACK RAILS. RAILROAD COMMUNICATIONS ARE SENT THROUGH THE RAILS AND WILL BE DISRUPTED BY A SHORT BETWEEN RAILS.
11. DETAILS SHOWN APPLY FOR TIMBER TIES. SPECIAL DETAILS ARE REQUIRED FOR CONCRETE TIES.

TEMPORARY CONSTRUCTION CROSSING - NOTES

1. A "TEMPORARY CROSSING PERMIT" MUST BE OBTAINED FROM KCSR PRIOR TO INSTALLATION OF THE CROSSING BY PAYING RESPECTIVE APPLICATION AND PERMIT FEES.
2. KCSR RESERVES THE RIGHT TO APPROVE OR REJECT THE CROSSING REQUEST.
3. A FLAGMAN IS REQUIRED AT ALL TIMES WHEN THE CROSSING IS IN USE.
4. TEMPORARY CONSTRUCTION CROSSING SHALL BE REMOVED IMMEDIATELY AFTER THE PASSAGE OF THE CONSTRUCTION EQUIPMENT.
5. THE TEMPORARY CROSSING SHALL BE OF SUFFICIENT STRENGTH TO SPAN BETWEEN IT'S SUPPORT WITHOUT BEARING UPON THE RAILS AND TO WITHSTAND THE INTENDED LOADS INCLUDING IMPACT. A MINIMUM CLEARANCE OF 2" (TWO INCHES) ABOVE THE TOP OF RAIL MUST BE PROVIDED.
6. TEMPORARY CONSTRUCTION CROSSING ON TRACK CONTAINING CONCRETE TIES ARE NOT ALLOWED UNLESS THE CROSSING MATS COMPLETELY CROSS THE TRACK STRUCTURE WITHOUT ANY INTERMEDIARY SUPPORTS.
7. TEMPORARY CONSTRUCTION CROSSINGS ARE NOT ALLOWED WHERE MULTIPLE TRACKS ARE PRESENT, IN RAIL YARDS, AT TURNOUTS AND CROSSOVERS, INSULATED JOINTS, INADEQUATE SIGHT DISTANCES, AND OTHER LOCATIONS WHERE KCSR DEEMS THE TEMPORARY CONSTRUCTION CROSSING TO BE UNSAFE.
8. CROSSING SHALL BE PRE-FABRICATED TO THE MAXIMUM EXTENT POSSIBLE AND FURNISHED WITH LIFTING HOOKS TO SIMPLIFY REMOVAL.
9. ALL MATERIALS FOR THE TEMPORARY CONSTRUCTION CROSSING SHALL BE THE SUPPLIED BY THE CONTRACTOR AT CONTRACTOR'S SOLE COST.
10. AFTER THE CONSTRUCTION OF THE CROSSING AND PRIOR TO ITS USE, APPROVAL BY KCSR OR ITS DESIGNATED PERSONNEL MUST BE OBTAINED. THIS PROCEDURE IS REQUIRED EVERY TIME THE CROSSING IS INSTALLED.
11. BEFORE REMOVAL, ALL MATERIALS PLACED FOR THE CROSSING SHALL BE COMPLETELY REMOVED AND THE AREA RESTORED TO ITS ORIGINAL CONDITION.
12. LONGITUDINAL SUPPORT TIMBERS FOR THE SHIELD SHALL NOT EXTEND ABOVE THE TOP OF RAIL WHEN THE SHIELD IS REMOVED.
13. CARE SHALL BE TAKEN TO NOT PLACE METAL ACROSS THE TRACK RAILS. RAILROAD COMMUNICATIONS ARE SENT THROUGH THE RAILS AND WILL BE DISRUPTED BY A SHORT BETWEEN RAILS.
14. IF THE TEMPORARY CONSTRUCTION CROSSING NEEDED FOR MULTIPLE DAYS, THE CROSSING MATS AND THEIR SUPPORTS SHALL BE COMPLETELY REMOVED AND STORED OUTSIDE THE KCSR ROW. ROAD APPROACHES CAN REMAIN IF IT DOESN'T INTERFERE WITH RAILROAD OPERATIONS, INSPECTIONS OR MAINTENANCE.
15. A TEMPORARY GATE OR BARRIER SHALL BE PLACED ACROSS THE ROAD AT A DISTANCE OF 15FT FROM THE NEAREST RAIL AND CLOSEDN AND LOCKED AT ALL TIMES WHEN THE CROSSING IS NOT IN USE.
16. ROAD APPROACHES TO THE TEMPORARY CROSSING SHALL BE IN ACCORDANCE WITH FRA, AREMA AND KCSR SPECIFICATIONS AND GUIDELINES.
17. ROAD APPROACHES SHALL NOT FALL GREATER THAN 3" (THREE INCHES) IN 30FT (THIRTY FEET) MEASURED FROM THE EDGE OF THE TRACK TIES.
18. REQUEST SHALL PROVIDE KCSR WITH THE DURATION FOR WHICH THE CROSSING WILL BE IN SERVICE.
19. TO THE EXTENT POSSIBLE, KCSR WILL ATTEMPT TO SUPPORT THE DATES REQUESTED; HOWEVER, KCSR MAKES NO GUARANTEES AND RESERVES THE RIGHT TO MODIFY THE REQUESTED DATES.
20. THE LOCATION OF THE TEMPORARY CROSSING SHALL BE APPROVED BY KCSR PERSONNEL OR THE KCSR AUTHORIZED REPRESENTATIVE.
21. GEOTEXTILE FABRIC SHALL BE PLACED UNDERNEATH THE EARTH FILL APPROACHES SO AS TO NOT DAMAGE THE RAILROAD RIGHT-OF-WAY. ANY DAMAGE TO THE RIGHT-OF-WAY SHALL BE RESTORED TO ITS ORIGINAL CONDITION AT THE END OF THE PROJECT AT NO COST TO KCSR.

