University Of Technology
Building and Construction Eng. Dept.
Final Exam – First Attempt – 2010/2011

Branch : Building & Const. Manage. **Class: Third**
subject : Sanitary Engineering **Time : 3 Hours**
Examiner : Dr. Aumar Alnakeeb **Date : 15/ 6/ 2011**

Note: Answer Four Questions Only.

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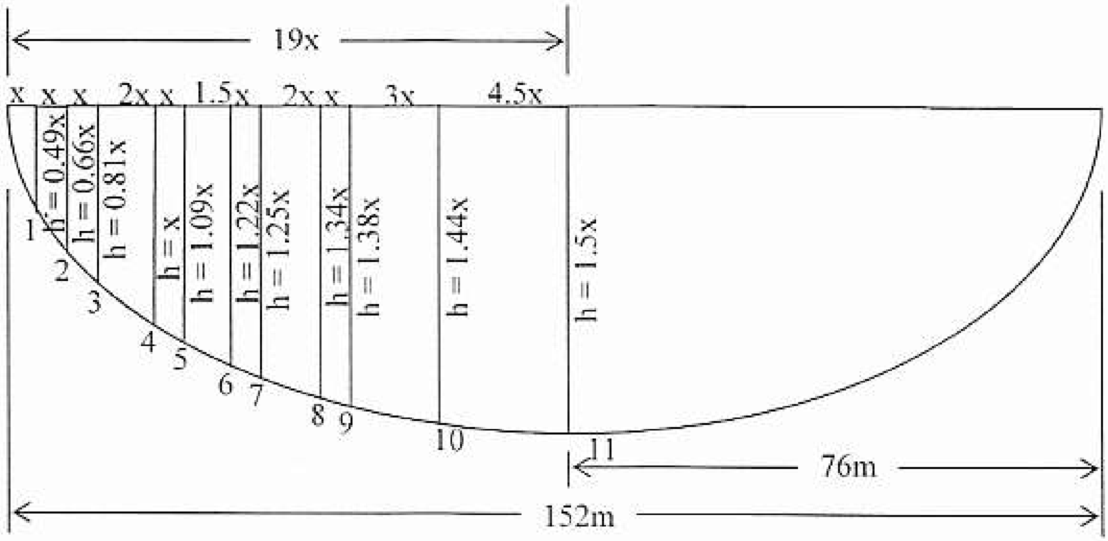
Q1\ Data obtained from velocity measurement for the river cross-section are shown in the figure below. Assume it have a regular section. Find the time of travel to reach 5 km river distance.



Line	Velocity (m/s)
1	0.04
2	0.07
3	0.11
4	0.20
5	0.33
6	0.47
7	0.53
8	0.60
9	0.68
10	0.81
11	0.91

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Q2\ Determine deoxygenation rate constant and ultimate BOD by Using Thomas slope method for equal time increments and BOD data at 20°C are shown in table below:

Time, (day)	0	1	2	3	4	5	6	7	8	9	10
BOD, (mg/L)	0	76.6	94.8	108.0	116.6	122.8	127.8	131.4	134.4	137.0	139.2

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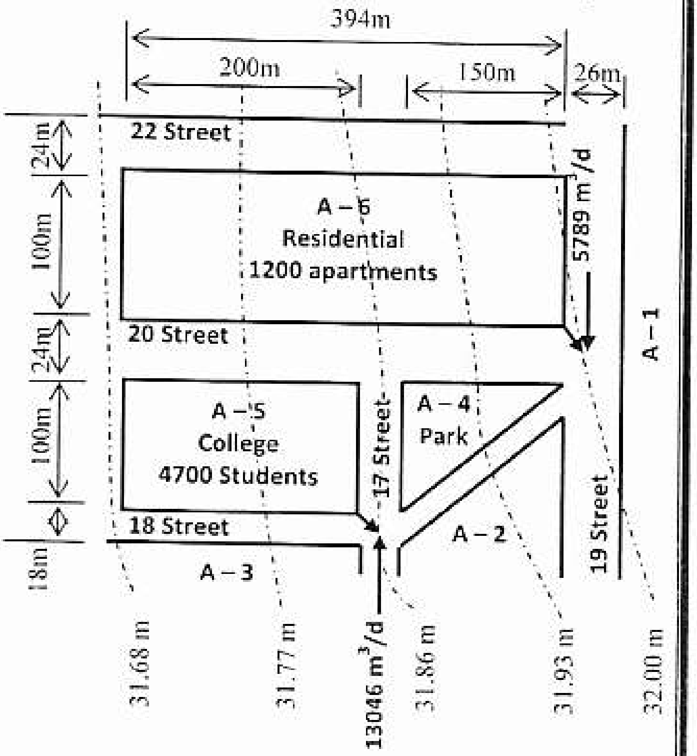
Q3\ Design and layout a gravity flow trunk sanitary sewer for the area shown in the figure below. Neglect infiltrations; assume that the following design criteria have been developed based on an analysis of local conditions and codes.

