

# NORFOLK SOUTHERN CORPORATION

## OVERHEAD GRADE SEPARATION DESIGN CRITERIA

### I. CLEARANCES

#### A. Permanent Clearances

1. Permanent Clearances as indicated on Permanent Clearance Details Sheet 1 are minimum, and greater clearances may be required to accommodate existing or proposed drainage ditches, and are preferred when they can be obtained without undue additional expense. Wherever practicable, overhead bridge structures shall have all piers and abutments located outside of the railroad right-of-way.
2. A minimum vertical clearance of 23'-0" shall be provided, measured from top of high rail to lowest point of structure in the horizontal clearance area.
3. Overhead bridge structures shall provide the specified horizontal and vertical clearances for anticipated future tracks, changes in track centers, and raising of track for maintenance purposes. This information shall be determined by inquiry to the Chief Engineer Bridges & Structures.
4. All piers located less than 25'-0 from face of pier to centerline of nearest track shall be designed with crash wall protection. Edges of footings shall not be closer than 13'-0" from centerline of track to provide adequate room for shoring.
5. All piers and end slopes shall be located so that they do not interfere with existing track ditches. Where special conditions make this impossible, an explanation of such conditions must be submitted, along with the drainage plans and calculations, to the Chief Engineer Bridges & Structures for approval.
6. The profile of the existing top of rail (500 ft. each side of proposed road crossing)

should be plotted on the plans. If the track is in a sag at the proposed bridge location, the vertical clearance from the top-of-rail to the bridge should be increased sufficiently to permit raising the track enough to remove the sag. A note should be added to the profile stating: "The elevations of the existing top-of-rail profile shall be verified before beginning construction. All discrepancies shall be brought to the attention of the Chief Engineer Bridges & Structures."

7. Proposed vertical and horizontal clearances shall be adjusted so that the sight distance to railroad signals is not reduced, unless the signals are to be relocated as a part of the project.
8. On structures to be rehabilitated or replaced, the proposed minimum vertical and horizontal clearances as well as the existing clearances shall be indicated on the General Plan and Elevation sheet.
9. The permanent clearances shall be correlated with the methods of construction so that temporary construction clearances will not be less than the minimum allowed.

B. Temporary Clearances

1. The following criteria shall govern the use of falsework and formwork above or adjacent to operated tracks.
  - a. A minimum vertical clearance of 22'-0" above top of highest rail shall be maintained at all times.
  - b. A minimum horizontal clearance of 13'-0" from centerline of tangent track or 14'-0" from centerline of curved track shall be maintained at all times. Additional horizontal clearance may be required in special cases to be safe for operating conditions. This additional clearance will be as determined by the Chief Engineer Bridges & Structures.

2. The minimum allowable temporary clearances shall be indicated on the General Plan and Elevation Sheet.
3. All proposed temporary clearances which are less than those listed above must be submitted to the Chief Engineer Bridges & Structures for approval prior to construction and must also be authorized by the regulatory body of the State if less than the legally prescribed clearances.
4. The temporary clearance requirements noted above shall also apply to all other physical obstructions including, but not limited to: stockpiled materials, parked equipment, placement or driving of piles, and bracing or other construction supports.

## II. CRASHWALLS

1. A.R.E.M.A. Manual of Recommended Practice, Chapter 8, Article 2.1.5, latest edition, covers the requirements for crashwalls. Crashwalls are required when face of pier is closer than 25'-0" from centerline of the track (including future tracks), measured perpendicular to the track.
2. Crashwalls shall meet the following requirements:
  - a. Crashwalls for single column piers shall be a minimum of 2'-6" thick and shall extend a minimum of 10'-0" above the top of high rail. The wall shall extend a minimum of 6'-0" beyond the column on each side in the direction parallel to the track. The face of the crashwall shall extend at least six (6) inches beyond the face of the column on the side adjacent to the track.
  - b. For multi-column piers, the columns shall be connected with a wall with a minimum thickness of 2'-6". The wall shall extend a minimum of 10'-0" above the top of high rail. The wall shall extend a minimum of 2'-6" beyond the end of outside columns in a direction parallel to the track. The face of the crashwall shall extend at least six (6)

inches beyond the face of the columns on the side adjacent to the track.

- c. Reinforcing steel to adequately anchor the crashwalls to the column and footing shall be provided.
- d. For piers of heavy construction, crashwalls may be omitted. (See AREMA 2.1.5.1.)

