TABLE OF CONTENTS ~ PRELIMINARY

3.2.4 Railroad crossings

The following articles are intended to provide guidance for obtaining agreements with the railroad for constructing within their right-of-way (ROW). Each project is unique and early coordination with the railroad regarding their design requirements and guidelines will help in the design process for grade separation structures. All Iowa DOT projects involving railroads should be coordinated at the concept stage through the Office of Rail Transportation.

The design requirements and guidelines for grade separation structures over the Burlington Northern Santa-Fe (BNSF) Railway and Union Pacific Railroad (UP) may be different than other railroad crossings. The requirements for railroads will vary depending upon ownership. For the purpose of preliminary bridge design of overhead structures, the guidelines are divided into two groups: BNSF and UP ownership, and Non-BNSF and UP ownership. The sections covering submittals and underpass structures will apply to BNSF, UP and other railroads.

For preliminary design of railroad crossings, federal funding limitations should be considered. Federal funding will not include costs associated with improvements that increase the cost of the bridge above the limits specified in the Code of Federal Regulations (CFR 646). Considerations include the level of commitment for future track expansion, vertical and horizontal clearances, and berm placement location. In general, it is Iowa DOT policy to accommodate the railroad's requirements unless a significant cost will be incurred. In some cases, two bridge TS&Ls may be required to determine the limit of federal participation for a project.

3.2.4.1 BNSF and UP overhead structures

The guidelines provided within this section are intended for overhead grade separation projects impacting the BNSF and UP Railroads. The requirements and guidelines generally follow BNSF and UP Railroad guidelines, but are applied from an Iowa DOT project development perspective. For additional information and detail, the designer may refer to sections 1, 2, 3, 4 and 5 of BNSF-UP's *Guidelines for Railroad Grade Separation Projects* [BDM 3.1.5.2], AREMA's *Manual for Railway Engineering* [BDM 3.1.5.2], and any applicable sections of the AASHTO LRFD Specifications.

3.2.4.1.1 Vertical clearance

The minimum vertical clearance from the top of rail elevation to low beam is 23'-4". The BNSF and UP Railroads also request a 23'-4" vertical clearance for a distance 25 feet left and right of the centerline of track. Additional vertical clearance may also be requested by the railroad for correction of a sag in the track, construction requirements, and future track raises. To assist the railroad in evaluating the site specific needs, the profile of the existing top-of-rail, measured 1000 feet each side of proposed overhead structure, shall be shown on the standard sheet [OBS SS 1067].

Federal funding limits may not allow for participation in the additional project costs associated with the desired 50 foot wide vertical clearance envelope and additional clearance for future track raises. However, it is Iowa DOT policy to accommodate the requested clearances unless a significant expense will be incurred. Iowa DOT requests for variance to these desired additional clearances should be limited to these cases.

3.2.4.1.2 Horizontal clearance

The need to accommodate future track and/or access road must be coordinated with the Office of Rail Transportation in advance of establishing horizontal clearances for the bridge layout. These needs and requirements should be coordinated at the project concept stage, as they are a fundamental part of the bridge and roadway design development. Once the requirements for track and access road elements have been determined, the designer will be able to proceed to the next step of establishing pier and berm locations.

The BNSF and UP Railroads prefer all piers (including pier caps) and abutments to be located outside the railroad right-of-way. If this is not feasible, all piers and abutments should be located at least 25 feet measured perpendicular from centerline of nearest existing or future track. In unique situations and subject to site conditions, the absolute minimum horizontal clearance requiring special review and approval by the railroad shall be 18 feet measured perpendicular from the centerline of the track to the face of the pier protection wall.

Note that pier placement at the right-of-way line may also require an associated shifting of the bridge berm. Since the berm location determines the bridge length, shifting the berm out to the right-of-way may result in a bridge exceeding the length and cost allowed for federal participation. The cost difference may need to be provided to FHWA to determine the appropriate level of funding.

3.2.4.1.3 Piers

Piers within 25 feet, measured perpendicular from centerline of existing or anticipated future track shall be of heavy construction as defined in the AREMA Manual for Railway Engineering. Generally, for new bridges the office prefers the T-pier to satisfy heavy construction requirements in lieu of a pier protection wall. Top of pier footings located within 25 feet from centerline of track shall be a minimum of 6 feet below base of rail and a minimum 1 foot below the flow line of the ditch.

