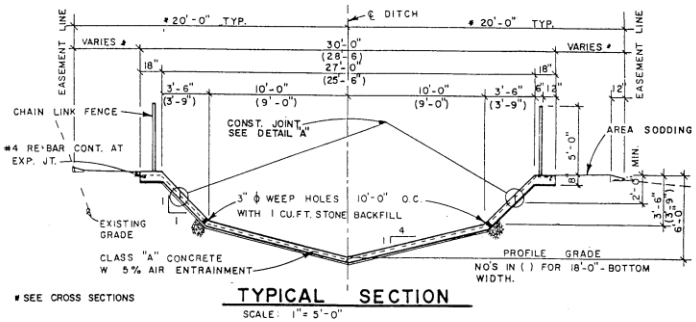
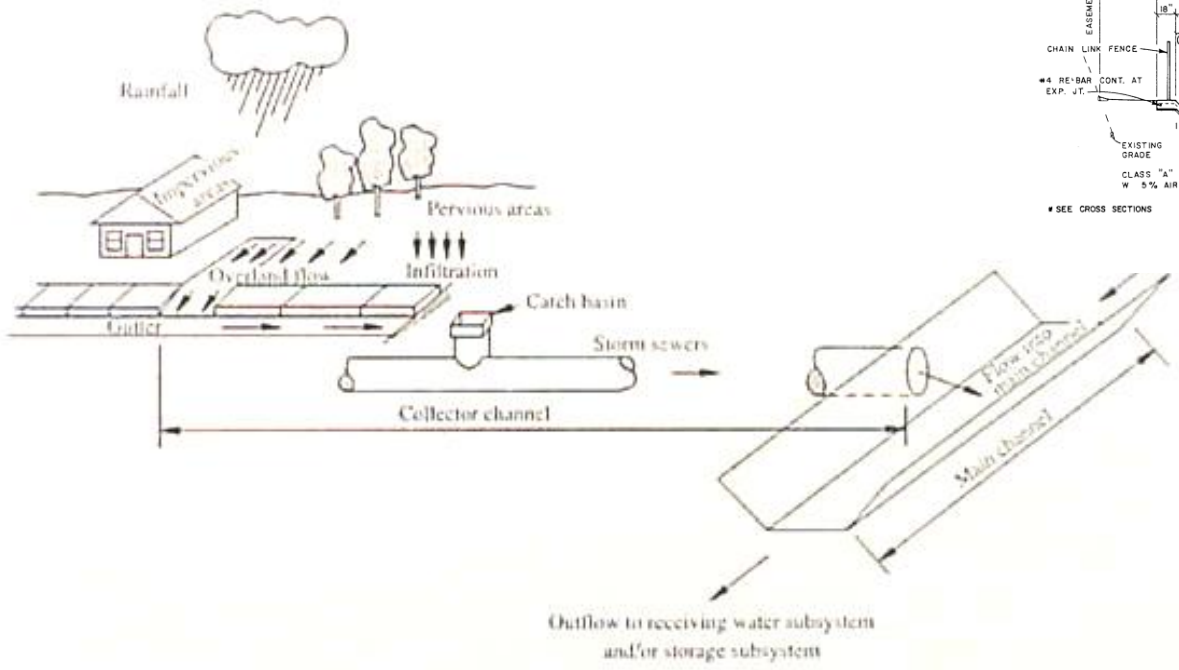
OPEN-CHANNEL FLOW
Introduction Ch-10 of HH

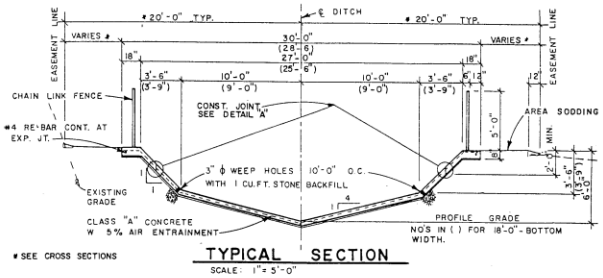
- Application
- Characteristics
- Section Parameters
- Flow State
- Types of Flow



