CE-441-ENVIRONMENTAL ENGINEERING II

Lecture 3- Design of sewer system

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Design Criteria Consideration

(1) Design Flow

(a) Sanitary Sewer

Q_{design} = Peak sewage flow + Infiltration

(b) Partially Combined Sewer

Q_{design} = Peak sewage flow +Storm flow+ Infiltration

WASA Criteria **(Peak sewage flow = Storm flow)**

Q_{design} = 2 x Peak sewage flow + Infiltration

(2) Design Equation

Manning's formula is used for sewer flowing under gravity

$$V = \frac{1}{n} . R^{\frac{2}{3}} . S^{\frac{1}{2}}$$

V = velocity of flow m/sec

R = Hydraulics mean depth = Area/Perimeter

= D/4 (Circular Sewer)

S= Slope of sewer

n= coefficient of roughness for pipe (0.013-0.015)

Design Criteria Consideration

(3)Minimum Self cleansing velocity

- Sanitary sewer = 0.6m/s
- Storm sewer= 1m/s
- Partially combined = 0.7m/s

(4)Minimum Sewer Size

- 225mm for lateral WASA

Commerically available diameter of Sewer in mm

TABLE
Dimensions of reinforced concrete pipe*

Internal diameter, mm (in)	Wall thickness, mm (in)		
	Wall A	Wall B	Wall C
310 (12)	44 (1¾)	51 (2)	
380 (15)	47 (1⅞)	57 (2¼)	
460 (18)	51 (2)	63 (2½)	
530 (21)	57 (2¼)	70 (2¾)	
610 (24)	63 (2½)	76 (3)	95 (3¾)
690 (27)	66 (2⅝)	83 (3¼)	101 (4)
760 (30)	70 (2¾)	89 (3½)	108 (4¼)
840 (33)	73 (2⅞)	95 (3¾)	114 (4½)
910 (36)	76 (3)	101 (4)	120 (4¾)
1070 (42)	89 (3½)	114 (4½)	130 (5¼)
1220 (48)	101 (4)	127 (5)	146 (5¾)
1370 (54)	114 (4½)	140 (5½)	159 (6¼)
1520 (60)	127 (5)	152 (6)	171 (6¾)
1680 (66)	140 (5½)	165 (6½)	184 (7¼)
1830 (72)	152 (6)	178 (7)	197 (7¾)
1980 (78)	165 (6½)	190 (7½)	209 (8¼)
2130 (84)	178 (7)	203 (8)	222 (8¾)
2290 (90)	190 (7½)	216 (8½)	235 (9¼)
2440 (96)	203 (8)	229 (9)	248 (9¾)
2590 (102)	216 (8½)	241 (9½)	260 (10¼)
2740 (108)	229 (9)	254 (10)	273 (10¾)
2900 (114)	241 (9½)		
3050 (120)	254 (10)		
3200 (126)	267 (10½)		
3350 (132)	279 (11)		
3500 (138)	292 (11½)		
3650 (144)	305 (12)		
3800 (150)	318 (12½)		
3960 (156)	330 (13)		
4110 (162)	343 (13½)		
4270 (168)	356 (14)		
4420 (174)	368 (14½)		
4570 (180)	381 (15)		

* Not all sizes are available in all classes.

Numerical

1. Design a sanitary sewer to serve a population of 7000 persons. The per capita water consumption is 400 lpcd. Adopt suitable design criteria

Numerical

2.Calculate the size and flow of a separate trunk sewer serving a population of 0.2 million and having a per person water consumption rate of 400 liter per capita per day.

Note:

- *Value of n =0.013 may be used*
- *Take infiltration as 10 % of average sewage flow.*

Numerical

3. Design a sewer for a maximum discharge of 650 L/sec. Consider manning's roughness coefficient of 0.013, the gradient of sewer is equal to 0.0001.

Numerical

4. A sewer pipe is serving an estimated population of 35000 persons. If the average water consumption of area is 350 liters per capita per day. Design the sanitary sewer that will avoid the solid deposition and should also be able to handle the peak sewage flow.

