Civinnovate

Discover, Learn, and Innovate in Civil Engineering

TUTORIAL: 1

1. The present population of a city is 300,000 which was 170,000 twenty years ago, 150,000 thirty years ago, 105,000 forty years ago, 95,000 fifty years ago and it was 30,000 sixty years ago. Estimate the population of the city after the next 20 years by changing rate of increase method, incremental increase method and geometrical increase method. Discuss for forecasted population with your comment.
   Estimate the water demand for that designed year.

2. Population of a town as obtained from the census report is as follows

Census year (B.S.)	2001	2011	2021	2031	2041	2051	2061
Population	24831	25293	25423	27263	38284	49909	67105

   Estimate the population of the town for years 2081 and 2091.

3. Assuming a geometric rate of growth of population of a semi-urban settlement , calculate with the help of the following census records, expected population of the settlement in 2041AD.

Year	1991	2001	2011
Population in thousands	242	485	710

4. The population of a locality as obtained from census reports is as follows:

Census year	1901	1911	1921	1931	1941	1951	1961	1971	1981
Population	8000	12000	17000	22500	29000	37500	47000	57000	66500

   Estimate the population of locality in the years 2021 and 2041 by any three methods. Then choose any one for design of water supply system with your own justification.

5. Forecast the population of a village at the end of 30 years design period by any three methods. The population data collected from population census as follows:

Year (B.S.)	2008	2018	2028	2038	2048
Population	2100	2550	2880	3050	3270

   Justify your population forecast with comment.

6. Determine the daily water demand for the coming year 2020 AD for the Duwakot VDC in Bhaktapur district as per following statistical data of 2000 AD
   i. No. of households(HHs) =300
   ii. Average population in a HH =5 nos.
   iii. Annual population growth rate =1.2%

v. 10 nos. of small poultry farms ... chicken and 60 animals (cows, buffaloes) in VDC.
vi. NEC campus with maximum capacity of 380 students and other staff 50.
vii. Other offices with altogether 180 personnel capacity.
viii. One healthpost without bed

7. Determine the daily water demand for the coming year 2030 AD for the Khara VDC in Rukum district as per following statistical data of 2000 AD.

(a) No. of households(HHs) =70
(b) Average population in a HH =7 nos.
(c) Annual population growth rate =2.1 %
(d) 7 nos. of schools with 50 day scholar students and staffs in each school
(e) Household animals with all together 1500 chicken and ducks and 160 animals (cows, buffaloes)
(f) Other offices with altogether 180 personnel capacity
(g) One healthpost with 10 beds capacity
(h) One police station with 12 cadets

8. Estimate the total water demand for the year 2085 B.S. for a village from the following survey data.

Base year	=2067 B.S.
Population	=2000
Annual population growth rate	=2.1%
No. of students in the school	= 10% of total population
No. of buffaloes	= 100
No. of chicken and birds	=500
No. of pigs, goats	= 100
No. of restaurant in the area	= 1
No. of tea shops	=1

9. Determine the daily water demand for the coming year 2030 AD for the Rukum VDC as per following statistical data of 2000 AD

i. No. of households(HHs) = 90
ii. Average population in a HH = 8 nos.
iii. Annual growth rate = 1.9 %
iv. 7 nos. of schools with all together 150 day scholars' students and staffs.
v. No. of buffaloes = 20
vi. No. of goats = 132
vii. No. of chicken and ducks = 325
viii. No. VDC office = 1
ix. Other offices with altogether 180 personnel capacity.
x. One healthpost with 10 beds capacity
xi. One police station with 12 cadets.
xii. No. of tea shops =1

volumes: Solution A with 100 ml volume and pH of 6 and solution B with 850 ml volume with pH of 7

2. 700 ml of water sample A with pH of 6 is mixed with 300 ml of sample B with pH of 7 and 500 ml of sample C with pH of 8. Calculate the pH of the resulting mixture.

3. The analysis of a water sample shows the following results in mg/l:
   $Na = 20$; $K = 30$; $Ca = 7$; $Mg = 12$; $Cl = 40$; $HCO_3 = 68$; $SO_4 = 7$; $NO_3 = 12$
   The concentration of strontium (Sr) is equivalent to a hardness of 2.52 mg/l and the carbonate alkalinity in this water is zero. Calculate the Total hardness, carbonate hardness and Non-carbonate hardness in mg/l as $CaCO_3$.

4. The total hardness value obtained from the complete analysis of a water sample is found to be 135 mg/l. The analysis further showed that the concentrations of all the three principal cations causing hardness are numerically the same. If the value of carbonate hardness is 60 mg/l, calculate the following:

   a) The value of non-carbonate hardness;
   b) The concentrations of principal cations; and
   c) The value of total alkalinity in mg/l

5. There are three samples A, B, C of water having pH values of 4.4, 5.4 and 6.4 respectively. Calculate how many times sample A is acidic than sample B and C respectively.

6. The analysis of a water sample from a well shows the following results in mg/l:
   $Na = 101.5$; $K = 21.5$; $Ca = 65$; $Mg = 51$; $Cl = 79.2$; $HCO_3 = 248$; $SO_4 = 221.8$
   Calculate the Total hardness, Carbonate hardness and Non-carbonate hardness in mg/l as $CaCO_3$.