K.C.S. STANDARDS	REVISIONS			DRAWN BY:	APPROVED BY:	DATE:	TEMPORARY TRACK SHIELD AND TEMPORARY CONSTRUCTION CROSSING	DRAWING NO.
	NO.:	DESCRIPTION:	BY: / DATE:					
	1	UPDATED DETAILS	SVH / APR. 2020					
				XX	XXX	2007		BR-117

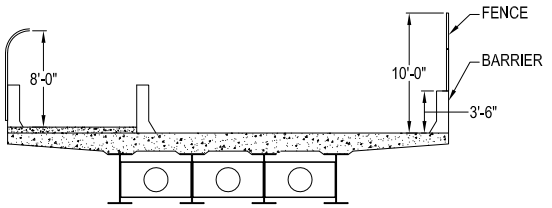


ELEVATION

(PERPENDICULAR TO THE TRACKS)

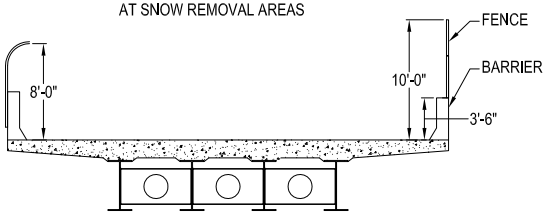
* FENCES, SPLASHBOARDS, SOLID BARRIERS (IF REQUIRED) SHALL EXTEND 25FT BEYOND CENTERLINE OF OUTER MOST TRACK OR ACCESS ROADWAY.

