

VIRGINIA DEPARTMENT OF TRANSPORTATION

LOCATION AND DESIGN DIVISION

DRAINAGE DESIGN MEMORANDUM

GENERAL SUBJECT: DRAINAGE DESIGN AT RAILROADS	NUMBER: DDM4
SPECIFIC SUBJECT: GUIDELINES AND CRITERIA FOR DRAINAGE DESIGN UNDER OR ADJACENT TO RAILROADS	DATE: September 1, 2005
	SUPERSEDES: IIM-LD- 229
ADMINISTRATOR APPROVAL: <i>R. T. Mills</i> State Hydraulics Engineer	

OVERVIEW

- On VDOT projects, where there is a need to install a culvert or a storm sewer pipe within railroad right of way, either under or adjacent to the tracks, the Hydraulic Engineer should contact the Department of Rail and Public Transportation to determine the specific design and construction criteria required by the Railroad Company and to initiate the process for obtaining any approvals needed from the Railroad Company. Railroad Companies generally follow engineering practices recommended by the American Railway Engineering and Maintenance-of-Way Association (AREMA) in their Manual of Recommended Practices for Railway Engineering, Volume I, Chapters 4 & 5. Railroad Companies reserve the authority to adopt and use more stringent design requirements, as they deem necessary. Some of the basic criteria for culverts and storm sewers that are to be located on railroad right of way are presented in this memorandum.
- Projects that have railroad involvement generally are not advertised for construction until the Rail/Highway Agreement is fully executed. The execution of the Agreement by the Railroad Company is contingent upon their review and acceptance of the project design, especially the drainage design, as it relates to or affects their facilities. It is important that the Railroad Company be provided a complete and current set of plans and drainage computations for their review. The plan review and comment period by the Railroad Company can typically take three months or more for each submittal. Many projects take two or more reviews to address comments or correct plan omissions or errors. The time needed for review and coordination with the Railroad Company should be taken into consideration when establishing project schedules.

CRITERIA

HYDRAULIC DESIGN CRITERIA

- Culvert design follows the same FHWA methods used for VDOT highway projects with the following minimum criteria:
 - The 25 year discharge shall produce a headwater elevation at the culvert entrance no greater than the top of the pipe ($HW/D = 1.0$).
 - The 100 year discharge shall produce a headwater elevation at the culvert entrance no greater than 1.5 times the height of the culvert ($HW/D = 1.5$) or 2.0' below the elevation of the bottom of the rail, whichever is less.
 - Where field conditions do not permit installation of pipes sizes meeting this criteria, “pre and post construction ” computations must be provided showing the headwater elevations for the 25 year and 100 year floods and demonstrating that there will be no increase in headwater depth due to the proposed construction. The Engineering Department of the Railroad Company must approve such designs.
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PIPE SIZE AND COVER

- The minimum pipe size for use under the track is 36” diameter. A smaller size pipe may be allowed with the approval of the engineering department of the railroad.
- The maximum pipe size for use under the track is 72” diameter. A larger size pipe may be allowed with the approval of the engineering department of the railroad.
- The minimum pipe cover is to be 5.5’ as measured from the outside top of the pipe (casing pipe if used) to the bottom of the rail. Since survey crews often obtain the elevation of the top of the rail, an assumed rail height of 7 ½” may be used in determining the elevation of the bottom of the rail. Cover may also be determined by using the top of the cross tie elevation if the top of the rail elevation is unknown. In locations where the minimum cover cannot be obtained, a request must be made to the Railroad Company for an exception, with a complete explanation of the need for the exception.