3.2.4.1.4 Bridge berms

It is the Iowa DOT policy to set the bridge berm location in accordance with the federal requirements. FHWA has indicated that full funding participation applies when the location of a bridge berm with a 2.5:1 slope is set at the top of rail elevation 26 feet from centerline of the outermost track (27.5 feet for 3:1 berm slope).

This method of setting the berm location provides for a small ditch sufficient for ballast to drain. Additional ditch drainage may require a culvert through the bridge berms to adequately convey the drainage. If a culvert is proposed, it must be analyzed to meet the BNSF and UP hydraulic design criteria summarized in the drainage section below.

Macadam stone slope protection should be proposed on the bridge berms. The railroad standard shows the slope protection terminating at the bottom of drainage ditch and must have a cut-off wall to protect the

slope from scour/erosion. In all cases, the toe of slope shall be below the finished track or roadway sub-grade.

3.2.4.1.5 Drainage

Railroad corridors are constructed with a drainage system designed to keep runoff away from the tracks and ballast. The proposed construction shall safely pass high flows and not inhibit low flows. A complete hydrologic and hydraulic study is required whenever new or additional drainage is added to the railroad right of way, or when a drainage structure is scheduled to be added, removed, or replaced. The drainage report and support documentation must include hydraulic data (EGL, water surface elevations, and velocities) for both the existing and proposed conditions. If the proposed bridge structure will not change the quantity and characteristics of the flow in railroad ditches and drainage structures, the plan shall include a general note stating so.

The BNSF and UP Railroad standard provides for an open ditch under a bridge to convey drainage. An open ditch results in a longer bridge as compared to setting the berm per FHWA requirements. As a result of the funding limitations, it is the Iowa DOT policy to propose a culvert to convey the railroad ditch drainage through the bridge berm in lieu of an open ditch whenever possible. The BNSF and UP Railroads have indicated that they will consider the acceptability of a culvert as a variance to their standard, but only if it can be demonstrated that the design Q_{100} headwater elevation will not rise above the sub-grade elevation (2'-3 below base of rail), and the design Q_{50} headwater elevation will rise no higher than the "low chord". Low chord is defined as the crown of the culvert.

If use of a culvert is found to be unacceptable in terms of meeting the railroad hydraulic design criteria, the railroad standard flat-bottom or V-shaped drainage ditch should be incorporated. FHWA will make a case by case determination relative to their participation for funding of the additional bridge length required to accommodate the open ditch for this situation.

3.2.4.1.6 Barrier rails and fencing

Early coordination with the railroad regarding recommendations for barrier rail and fencing is desired.

On sidewalk or trail facilities the top of the fence should be curved to discourage climbing. A minimum 8-foot vertical clearance should be provided for the full clear width of the trail or sidewalk. To prevent surface water from draining onto the railroad right of way, a one-foot parapet is required.

Fencing is also requested by the BNSF and UP on top of barrier rail on overhead structures without sidewalks or trails. Due to traffic safety concerns related to fencing on top of roadway barrier rail, the Iowa DOT generally proposes to the railroad that the fencing be omitted and that a 44-inch barrier rail be provided to control the amount of snow and debris falling onto the track. This proposal is subject to site specific review and variance by the railroad.

The 44-inch barrier rail and railroad fence requirements should be carried at a minimum to the limits of the railroad right-of-way or 25 feet beyond the centerline of track, future track or access road, whichever is greater. Barrier and fence may be reduced back to a more standard configuration on the bridge once the railroad minimum requirements have been met. The bridge final designer will determine based on cost and constructability whether it is more economical to keep the fence and rail uniform for the full length of the bridge or to taper back as soon as allowable.

3.2.4.2 Non-BNSF and -UP overhead structures

The guidelines provided within this section are intended for overhead grade separation projects impacting non-BNSF and UP Railroads. The requirements and guidelines for each railroad may be different, but generally follow AREMA's *Manual for Railway Engineering* [BDM 3.1.5.2] and any applicable sections of the AASHTO LRFD Specifications.

3.2.4.2.1 Vertical clearance

The preferred minimum vertical clearance from the top of rail elevation to low beam is 23'-4 directly above the rail.