** HEIGHT OF FENCE SHALL BE 8FT WHEN CURVED AND 10FT WHEN VERTICAL



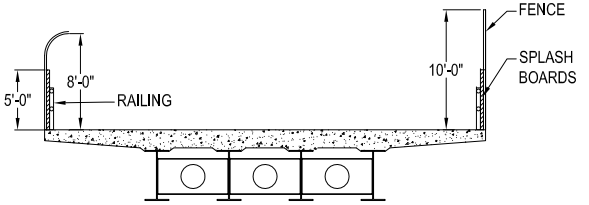
RAILROAD SAFETY FENCING

(PERPENDICULAR TO THE ROAD)
AT SNOW REMOVAL AREAS



RAILROAD SAFETY FENCING

(PERPENDICULAR TO THE ROAD)
AT SNOW REMOVAL AREAS



RAILROAD SAFETY FENCING

(PERPENDICULAR TO THE ROAD)
SPLASH BOARDS AT SNOW REMOVAL AREAS

GENERAL

1. FENCE SHALL BE PROVIDED AS INDICATED ON THE CROSS SECTIONS AND ELEVATION VIEW ON BOTH SIDES OF THE VIADUCT IN ALL NEW OR MODIFIED STRUCTURES.
2. SPLASHBOARDS OR SOLID 3'-6" HIGH BARRIER RAIL SHALL BE PROVIDED AS INDICATED ON THE CROSS SECTIONS AND ELEVATION VIEW ON BOTH SIDES OF THE VIADUCT IN ALL NEW OR MODIFIED STRUCTURES WHERE SNOW REMOVAL IS BEING PERFORMED.
3. LIGHTS ARE TO BE INSTALLED ON THE UNDERSIDE OF THE VIADUCT WHERE SHADOWS CAST BY THE STRUCTURE WOULD INTERFERE WITH RAILROAD OPERATIONS.
4. SLOPE PAVING SHALL BE PROVIDED WHERE END SLOPES EQUAL TO, OR EXCEED, 2 HORIZONTAL TO 1 VERTICAL..
5. FALSEWORK FOR CONSTRUCTION OF OVERHEAD STRUCTURES SHALL COMPLY TO AREMA GUIDELINES.
6. DEMOLITION OF EXISTING OVERHEAD STRUCTURES SHALL COMPLY TO KCSRC GUIDELINES.
7. TEMPORARY SHORING SHALL BE DESIGNED IN ACCORDANCE WITH KCSRC SHORING REQUIREMENTS.
8. CONTACT KCSRC' S "CALL BEFOR YOU DIG" AT LEAST 48 HOURS PRIOR TO COMMENCING WORK TO DETERMINE LOCATION OF FIBER OPTICS.
9. CONTRACTOR SHALL BE RESPONSIBLE FOR IDENTIFICATION LOCATION AND PROTECTION OF EXISTING UTILITIES.
10. EXCEPTIONS TO THESE STANDARDS MUST BE APPROVED BY KCSR'S CHIEF ENGINEER DESIGN.

CLEARANCES

1. MINIMUM VERTICAL CLEARANCE SHALL BE 23'-6" ABOVE THE PLANE OF TOP-OF-RAILS. 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.
2. MINIMUM HORIZONTAL CLEARANCES, MEASURED AT RIGHT ANGLE FROM CENTERLINE OF TRACK, SHALL BE AS SHOWN IN ELEVATION VIEW.
3. CONSTRUCTION CLEARANCES SHALL BE 22 FEET VERTICAL ABOVE THE PLANE OF TOP-OF-RAILS AND 14 FEET HORIZONTAL AT RIGHT ANGLE FROM CENTERLINE OF THE TRACK.

FUTURE TRACKS

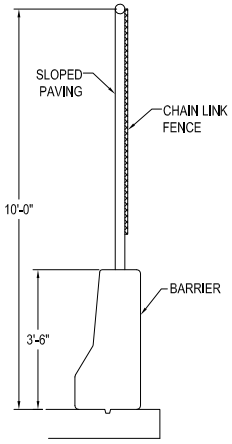
1. SPACE IS TO BE PROVIDED FOR ONE OR MORE FUTURE TRACKS AS REQUIRED FOR LONG RANGE PLANNING OR OTHER OPERATING REQUIREMENTS. WHERE PROVISION IS MADE FOR MORE THAN TWO TRACKS, SPACE IS TO BE PROVIDED FOR ACCESS ROAD ON BOTH SIDES OF TRACK.
2. PIERS PIER PROTECTION WALLS SHALL BE PROVIDED IN ACCORDANCE WITH AREMA, CHAPTER 8.
3. TOP OF FOOTINGS WITHIN 25 FT. FROM CENTERLINE OF TRACK SHALL BE A MINIMUM OF 6 FEET BELOW BASE OF RAIL AND A MINIMUM OF 1 FOOT BELOW FLOW LINE OF DITCH.

DRAINAGE

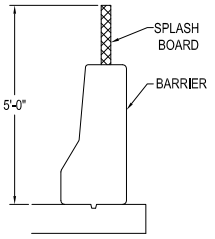
1. DRAINAGE FROM THE OVERPASS SHALL BE DIVERTED AWAY FROM KCSRC'S TRACKS AND NOT DISCHARGED ONTO THE TRACKS OF ROADBED.
2. A STANDARD FLAT-BOTTOM DITCH SHALL BE PROVIDED ON EACH SIDE OF THE TRACKS AS NECESSARY. IN SOME CASES A "V" DITCH CAN BE PROVIDED WITH THE APPROVAL OF KCSR.
3. CULVERTS MAY BE INSTALLED ON OPPOSITE SIDE OF COLUMN FROM TRACK DITCHES WHEN APPROVED BY CHIEF ENGINEER DESIGN. MAINTENANCE OF CULVERTS IS TO BE AT APPLICANT'S EXPENSE

