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Technology That Separates

STORM BULLETIN 12

STORM SEWER SYSTEMS PEAK FLOW CAPACITY

- **The peak flow capacity of a storm sewer system** is determined by the potential energy available for gravity transport of the stormwater (site topography establishes headwater (HWE) and tailwater elevations (TWE)) and flow conductance of the storm drainage system (including flow restrictions in downstream drainage systems).
  - **The Potential energy** is normally limited by the headwater elevation. This is where the stormwater begins to pond, such as in a parking lot at the inlet to a catch basin. Tailwater elevation can often be assumed equal to the elevation of the crown of the storm sewer pipe at the outlet. In some cases there is significant submergence at the outlet (e.g. discharge into a flooded ditch or pond).
  - **Flow conductance** of the storm sewer system is based on pipe friction and the turbulent effects at junctions in the system (e.g. catch basins, manholes, and other structures).

- **A sample format for estimating peak flow capacity** of a simple storm sewer system is given below.
  - Storm pipe data: Where
    Length (L) = 50 ft
    Diameter (D) = 12 in,
    Area (A) = 0.78 ft^2
    Slope (S) = 6.00 %
    “n” value* = 0.012
    Q is flow with units of ft^3/sec
    pipe conveyance factor (C)** = 40.0
    catch basin at inlet
    end section at outlet with invert at bottom of drainage ditch.
    Ditch bottom elevation = 100.00

  If the ditch contains 3-ft of water the TWE = 103.00 (pipe outlet submerged by 2.0 feet) and the HWE (pond at catch basin rim) =105.00 (two feet above the water level in the ditch).
  If K (catch basin inlet loss coefficient) = 1.50 then the inlet loss = 1.5(Q/A)^2)/64 = 0.038Q^2 and the friction loss in the pipe = L(Q/C)^2 = 0.031Q^2.

So where Q =	2	4	8	12
the Velocity ft/sec (Q/0.78)=	2.6	5.2	10.4	15.6
the Friction loss, ft (0.031Q^2)=	0.12	0.5	1.9	4.5
the Junction loss, ft (0.038Q^2)=	0.15	0.6	2.4	5.5
the Total calculated head loss, ft=	0.27	1.1	4.3	10.0
and the avail. head loss=HWE-TWE=	2.0	2.0	2.0	2.0

  Based on the above table, the available head loss is adequate to generate a peak flow of 5-6 ft^3/sec. The catch basin inlet loss is significant due to the relatively short length of the storm pipe. Note the considerable inlet loss at high flow velocity -- most storm systems contain numerous junctions and operation at a velocity above 8 ft/sec can result in significant surcharge when the pipe is flowing full. As a reference point, consider that sanitary sewer systems are designed to operate at 2 ft/sec at full flow.

An important point made by this table is that pipe slope does not necessarily determine storm sewer system flow capacity. For a 12-in pipe at 6.0 % slope, the full flow capacity, based only on friction loss would be approximately 9-10 ft^3/sec. However, as shown by the above table, turbulence at the catch basin pipe junction limits flow capacity to 5-6 ft^3/sec, even with the benefit of pond up to the rim of the catch basin.

*"n" is Manning's n, a term used to describe material roughness (no units). n becomes a constant for a specific kind of pipe flowing full.
** (C) This is calculated using "n" and the pipe diameter as parts of the calculation.