VIRGINIA DEPARTMENT OF TRANSPORTATION

LOCATION AND DESIGN DIVISION

DRAINAGE DESIGN MEMORANDUM

GENERAL SUBJECT: UNDERDRAIN	NUMBER: DDM 5.1
SPECIFIC SUBJECT: DRAINAGE FOR PAVEMENT STRUCTURE; UNDERDRAINS IN GORE AREAS	DATE: September 1, 2005
	SUPERSEDES: DDM5,IIM-LD-01 (D) 130.8, IIM-LD-89 (D) 74.1
ADMINISTRATOR APPROVAL: *R. T. Mills* State Hydraulics Engineer	

GUIDELINES

- When a Standard Underdrain UD-3, UD-4 or UD-7 passes through a commercial entrance, “non-perforated” pipe is required between the limits of the curb returns. This “non-perforated” pipe is to be summarized with the applicable underdrain. (See Standards UD-3, UD-4, and UD-7 and Sample Summary)

- Standard underdrains will provide drainage for pavement structures as recommended by the Materials Division.

- Standard EW-12 shall be used at outlet ends of all underdrains which do not tie to other drainage structures (inlets, manholes, etc.).

- When ramp gore areas are above and sloping toward rigid pavement, abutted by asphalt shoulders, UD’s will be provided at the gore to collect and drain water under the pavement.

- Designers are cautioned that special attention must be given to superelevated curves and transitions to assure that the underdrain is properly located to provide drainage for subbase material.

DESIGN PROCEDURES

- The Roadway Designer will submit Form LD-252 to the Materials Division, requesting preliminary pavement design and underdrain type and location recommendations. Form LD-252 will be submitted during the early stages of project development so that the requested information will be available to the Drainage Designer during the drainage design phase prior to the Field Inspection.

- The Materials Division will provide the Roadway Designer with recommendations for the preliminary pavement design and the type and location of underdrains for the project. Underdrain recommendations will include Standard UD-2, UD-4, UD-5, UD-6 and/or UD-7 underdrains, as appropriate. Recommendations will include Standard UD-1 underdrains when sufficient data exists to determine locations.

- Prior to submitting a request to the Hydraulics Unit for drainage design, the Roadway Designer will depict the underdrains on the drainage layer of the electronic files and /or hard copy of the plans at the locations recommended by the Materials Division. The Roadway Designer will depict only those underdrains that parallel the roadway centerline. A copy of the Materials Division's report will be included in the data forwarded to the Hydraulics Unit with the request for the drainage design.

- The Roadway Designer will depict Standard UD-3 Sidewalk Underdrains on the drainage layer of the electronic files and/or hard copy of the plans at the locations recommended by the District Construction Engineer.

- The Drainage Designer will:

    - Determine the locations for CD-1 or CD-2's at:

        - Down grade end of cut to fill transitions.
        - Sag points in roadway grade.
        - Bridge approach slabs.

- o Determine outlet pipe locations for all parallel underdrain systems. Unless otherwise approved by the State Materials and the State Hydraulics Engineer, the following criteria will apply to spacing of outlet pipes:

  - UD-1 – Variable spacing
  - UD-2 – 500 feet maximum spacing
  - UD-3 – 1000 feet maximum spacing
  - UD-4 – 350 feet maximum spacing
  - UD-5 – 350 feet maximum spacing
  - UD-7 – 350 feet maximum spacing

- o For Rural (shoulder/ditch design) projects:

  - Determine the modifications required (If any) to the ditch typical section in order to provide a minimum 12 inches of freeboard (vertical clearance) between invert of outlet pipe and invert of receiving ditch.
    Or
  - Design a storm sewer system under the ditch line for the connection of underdrain outlet pipes that provide for the minimum 12 inches of freeboard between the invert of the outlet pipe and the invert of the receiving structure.

- o For Urban (curb and gutter/storm sewer design) projects:

  - Design the storm sewer system to provide the minimum 12 inches of freeboard between the invert of the outlet pipe connection and the invert of the receiving structure.

- o Specify EW-12 Endwall at end of outlet pipe or specify connection to another structure (manhole, drop inlet, etc.)

- o Depict the required underdrains and/or outfall systems on the drainage layer of the electronic files or on redline prints of the plans. The information will be transmitted to the Roadway Designer along with the normal drainage design for the project.

TYPES AND USAGE

- Drainage for Pavement Subbase:

STANDARD	**USAGE AND PURPOSES**
UD-1	As recommended by materials division to lower ground water table in cuts
UD-2	Drains raised grass median strips as recommended by Materials Division
CD-1 & 2	Drains subsurface water from cuts and fills according to road and bridge standards and as recommended by Materials Division
UD-3	Drains area under sidewalk
UD-4	Provides drainage for pavement structure as recommended by Materials Division
UD-5	Same as UD-4; more easily added to previously constructed projects
UD-7	Provides pavement structure drainage as recommended by Material Division for existing pavements
EW-12	Used at outlet ends of all underdrains which do not tie to other drainage structures (inlets, manholes, etc.)

- Underdrains in Gore Areas

    - Ramp gore areas on down grades are prone to retaining water that may spill over the pavement. This may result in slippery pavement and icing if the pavement structure is not adequately drained. See Standard UD-4 for method of installation.

PLAN DETAILS

- When showing EW-12's on plans, label as follows showing appropriate slope:

  1 – St'd. EW-12 Req'd. (4:1 Slope)

SUMMARY

- Following is a typical method of summarizing underdrains:

UNDERDRAIN SUMMARY							
STA. to STA.	UD-1	UD-4		CD-1	OUTLET PIPE	EW-12	
		Perforated	Non-Perforated			2:1	4:1
	L.F.	L.F.	L.F.	L.F.	L.F.	Each	Each
20+00 To 31+00 Rt.	1100				500	1	1
25+00 To 51+00 Rt.		2350	250		400	2	
31+50 Lt.				200	250	1	1
TOTALS	1100	2350	250	200	1150	4	2