CRASH WALL

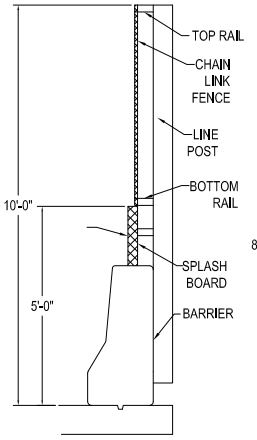
1. CRASH WALL SHALL BE BUILT IN ACCORDANCE WITH THE REQUIREMENTS OF AREMA CHAPTER 8.
2. CRASH WALL (PIER PROTECTION WALL) SHALL BE PROVIDED TO PROTECT PIERS AND COLUMNS SUPPORTING THE OVERHEAD STRUCTURE WHEN IT IS LOCATED WITHIN TWENTY-FIVE (25) FEET FROM THE CENTERLINE OF THE NEAREST TRACK.
3. CRASH WALL SHALL BE 12FT ABOVE THE TOP OF RAIL WHEN PIERS AND COLUMNS ARE WITHIN 12 (TWELVE) FEET FROM THE CENTERLINE OF THE NEAREST TRACK.
4. CRASH WALL SHALL BE 6FT ABOVE THE TOP OF RAIL WHEN PIERS AND COLUMNS ARE BETWEEN TWENTY-FIVE (25) FEET AND 12 (TWELVE) FEET FROM THE CENTERLINE OF THE NEAREST TRACK.
5. FOUNDATIONS FOR THE CRASH WALL SHALL BE AT LEAST FOUR (4) FEET BELOW THE GROUND LEVEL AT THE LOCATION OF THE CRASH WALL.
6. FOR SINGLE COLUMN, THE MINIMUM CROSS-SECTIONAL AREA IS THIRTY (30) SQUARE FEET (12 FEET IN LENGTH X 2.5 FEET IN WIDTH = 30 SQUARE FEET).
7. COLUMNS WITH THIRTY (30) SQUARE FEET OF AREA MUST HAVE THE LARGER DIMENSION PARALLEL TO THE TRACK (SUCH AS A FIVE (5) FOOT X SIX (6) FOOT COLUMN WITH THE SIX (6) FOOT DIMENSION PARALLEL TO THE TRACK IS CONSIDERED AS HEAVY CONSTRUCTION COLUMN).
8. ROUND COLUMNS MAY NOT MEET THE HEAVY CONSTRUCTION CRITERIA.



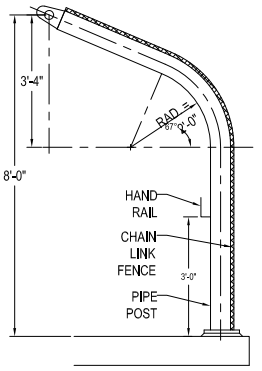
BARRIER WITH FENCE
NO SCALE



BARRIER WITH SPLASHBOARD
NO SCALE



BARRIER WITH SPLASHBOARD AND FENCE
NO SCALE



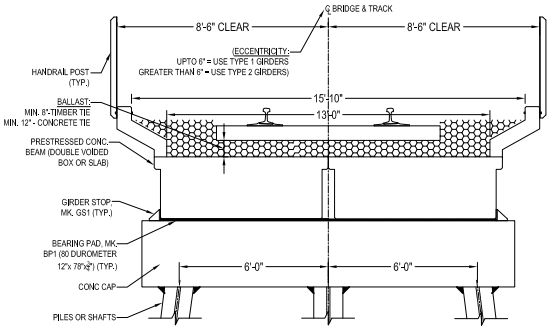
FENCE FOR WALKWAYS
NO SCALE

K.C.S. STANDARDS

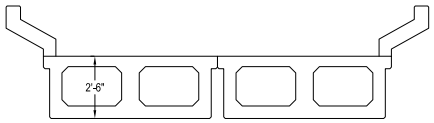
REVISIONS				DRAWN BY:	APPROVED BY:	DATE:
NO.:	DESCRIPTION:	BY:	DATE:			
				XX	XXX	2020