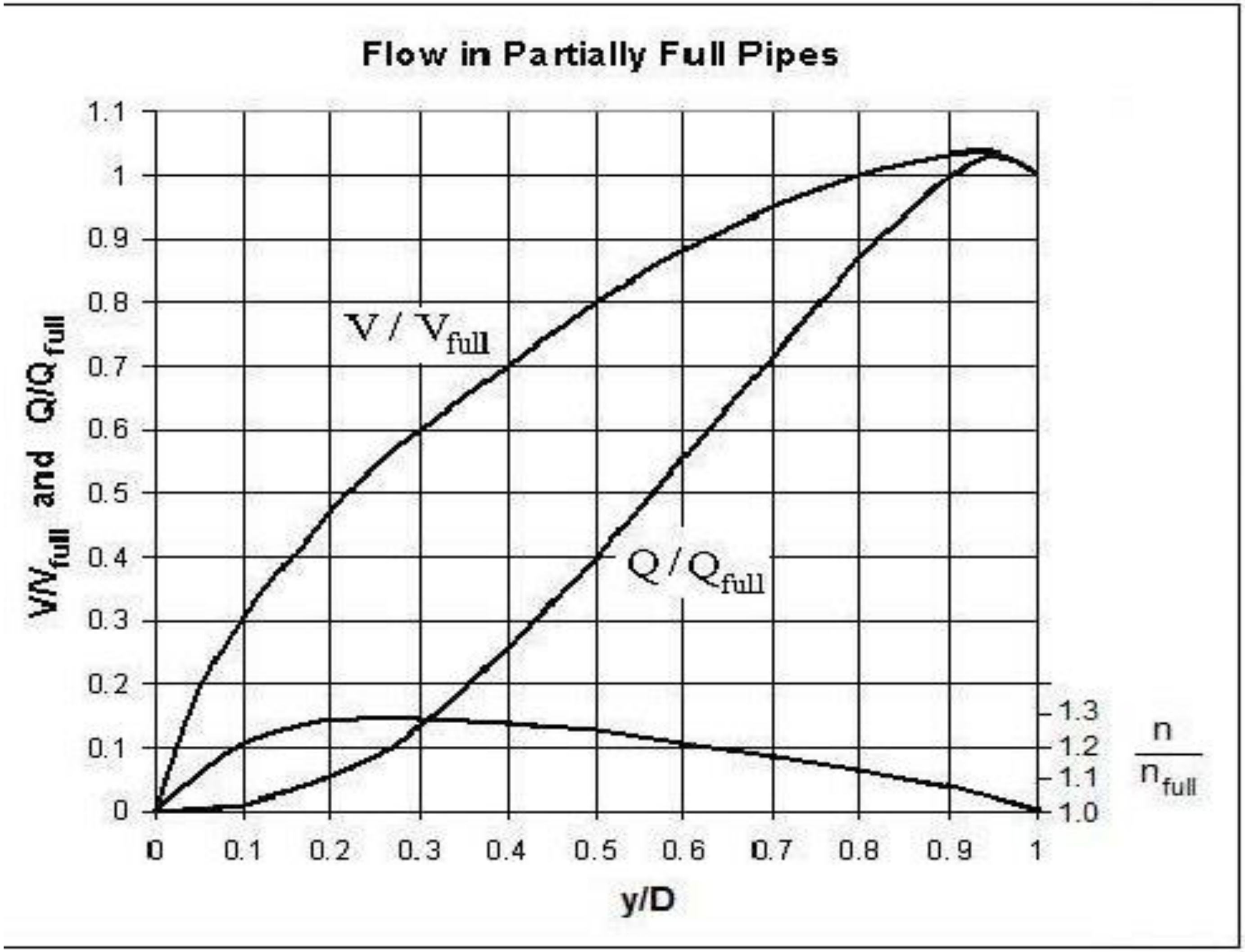
Use design Criteria

5. Calculate the size and slope of an partially combined sewer serving a population of 15000 persons. How many extra persons can serve if the slope is doubled. The per capita water consumption is 400 Lpcd.

Sewers Flowing Partially Full

- It is necessary to determine velocity and depth of sewage in a pipe when it is flowing only partially full.
- For this , use of graph will allow quick computation of the hydraulic elements of partially flow circular sewer.

Sewers Flowing Partially Full



- **For using this graph , it is necessary to calculate the hydraulics elements or design parameters when a sewer is flowing full.**
- **Then by calculating the ratio of any two known hydraulic elements partially flow sewers elements can be calculated**

Significance of partial flow study

Conditions during partial flow, must frequently determined in combined/ partially combined sewers due to following reasons:

1. To investigate velocities during dry weather flow to eliminate possibilities of deposits occurring in pipes.
2. Knowledge of depth of flow is of value in designing sewer intersections. Large sewers should be brought together at elevations so that water may not back up into the other.

Numerical

6. A 600mm circular combined sewer is laid on a slope of 0.0021 and it is flow full with n=0.013.What will be the velocity and depth of flow when sewer is carrying 0.054m3/sec discharge.