PIPE MATERIALS AND INSTALLATION

- Pipes to be installed under existing tracks will generally require the bore and jack or tunneling method of installation and must be so noted on the construction plans. An exception to this may be granted by the Railroad Company for spur tracks or tracks with infrequent use. Special circumstances, such as minimum cover, or other restrictions may sometimes necessitate that a pipe or box culvert be installed by the open cut method. These sites should be carefully reviewed by VDOT, the Department of Rail and Public Transportation and the Railroad Company to decide the appropriate methods and materials to be specified in the construction plans.
 - SMOOTH WALL STEEL PIPE
 - The Railroad Company's standard pipe material for the bore and jack installation method is smooth wall steel pipe capable of supporting the Cooper E-80 loading. A structural analysis that is consistent with the Cooper E-80 loading requirements must be available for the Railroad Company's review and approval should they desire. Section 105 of the Road and Bridge Specifications outlines the procedures that should be followed for this process.
 - The smooth wall steel pipe may function as the carrier pipe (i.e., used to convey the stormwater run-off) or function as a casing pipe for the actual carrier pipe. If installed as the carrier pipe, the smooth wall steel pipe must conform to the criteria set forth in the appropriate notes for uncoated galvanized steel pipe shown in Table A & A1 of the "Allowable Pipe Criteria for Culverts and Storm Sewers" in Standard PC-1 of the Road and Bridge Standards. The State Location and Design Engineer and the District Materials Engineer must approve any deviation from the noted criteria. The drainage description for smooth wall steel pipes installed under the railroad by the bore and jack method should specify:

Jacked Smooth Wall Steel Pipe Req'd.

Pipe shall be designed to support Cooper E-80 loading in accordance with Section 105 of the Road and Bridge Specifications and installed by the bore and jack method. Smooth wall steel pipe shall have a minimum wall thickness of (See Table A).

Table A

Smooth Wall Steel Casing Pipe Minimum Wall Thickness For Installation Under Railroads	
Pipe Size Inches	Minimum Wall Thickness Inches
24	0.500
30	0.500
36	0.500
42	0.625
48	0.625
54	0.750
60	0.875
66	0.875
72	1.000

○ CONCRETE PIPE

- Under certain conditions, CSX Transportation, Inc. will allow concrete pipe Class V to be installed beneath the tracks without a casing pipe. In these cases, Class V concrete pipe may be used up to a cover height of 14'. For cover heights greater than 14', a Special Design Concrete Pipe must be used. A structural analysis that is consistent with the Cooper E-80 loading requirements must be provided to the Railroad Company for their review and approval. Section 105 of the Road and Bridge Specifications outlines the procedures that should be followed for this process. The drainage description for such pipes should specify:

For cover heights 14' or less

*Jacked Concrete Pipe Req'd. Class V
Pipe shall be installed by the bore and jack method.*

For cover heights greater than 14'

*Special Design Jacked Concrete Pipe Req'd.
Pipe shall be designed to support Cooper E-80 loading in accordance with Section 105 of the Road and Bridge Specifications and installed by the bore and jack method.*

The note referencing the Cooper E-80 loading and Section 105 of the Road and Bridge Specifications should also be included on the appropriate Drainage Summary Sheet.

o CORRUGATED STEEL PIPE

- For pipes to be installed under proposed or relocated tracks to be constructed on a new location, the open cut method of installation should be used. The pipe material generally accepted by the Railroad Company for this type of installation is corrugated steel capable of supporting the Cooper E-80 loading requirements. Aluminized Type 2 or Polymer Coated are the standard types of corrugated steel pipe allowed by VDOT. A structural analysis that is consistent with the Cooper E-80 loading requirements must be available for the Railroad Company's review and approval should they desire. Section 105 of the Road and Bridge Specifications outlines the procedures that should be followed for this process. The drainage description for such pipes should specify:

Corrugated Steel Pipe Req'd.

Pipe shall be designed to support Cooper E-80 loading in accordance with Section 105 of the Road and Bridge Specifications.