TRACK CLEARANCES, CRASHWALLS, RAILROAD SAFETY FENCING

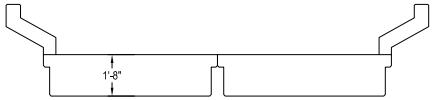
DRAWING NO. **BR-120**



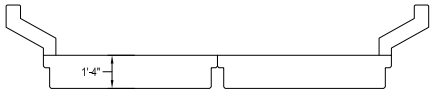
TYPICAL CONCRETE GIRDER BENT



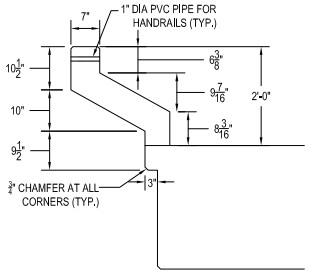
30" DEEP DOUBLE VOIDED PRESTRESSED BOX BEAM:
MAXIMUM SPAN LENGTH = 34FT



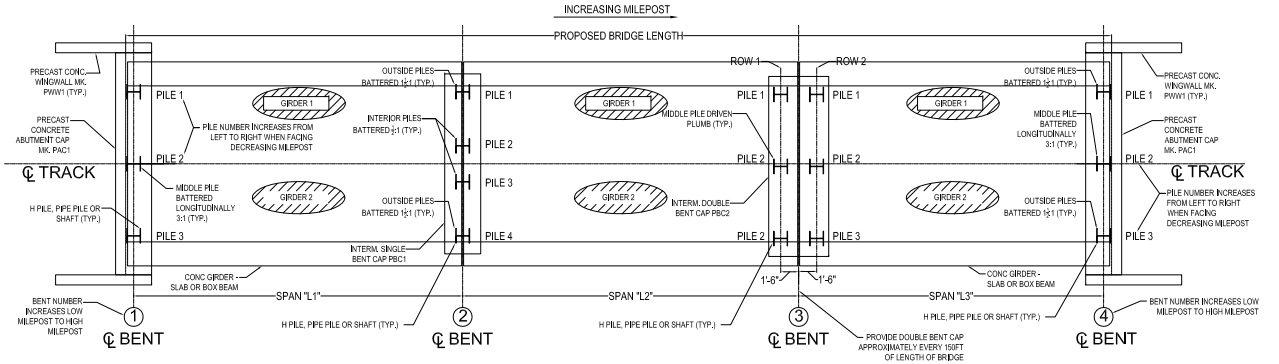
20" DEEP PRESTRESSED SLAB BEAM:
MAXIMUM SPAN LENGTH = 25FT



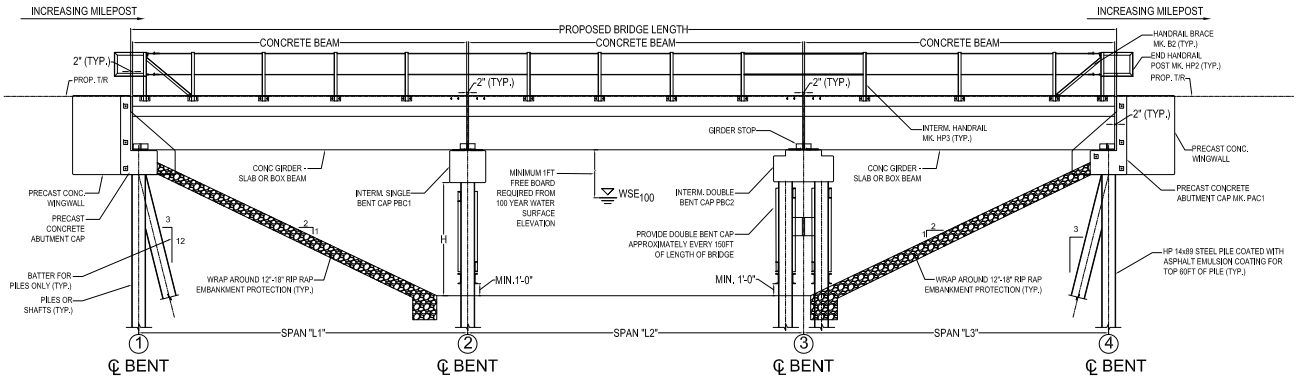
16" DEEP PRESTRESSED SLAB BEAM:
MAXIMUM SPAN LENGTH = 18FT



FLARED CURB DETAILS



TYPICAL PLAN VIEW



TYPICAL ELEVATION VIEW

K.C.S. STANDARDS	REVISIONS NO.:	DESCRIPTION:	BY:	DATE:	DRAWN BY:	APPROVED BY:	DATE:	CONCRETE GIRDER STANDARDS	DRAWING NO. BR-??
					XX	XXX	2020		