### III. DRAINAGE

1. The bridge and roadway plans should indicate all proposed drainage encroachments on Railroad right-of-way.
2. In order to evaluate the impact of the proposed project relative to existing site drainage, cross sections perpendicular to the centerline of track should be submitted along with the drainage plans. At each bridge site, 5-10 cross sections should be submitted to adequately depict the site conditions; however, a minimum of 5 cross sections will be required. One cross section is to be taken at the centerline of the road crossing, one at each limit of construction and one located midway between each end and the center. The existing railroad ditch and the proposed toe of slope for the end fill should be located on all cross section.
3. Drainage plans must be included with the bridge and roadway plans submitted to the Chief Engineer Bridges & Structures 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. A 100-year recurrence interval is the minimum design storm. If the proposed project will not change the quantity and/or character of flow in the Railway's ditches and/or drainage structures; the plans shall include a general note stating this.
4. Maintaining the existing drainage and providing for future drainage improvements is of the utmost importance. Existing track ditches must be maintained at all times.
5. Where the project design calls for an increase in the drainage flow through the railroad embankment,

the flow may be required to be handled by means of a separate drainage structure. See Guidelines for Under Track Culverts.

6. Horizontal clearances must provide sufficient space for construction of the required track ditch parallel to the standard roadbed section.
7. 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 handle the drainage. The ditch design shall be submitted to the Chief Engineer Bridges & Structures for approval.
8. No scuppers or other deck drains, roadway drainage, catch basins, inlets or outlets are permitted to drain onto Railway property. Any variance of this policy must have the approval of the Chief Engineer Bridges & Structures. If an exception is granted, maintenance of the drainage structures will be the responsibility of others and not the Railway. Drainage from scuppers and deck drains must be conveyed through pipes, preferably to a point off Railroad property. If a variance of this policy is granted, deck drains and scuppers will not be permitted on the portion of the bridge between the parallel track ditches. (See Sheet 1). If the drainage must be conveyed into a railroad ditch, calculations must be provided to the Chief Engineer Bridges & Structures for approval that indicate the ability of the ditch to carry the additional runoff.
9. Approval of the drainage plan does not relieve the submitting agency and/or designer of ultimate responsibility and liability for a satisfactory drainage design.

#### IV. CONSTRUCTION EXCAVATION

1. Footings for all piers, columns, walls or other facilities shall be located and designed so that any temporary sheeting and shoring for support of adjacent track or tracks during construction will not be closer than 10'-0" from centerline of track. Edges of footings located no closer than 13'-0" from centerline of track should satisfy the minimum of 10'-0". Excavations will not be

allowed closer than 10'-0" from centerline of track unless specifically approved by the Chief Engineer Bridges & Structures.

2. All plans and calculations for shoring shall be prepared and signed by a Registered Professional Engineer. The Engineer will be responsible for the accuracy for all controlling dimensions as well as the selection of soil design values which will accurately reflect the actual field conditions.
3. The plans shall contain details of the shoring system showing sizes of all structural members, details of connection, and embedment depth. The plans shall include a plan view showing all the proposed excavations and distances from centerline of track to face of excavation. Plans shall show a section normal to the track showing the shoring location relative to the centerline of track and showing the height of sheeting and track elevation in relation to the bottom of excavation. The plans must be complete and accurately describe the nature of the work.
4. Plans and calculations covering all falsework, shoring, excavation supports, etc., adjacent to railroad tracks should be certified to be complete and satisfactory by the submitting public agency prior to being submitted to the Chief Engineer Bridges & Structures for review. Four (4) copies of plans and calculations should be submitted. A minimum of 30 days should be allowed for the Railroad's review of such plans. No excavation will be allowed until the plans and calculations are reviewed and approved by the Chief Engineer Bridges & Structures. All excavations on or adjacent to the Railroad right-of-way shall be reviewed by the Railroad before excavation begins.
5. Shoring located between 10'-0" and 14'-0" from the centerline of track should be designed using interlocking sheeting. Soldier piles and lagging will be considered only when its use is specifically approved by the Chief Engineer Bridges & Structures. Consideration for the use of soldier piles and lagging will only be made if the required penetration of steel sheet piling

cannot be obtained and when dry, stable material will be encountered.

6. All excavations within the limit shown on Sheet 4, copy attached, shall be designed for Railroad live load surcharge. All shoring designed for Railroad live load surcharge shall be based on Cooper's E-80 live load. AREMA Chapter 8, Part 20, Section C, Paragraph 2(b), refers to the Boussinesq equation as a method to determine lateral pressure values for Railroad surcharge loading. Attached is a chart and graph indicating the lateral pressures associated with various depths of excavation and distances from the centerline of track as determined by the Boussinesq equation that may be used as a guide. The use of the AREMA Boussinesq equation is not the only method available to obtain lateral pressures for surcharge loading; however, pressure values significantly less than those determined by the Boussinesq equation do not adequately consider Railroad live load surcharge.
7. Railings shall be constructed (in accordance with plans approved by the Chief Engineer Bridges & Structures) around all excavations on Railroad's property. Walkways with railings shall be constructed (in accordance with plans approved by the Chief Engineer Bridges & Structures) over open excavations adjacent to the tracks located within the normal walkway. Refer to AREMA Section 15 for walking and railing design criteria. Railings shall not be closer than 10'-0" horizontally from centerline of track.
8. Approval of the excavation plan does not relieve the submitting agency and/or designer and/or contractor of ultimate responsibility and liability for the excavation plan.

