11.8 Inlets

11.8.1 General

Inlets are drainage structures that collect surface water through grate or curb openings and convey it to storm drains or directly outlet to culverts.

11.8.2 Standard ConnDOT Inlets

- Type “C” catch basin – This inlet consists of both a curb-opening inlet and a grate placed in a side-by-side configuration. In computing the inlet capacity, the curb opening is neglected and only grate opening is considered. The curb opening provides a relief if the grate should become clogged.
  Type "C" catch basin double grate-Type I - This catch basin can be used on grades to reduce bypass since the frontal width increases by a factor of 2. The placement of this inlet needs to be evaluated to ensure that the grates do not protrude into the travelway which would cause traffic to veer away from it.*
  Type "C" catch basin double grate Type II - these inlets are predominantly used at sags. They provide greater interception capacity than the single or Type I structures since the curb opening is longer and the perimeter of the grate to accept flow is greater.
- Slotted Drain - This inlet consists of a pipe cut along the longitudinal axis with a grate of spacer bar to form slot openings. Slotted inlets function as weirs with flow entering from the sides.
- Type “C-L” catch basin – This catch basin is a grate inlet placed in a swale or edge of roadway without curbing.
  Type "C-L" catch basin double grate Type I - This is similar to the Type “C” catch basin double Grate Type I inlet except is more commonly used in swales where additional interception is required.*
  Type "C-L" catch basin double grate Type II - these inlets are predominantly used at sags. They provide greater interception capacity than the single or Type I structures since the perimeter of the grate to accept flow is greater.

  A typical detail showing grading adjacent to a type “C-L” catch basin located in a swale can be found in Appendix B.
- End Sections & End Walls - these inlets will be designed using the procedures found in the culvert chapter.
- Lawn Drains - These inlets vary in size dependant on discharge. They are economical to use in residential areas and traffic islands where minimal flow occurs.
- "D-G" type endwall - This inlet was developed primarily to drain earth and paved ditches at the top of cut slopes. These inlets should only be located beyond the area required for safe recovery of vehicles and where they will not be encountered by pedestrians. The capacity of these can be computed using the formula, $Q = 3.33\ LH^{1.5}$ (English version). Flow should not submerge the grate and the water surface developed by the outlet pipe should be low enough not to cause the weir to be submerged.
- Catch Basins without sumps – should be used where utility conflicts exist; storm sewer systems that convey watercourses; and where pipe 36 inches and larger is required. This structure has a formed invert.
- Drop Inlets – may be used where utility conflicts exist. This system has no inlet pipes other than underdrains.

*Note: These catch basins can also be used for connecting those pipes which cannot fit into the single grate structures. This avoids the need for special junction box designs in most instances. When these inlets are used for this purpose, they should be specified without sump to decrease junction losses.

11.8.3 Standard ConnDOT Grates

There are two grates currently used by the Department. These are designated Type "A" and "B" in the Roadway Standards. Type "B" grate will be used on limited access highways. Type "A" grate will be used in all other locations which are subject to bicycle and pedestrian traffic.

11.8.4 Inlets On Grade

The capacity of an inlet depends upon its geometry and the cross slope, longitudinal slope, total flow, depth of flow and pavement or swale roughness. The depth of water next to the curb is the major factor in the interception capacity of gutter inlets. At low velocities, all of the water flowing in the section of gutter occupied by the grate, called frontal flow, is intercepted by grate inlets, and a small portion of the flow along the length of the grate, termed side flow, is intercepted.

Experience indicates that for design purposes, it is safe to consider interception of the entire frontal flow and disregard side flow. The remainder of the flow outside the width of the inlet will bypass to the next inlet. All inlets are to be designed without considering depression unless the plans specify it, with contours.