Bed Slope, So = 0.004
Manning's n = 0.014

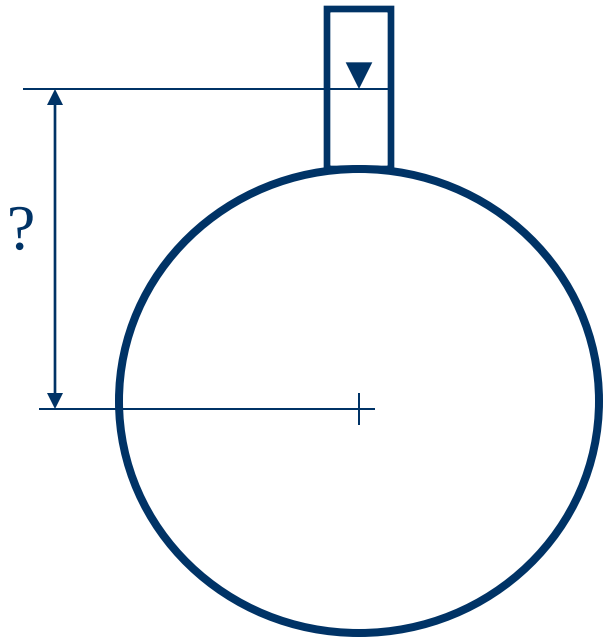
Application



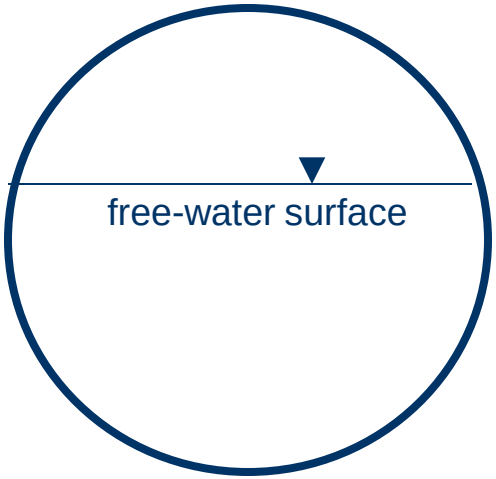


Bed Slope, So = 0.004
Manning's n = 0.014

Pressure vs. Open-channel flow



pressure flow
(pressure driven)



open-channel flow
(typ. gravity driven)

Section Parameters

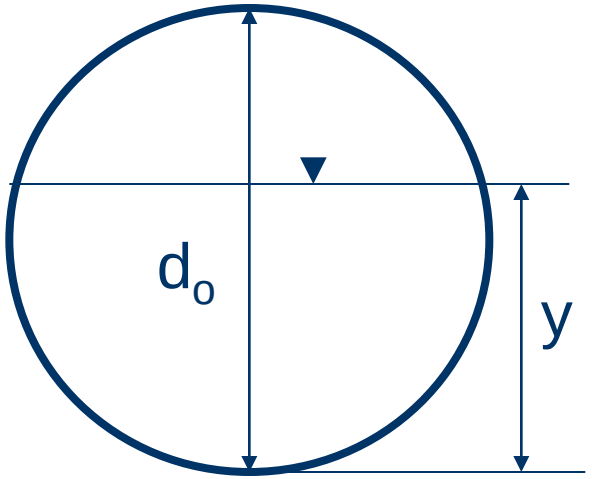
- **Reach Length** =L [L]= arbitrary horizontal distance between two cross-sections
- **Bed slope** = So [L/L] = -dz/dx = -(z2-z1)/L = tanθ
- **Flow depth** =y [L] = vertical distance from channel bottom to free water surface
- **Depth of flow sec** =d [L] = flow depth normal to flow, d=ycosθ
- **Top width** = T[L] = Width at free-surface
- **Flow area** = A[L2] = cross-sectional area normal to flow direction
- **Wetted perimeter** = P[L] = length of channel boundary in contact with water
- **Hydraulic radius** = R[L] = A/P
- **Hydraulic depth** = D[L] = A/T
- **Section Factor Critical Flow** = Zc =$AD^{1/2}$ [$L^{5/2}$]
- **Section Factor Uniform Flow** = Zn = $AR^{2/3}$ [$L^{8/3}$]