V. EROSION CONTROL

1. Embankment slopes adjacent to the track must be paved for a minimum of two (2) feet beyond the outside edge of the bridge foundation structure and, where conditions warrant, the slope paving shall be extended around the curved face of the endroll to a line opposite the abutment. The pavement shall consist of a prepared sub-base and

filter fabric with a 4-inch minimum thickness of Class B concrete or placed grouted rip-rap on the surface. NOTE: If deck drainage or highway drainage is allowed to be discharged onto the embankment slopes, concrete paving must be used.

2. The bridge and roadway plans shall indicate the proposed methods of erosion control and must specifically address means to prevent silt accumulation in the ditches and culverts and to prevent fouling the track ballast and sub-ballast. If the plans do not show erosion control, the contractor must submit a proposed method of erosion control and must have the method approved by the Chief Engineer Bridges & Structures prior to beginning any grading on the project site.
3. Existing track ditches shall be maintained at all times throughout the construction period. After the construction has been completed, all erosion control devices must be removed, all deposits of silt removed, and the ditches must be restored.
4. Approval of the erosion control plan does not relieve the submitting agency and/or designer of ultimate responsibility and liability for a satisfactory erosion control plan.

VI. DEMOLITION, ERECTION, HOISTING

1. Railroad tracks and other railroad property must be protected from damage during the procedure.
2. The Contractor is required to submit a plan showing the location of cranes, horizontally and vertically, operating radii, with delivery or disposal locations shown. The location of all tracks and other railroad facilities as well as all obstructions such as wire lines, poles, adjacent structures, etc. must also be shown.
3. Crane rating sheets showing cranes to be adequate for 150% of the actual weight of the pick. A complete set of crane charts, including crane, counterweight, and boom nomenclature is to be submitted.
4. Plans and computations showing the weight of the pick must be submitted. Calculations shall be

made from plans of the existing and/or proposed structure showing complete and sufficient details with supporting data for the demolition or erection of the structure. If plans do not exist, lifting weights must be calculated from field measurements. The field measurements are to be made under the supervision of the Registered Professional Engineer submitting the procedure and calculations.

5. A data sheet must be submitted listing the types, size, and arrangements of all rigging and connection equipment.
6. A complete procedure is to be submitted, including the order of lifts, time required for each lift, and any repositioning or re-hitching of the crane or cranes.
7. All erection or demolition plans, procedures, data sheets, etc. submitted must be prepared, signed and sealed by a Registered Professional Engineer.
8. The Railroad's representative must be present at the site during the entire demolition and erection procedure period.
9. All procedures, plans and calculations shall first be approved by the Engineer and the Railroad Engineer before procedure begins; however, such approval does not relieve the Contractor from liability.

VII. MISCELLANEOUS

1. Railroad shall be furnished as built drawings showing the actual clearances as constructed. Depth, size, and location of all foundation components will be shown.
2. The plans for the overhead bridge shall show dimensioned locations of all existing utilities, as well as the location of all proposed utilities, within the Railroad's right-of-way. The plans shall define the responsibility for locating, marking, or installing and protecting such utilities. The Railroad is not responsible for locating utilities.

3. Attention shall be given to the need to provide a walkway adjacent to switches and tracks where trainmen are required to work on the ground.
4. If fiber optic cables are presently buried on the Railroad right-of-way or if such installations are scheduled during the course of an overhead bridge project, then the presence of such facilities shall be considered in the overhead bridge design and appropriate measures for protection of the fiber optic cables shall be addressed on the plans and in the contract documents.
5. Cast-in-place girders or pier caps will not be permitted in spans over operated tracks.
6. Pedestrian fencing should be provided for all structures designed to carry pedestrian or bicycle traffic. Consideration should be given to provide pedestrian fencing on other structures where special circumstances, such as past history of vandalism, may require.
7. Preliminary plans should be submitted to the Chief Engineer Bridges & Structures for review at least 29 weeks prior to the proposed letting date. See "Schedule for Review of Grade Separation Projects."

Office of Chief Engineer  
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