1. For design period use the saturation period.
2. Population density For residential area is 6 persons/apartment of average wastewater flow 180 L/ (c d).
3. For institutional average flow 35 L/ (stud. d)
4. For peaking factor use the formula: $PF = \frac{5}{\sqrt[6]{P}}$ where P = Population in thousand; For institutional PF = 3.0
5. n = 0.013
6. Minimum depth of cover = 2.0m



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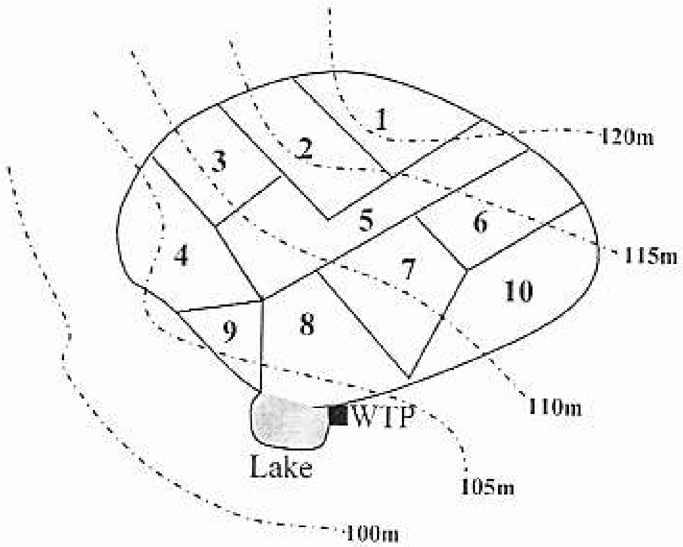
Q4\ A meteorological data recorded the monthly mean rainfall of the city district areas are shown in the tables and figure below. (A) Estimate the amount of water that can store in a lake and how many people can be served, assuming 200 L/(c d) is needed. (B) If the city recorded the population of 34,516 and 48,781 in the 1980 and 1998 census, respectively; use constant percentage method to estimate the end year this lake can serve as a source of water treatment plant.

month	Rainfall (cm)	Evaporation (cm)	Infiltration (cm)
1	133	16	10
2	128	18	10
3	97	17	8
4	141	33	13
5	62	15	6
6	46	13	5
7	14	5	2
8	19	6	3
9	38	9	4
10	75	14	7
11	83	12	7
12	107	14	8



District	Area (ha)
1	61
2	72
3	44
4	83
5	88
6	66
7	92
8	97
9	22
10	105

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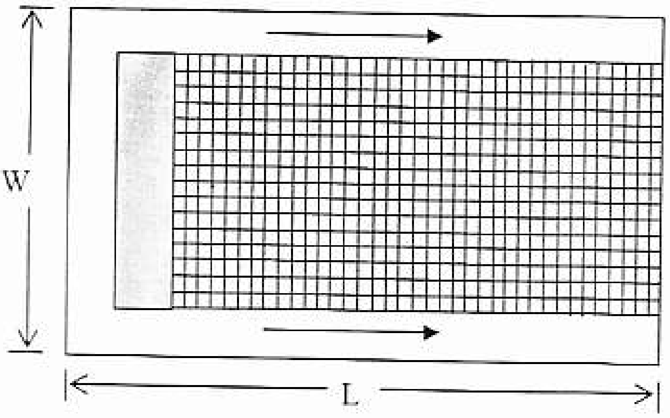
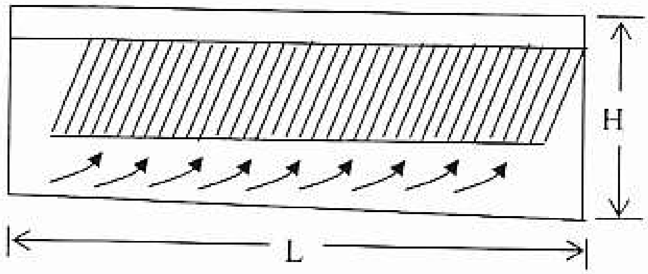
Q 5\ Design and check the horizontal velocity and Reynolds number of tube settler sedimentation basin shown in figure below. Use the following data:

1. Minimum floc size to be removed = 0.02 mm with S.G. = 2.6
2. Theoretical settling velocity = 0.22 mm/s
3. $\mu = 0.00113 \times 10^{-3}$ N s/m^2; $\rho = 999$ kg/m^3
4. Square honeycombs size = 50.8 mm inclined at a 60°
5. Tube vertical height is 1.3 m
6. Basin flow rate = 0.5 m^3/s
7. Safety factor = 0.6
8. L = 4W





With my best wishes.