3.2.4.2.2 Horizontal clearance

The need to accommodate future track and/or access road and the determination of applicable rail company guidelines for horizontal clearance must be coordinated with the Office of Rail Transportation. These needs and requirements should be coordinated at the project concept stage, as they are a fundamental part of the bridge and roadway design development. Once the design criteria for track and access road elements have been determined, the designer will be able to proceed to the next step of establishing pier and berm locations.

It is desirable to provide pier (including pier caps) and abutment locations at least 25 feet measured perpendicular from the centerline of nearest existing or future track. In unique situations and subject to site conditions, the preferred minimum horizontal clearance shall be 18 feet measured perpendicular from the centerline of the track to the face of the pier protection wall. Horizontal clearance less than 18 feet may be allowed on a case by case basis, if approved by the railroad.

3.2.4.2.3 Piers

Piers within 25 feet, measured perpendicular from centerline of existing or anticipated future track shall be of heavy construction as defined in the AREMA Manual for Railway Engineering. Generally, for new bridges the office prefers the T-pier to satisfy heavy construction requirements in lieu of a pier protection wall.

Top of pier footings shall be a minimum of one foot below finished ground line.

3.2.4.2.4 Bridge berms

It is the Iowa DOT policy to set the bridge berm location in accordance with the federal requirements. FHWA has indicated that full participation applies when the location of a bridge berm with a 2.5:1 slope is set at the top of rail elevation 26 feet from centerline of the outermost track (27.5 feet for 3:1 berm slope).

This method of setting the berm location provides for a small ditch sufficient for ballast to drain. Additional ditch drainage may require a culvert through the bridge to adequately convey the drainage.

Macadam stone slope protection should be proposed on the bridge berms.

3.2.4.2.5 Drainage

Railroad corridors are constructed with a drainage system designed to keep runoff away from the tracks and ballast. If drainage must be carried through the approach fills, this should be accomplished by using a culvert, not by using an open ditch which increases the bridge length and cost. If the proposed bridge structure will not change the quantity and characteristics of the flow in railroad ditches and drainage structures, the plan shall include a general note stating so.

3.2.4.2.6 Barrier rails and fencing

Early coordination with the railroad regarding recommendations for barrier rail and fencing is desired.

Most of the railroad bridges carrying vehicular traffic will make use of the F-shape barrier rail. The designer shall determine the appropriate barrier rail height by consulting the Iowa DOT policy for bridge rail height. See BDM 5.8.1.1.1 and BDM 5.8.1.2.1.

Fencing shall be provided for the full length of bridge on all sidewalk or trail facilities. The standard 6-foot high chain link fence is generally proposed.

On a case by case basis, there may be an alternative to rail or fence proposed. Reasons may include a request by the railroad or project aesthetics. A statement shall be included with the TS&L submittal to the Iowa DOT Office of Rail Transportation, relative to the proposal for barrier rail and fencing.

3.2.4.3 Underpass structures

Requirements for railroad underpass structures will follow the recommendations and guidelines applicable to the railroad company owner. Contact the Iowa DOT Office of Rail Transportation for coordination of applicable standards at the concept level of project development. Early coordination is necessary, as some railroad structures (including BNSF and UP) will require additional vertical clearance as compared to highway grade separation structures.

Once the proper design guidelines have been identified, the preliminary bridge design effort may be initiated. Special attention should be given to minimize project impacts on the railroad company service. If new alignment is not feasible or if staging is not agreeable to the railroad company, a shoofly bridge may be considered. All options shall be closely coordinated with the Iowa DOT Office of Rail Transportation.

3.2.4.4 Submittals

After TS&L completion, the Preliminary Bridge Section Leader will make the following documentation available to the Iowa DOT Office of Rail Transportation for submittal to the railroad:

(1) A response to railroad review comments on the concept submittal.
(2) A pdf file of the bridge TS&L.
(3) The site drainage report, if drainage is affected.
(4) A bridge plan view showing the location of the proposed shoofly (only for railroad underpass bridges).
(5) If the project will be constructed in stages, controlling dimensions should be included on the TS&L.
(6) For BNSF and UP RR submittals (See BDM C3.2.4.4).