Parameters: Circular Section

TABLE 10.1 GEOMETRIC ELEMENTS FOR CIRCULAR SECTION

$\frac{y}{d_0}$	$\frac{A}{d_0^2}$	$\frac{P}{d_0}$	$\frac{R}{d_0}$	$\frac{T}{d_0}$	$\frac{D}{d_0}$	$\frac{A\sqrt{D}}{d_0^{5/2}}$	$\frac{AR^{2/3}}{d_0^{8/3}}$
0.01	0.0013	0.2003	0.0066	0.1990	0.0066	0.0001	0.0000
0.05	0.0147	0.4510	0.0326	0.4359	0.0336	0.0027	0.0015
0.10	0.0409	0.6435	0.0635	0.6000	0.0682	0.0107	0.0065
0.15	0.0739	0.7954	0.0929	0.7141	0.1034	0.0238	0.0152
0.20	0.1118	0.9273	0.1206	0.8000	0.1398	0.0418	0.0273
0.25	0.1535	1.0472	0.1466	0.8660	0.1774	0.0646	0.0427
0.30	0.1982	1.1593	0.1709	0.9165	0.2162	0.0921	0.0610
0.35	0.2450	1.2661	0.1935	0.9539	0.2568	0.1241	0.0820
0.40	0.2934	1.3694	0.2142	0.9798	0.2994	0.1603	0.1050
0.45	0.3428	1.4706	0.2331	0.9950	0.3446	0.2011	0.1298
0.50	0.3927	1.5708	0.2500	1.0000	0.3928	0.2459	0.1558
0.55	0.4426	1.6710	0.2649	0.9950	0.4448	0.2949	0.1825
0.60	0.4920	1.7722	0.2776	0.9798	0.5022	0.3438	0.2092
0.65	0.5404	1.8755	0.2881	0.9539	0.5666	0.4066	0.2358
0.70	0.5872	1.9823	0.2962	0.9165	0.6408	0.4694	0.2608
0.75	0.6318	2.0944	0.3017	0.8660	0.7296	0.5392	0.2840
0.80	0.6736	2.2143	0.3042	0.8000	0.8420	0.6177	0.3045
0.85	0.7115	2.3462	0.3033	0.7141	0.9964	0.7098	0.3212
0.90	0.7445	2.4981	0.2980	0.6000	1.2408	0.8285	0.3324
0.94[a]	0.7662	2.6467	0.2896	0.4750	1.6130	0.9725	0.3353
0.95	0.7707	2.6906	0.2864	0.4359	1.7682	1.0242	0.3349
1.00	0.7854	3.1416	0.2500	0.0000	∞	∞	0.3117

[a]Maximum flow occurs at 0.94 full depth.



Flow State

- Reynolds Number
  - Laminar flow
  - Turbulent flow

$$\mathrm{Re} = \frac{VR}{\nu}$$

- Froude Number
  - Subcritical flow
  - Supercritical flow
  - Critical flow

$$Fr = \frac{V}{\sqrt{gD}}$$

Types of Flow

Variation in Time?

- **Steady flow** velocity and depth change with time
- **Unsteady flow** velocity and depth change with time

Variation in Space?

- **Uniform flow** velocity and depth same at every cross-section
- **Nonuniform flow** velocity and depth vary between cross-sections