Useful Equations & Notes

$$\frac{dy_i}{dt} = y_i' = \frac{(y_i - y_{i-1})\left(\frac{t_{i+1} - t_i}{t_i - t_{i-1}}\right) + (y_{i+1} - y_i)\left(\frac{t_i - t_{i-1}}{t_{i+1} - t_i}\right)}{t_{i+1} - t_{i-1}}$$

$$na + b\sum y - \sum y' = 0 \qquad K_1 = -b$$

$$a\sum y + b\sum y^2 - \sum yy' = 0 \qquad L_a = -a/b$$

$$k_p = (\ln P_2 - \ln P_1)/(t\_2 - t\_1)$$

$$\ln P = \ln P_2 + k_p(t - t_2)$$

$$u = \frac{Q_w}{A(H\cos\theta + w\cos^2\theta)}$$

$$v = \frac{Q}{A}\sin\theta \qquad R = \frac{vr}{\mu}$$

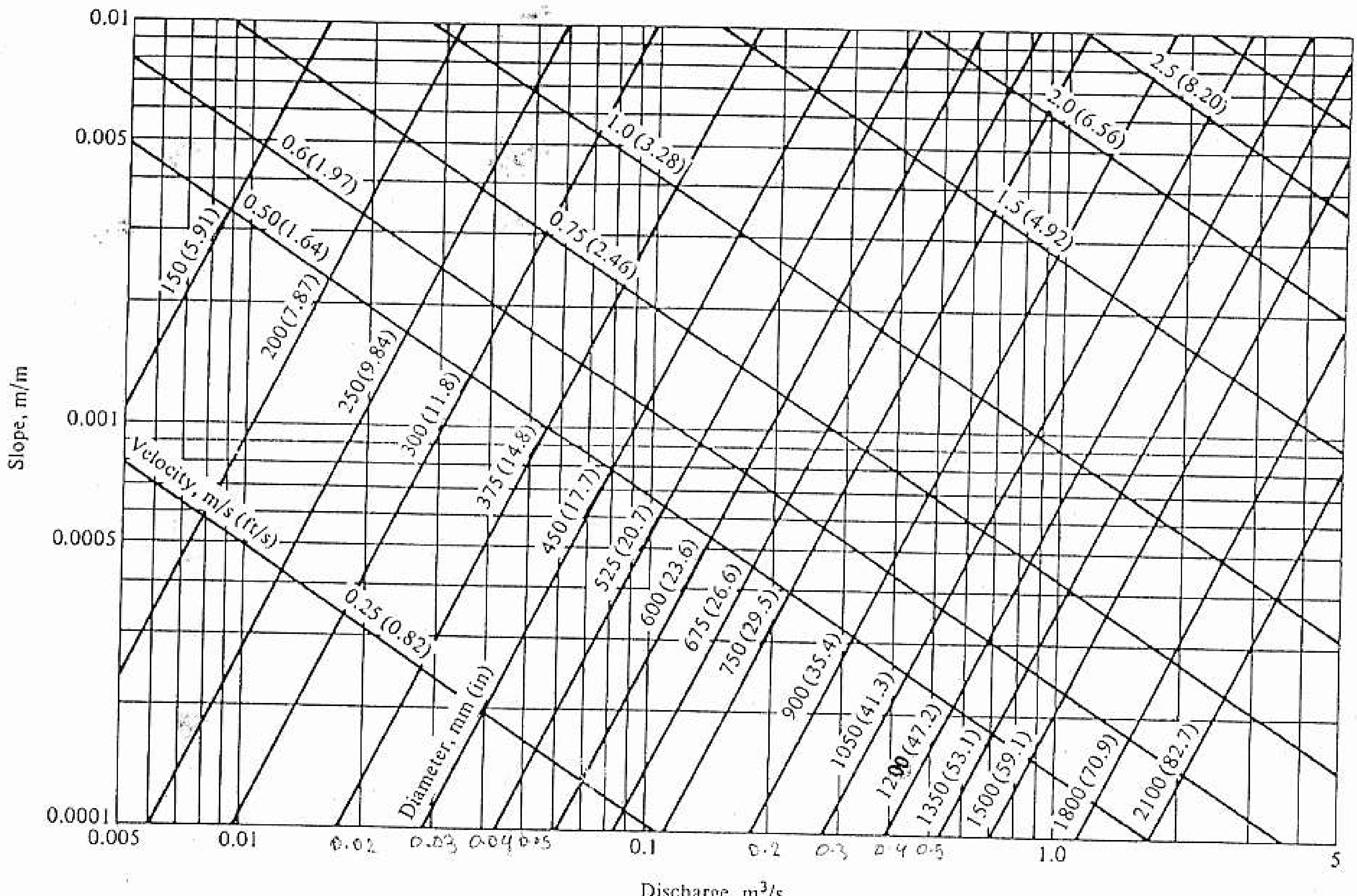


Figure 6-10 Nomograph for solution of Manning's equation for $n = 0.013$.