- The note referencing the Cooper E-80 loading and Section 105 of the Road and Bridge Specifications should also be included on the appropriate Drainage Summary Sheet. For locations where VDOT does not normally allow corrugated steel pipe (see Allowable Pipe Type Tables in Standard PC-1 of the Road and Bridge Standards), concern should be expressed to the Railroad Company about the use of this type of pipe material. Railroad Companies generally require that VDOT own and maintain any drainage structures that VDOT installs on railroad right of way. Therefore, we should endeavor to use the type of material that has proven to provide an appropriate life expectancy for specific site conditions. However, the Railroad Company will have final approval on the type of material and the installation method.

DROP INLETS

- Drop inlets should generally not be located on the railroad right of way. When determined necessary to locate drop inlets on railroad right of way, they should be located no closer than 18' from the track centerline. Railroads have a responsibility to their employees and customers to provide a hazard free operating corridor and are concerned with the hazard potential presented by grate inlets, especially those located in ditches. Any grate inlet that must be located within 18' from the track centerline, or in an area where there is concern with a hazard potential due to grate openings, should have the bar spacing of the grates specified as would be required for pedestrian accessible areas. Where a Standard DI-5 or DI-7 inlet is proposed in these areas, a Type III grate shall be specified.

DITCHES

- Drainage ditches on railroad right of way that will convey VDOT roadway or bridge deck run off must be analyzed for the effects of the 100 year frequency discharge. This does not necessarily mean that the ditch must contain the 100 year storm but rather the effects of the 100 year storm must be documented. The analysis must be submitted to the Engineering Department of the Railroad Company for their review and approval. The analysis should present a factual scenario that is clear and easily understood. A computer printout that is not clearly presented or explained is not usually acceptable to the Railroad Company.
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FOUNDATIONS FOR SIGNALS

- The location of proposed drainage structures may conflict with the foundations of proposed Railroad Company installed warning devices at rail crossings. The location of the warning device is prescribed by federal regulations and varies according to the typical section of the roadway and the alignment of the rail crossing. The location of proposed drainage structures in these areas should be reviewed with the Department of Rail and Public Transportation to determine any possible conflicts.
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ENDWALLS AND OTHER STRUCTURES

- For construction detail requirements when placing pipe endwalls, manholes and other such structures adjacent to railroads, see Section 2E-24 of the VDOT Road Design Manual.
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GUIDELINES

- The following general guidelines are presented to assist the Drainage Designer in developing a design that is acceptable to the Railroad Company. These guidelines are representative of the comments received from Railroad Companies on past VDOT projects.
 - For projects that are rebuilding an existing crossing, the existing drainage patterns should not be altered and documentation (a narrative with hydrologic and hydraulic computations) should be provided to the Railroad Company that indicates no increase in volume, velocity or flow depth/headwater depth is caused by the project on railroad right of way.

- Railroad Companies do not generally allow new drainage outfalls to discharge onto railroad right of way. Any existing outfall that is to be replaced or altered should be acceptable provided the documentation as previously noted for volume, velocity and flow depth/headwater depth is provided to the Railroad Company.
- When a constructed outfall (ditch or pipe) must be directed into a railroad ditch paralleling the rail bed, the constructed ditch or pipe should intersect the railroad ditch at an angle, in lieu of perpendicular, in order to lessen concerns with potential erosion. The appropriate erosion control measures should be applied at the intersection point to ensure stability of the rail bed and the existing railroad ditch.
- Proposed storm drain pipes paralleling the railroad tracks are not generally permitted to occupy the railroad right of way.
- Proposed roadway culverts and storm drains are not generally permitted to connect to existing railroad culverts. For situations where such a connection is unavoidable, the Railroad Company usually requires that VDOT assume maintenance responsibility for the railroad culvert.
- Scuppers, deck drains, drop inlets or other concentrated flow outlets from bridge decks are generally not allowed to drain directly onto the railroad right of way.
- Primary and emergency spillways and outfall structures of stormwater management basins, as well as the basin itself, are generally not allowed to be located on the railroad right of way. Where flow from a stormwater management basin is directed onto railroad right of way, documentation should be provided to the Railroad Company that indicates no increase in volume, velocity or flow depth/headwater depth is caused by the project on railroad right of way.