11.8.5 Inlets At Low Points

In locations such as underpasses and in sag vertical curves in depressed sections, where significant ponding can occur, flanking inlets shall be placed on each side of the inlet at the low point in the sag. The flanking inlets should be placed so that they will limit spread on low gradient approaches to the level point and act in relief of the inlet at the low point if it should become clogged. (See Section 11.8.7.) Flanking inlets are not usually considered as intercepting flow in design computations.

11.8.6 Curbing

Curbs are used where runoff from the pavement would erode fill slopes. Curbs could be eliminated where other permanent erosion control measures such as rock embankments are provided. Curbs may also be required in developed areas, with sidewalks and in cut sections with positive backslopes at the gutter. Where curbs are used with positive backslopes, a minimum shoulder width of 1.2 meters (4 ft) is required to achieve the proper cross slope to contain the flow. Curbing is required for any slope steeper than 1 (vertical) : 4 (horizontal) with the exception of the high side of superelevated sections. If curbing is not possible then erosion control matting should be used to stabilize the embankments until vegetation is established. Refer to the Highway Design Manual for additional guidance for the use of curbing.

11.8.7 Inlet Locations

This section stipulates where the location of inlets should be.

- Inlets are generally located immediately upgrade of a bridge. If on the downgrade of a bridge there is no extension or curbing, an inlet may be needed to prevent erosion.
- On vertical sags, flanker basins shall be located 0.06 m (0.2 ft) higher than the low point catch basin.
- Inlets should not be located in driveways or within 1.5 meters (5 ft) from driveway returns to preclude loss of traction.
- Bridge inlets may not be able to be located to meet the hydraulic requirements. Bridge inlets should be located with the approval of the bridge engineer. Keep in mind that an increase in width or spread may be justified for a short length of roadway to avoid the use of bridge inlets.
- At sag vertical curves of expressways where curbing is not used, a type "C-L" catch basin shall be placed at the outer edge of the shoulder and within the shoulder. This inlet will collect rain and snow melt which cannot reach the actual sag location due to the dam created by snow plowing operations. **No interception should be computed for this inlet and a 300 mm (12 in) pipe is to be used for an outlet**.
- Drainage inlets are sized and located to limit the spread on traffic lanes to tolerable widths as is indicated in Table 11-2. Grate inlets should be located outside the through-traffic lanes to minimize the shifting of vehicles attempting to avoid them.
- Where there is a danger of damage to adjacent property by flow overtopping the curb in a sag, flanking inlets should be used and the location checked to insure that the curb is not overtopped due to insufficient inlet capacity.
- Inlets should be located so that concentrated flow and sheet flow will not cross traffic lanes. Where pavement surfaces are warped, as at cross streets or ramps, surface water should be intercepted just before the change in cross slope.
- Inlets should be located just upgrade of pedestrian crossings if required near the crossing.
- Special care should be given to inlet placement to insure adequate capacity at bridge approaches and at sag vertical curves where ponding deeper than the curb height could occur.
- The maximum depth of flow in a gutter or shoulder shall be limited to 25 mm (1 in) below the top of curb, except at sag locations.
- Where driveways descend from the highway, the maximum depth of flow will be limited to 0.10 meters (0.3 ft).
- At intersections where the grades of both roads are positive, there usually is a vertical sag created at the curb line. To determine the exact location of these inlets and to determine their capacity, it is necessary to develop a profile of the gutter and a contour of the impacted quadrant of the intersection.
- Positive slopes, channelization islands, gore areas, etc. can cause snow melt from the roadside to freeze, creating ice conditions which require application of abrasives and chemicals. These designs can be avoided in most instances when thought is given to winter highway operations. A few measures which can be used are:

  1. Insure that slopes either flow to gutters or that they are negative from the roadway.
  2. Islands which do not flow to gutters should be depressed and drained with an inlet.
  3. Careful inlet designs at the optimum location to control flows in gore areas.

- At roadway transitions from cut to fill at the downhill terminus of a negative shelf should be drained with an inlet or properly designed channel to preclude erosion.