7. Calculate the hardness of water with the following analysis

Concentration presence (mg/l)	Concentration presence (mg/l)
Na^+ -20	Cl^- --40
Ca^{2+} -15	SO_4^{2-} --16
Mg^{2+} -10	NO_3^- —1
Sr^{2+} -2	Alkalinity-50

1. Water is to be supplied to a village having daily water demand of 66370 liter from a stream source with a safe yield of 0.78 l/sec through 22 public stand posts. Assume the flow from each public standposts as 0.1liter/sec. Take hourly consumption pattern as follows. Determine the capacity of service reservoir.

Distribution hours	Water consumption
5 A.M.-7 A.M	25%
7 A.M –12:00	35%
12-5 P.M.	20%
5 P.M.-7 P.M.	20%
7P.M.-5 A.M	0%
	100%

2. Determine the storage capacity of a service reservoir for a town having one million population with per capita water demand of 150 liters/day. Assume that uniform pumping is done from 6.00 to 18.00 hours. Neglect the fire demand. The variation in demand is as the follows.

Time.(hr)	Water demand (%)
05-09	40
09-12	15
12-15	10
15-18	15
18-21	20
21-24	0
24-05	0

3. A village in mid-western development region of Nepal has a design year water demand of 15000 liters/day. The demand is to be met by continuous system of supply from spring source with safe yield of 0.2 lps. The consumption pattern is as follows:

Time(hour)	Consumption, %
5.00-7.00	25
7.00-12.00	35
12.00-17.00	20
17.00-19.00	20
19.00-5.00	0

4. A town with a population of 0.1million is to be supplied with water daily at 200 liters per head. The variation in demand is as follows.

Time	% of total demand
6 A.M.-9 A.M	40%
9 A.M –12 Noon	10%
12 Noon - 3 P.M.	10%
3 P.M.- 6 P.M.	15%
6P.M.- 9 P.M	25%
	100%

Determine the capacity of service reservoir assuming pumping to be at uniform rate and the period of pumping is from 6 A.M. to 6 P.M. Neglecting fire demand. Solve by both analytical and graphical method.

5. The water demand of a town is 960 m^3/day. The water demand is to be met through pumping from a tube well. The recommended pumping period is 4.00 to 10.00 hours in the morning ad 16.00 to 22.00 hours in evening. The water is supplied to the consumers from the reservoir by intermittent system supplying water from 5.00 to7.00 hours in the morning and 16.00 to 18.00 hours in the evening. Calculate the capacity of the balancing reservoir by mass curved method. Assume necessary data suitably.

6. Determine the storage capacity of a balancing reservoir by analytical method for 10 hr. pumping (from 5.00 AM –10.00 AM and 2.00 PM –7.00 PM) and continuous water supply. The city with a population of 2.5 million has a water demand of 110 lpcd. The consumption pattern is as follows:

Time	Consumption %
05.00 –10 .00	35
10.00 –14.00	15
14.00 –19.00	25
19.00 –22.00	15
22.00 –05.00	10

7. A city with a population of 1.2 million has a water supply of 250 liters per capita per day. The house variation in the consumption of water is as follows. Determine the capacity of balancing reservoir by both analytical and mass curve methods. If case
(a) pumping (gravity) and supply (gravity) both continuous.

(b) pumping continuous and water supply intermittent (1^{st}. shift 5 A.M. to 7 A.M. hr and 2^{nd}. shift 4P.M. to 6 P.M.)

water supply continuous.

(d) pumping is to be done for 12 hrs from 5 A.M. to 11 A.M. and 3 P.M. to 9 P.M., water supply continuous. and water supply intermittent (1^{st}. shift 5 A.M. to 7 A.M. hr and 2^{nd}. shift 4P.M. to 6 P.M.)

Consumption patterns

Hours	Water consumption in liter/ capita
12 midnight to 5 A.M.	10
5 A.M. to 11 A.M.	95
11 A.M. to 3 P.M.	30
3 P.M. to 9 P.M.	90
9 P.M. to midnight	25

8. The following data gives the monthly inflows during the low flow period at the site of a proposed dam. Determine analytically the storage capacity required of impounded reservoir to maintain a constant demand of 3500 million liters of water per month.

Month	**Inflow, m^3/s**	**Month**	**Inflow, m^3/s**
January	0.05	July	1.85
February	0.47	August	3.04
March	0.69	September	3.25
April	1.05	October	1.15
May	1.35	November	0.25
June	1.95	December	0.15

1. Find the settling velocity of spherical silica particles of specific gravity 2.67 in water at 25°C, if the diameter of particle is as given below:
   a. 0.04 mm
   b. 0.4 mm
   c. 1.0 mm

   Assume kinematics viscosity υ =0.9 centistoke.

2. Find the settling velocity of discrete particles having the diameter of 0.05 mm and 0.15 mm, specific gravity 2.65 and 2.1 respectively in water under conditions when Reynolds number is less than 0.5. The temperature is 20 °C.

3. Find the diameter of the particles with the specific gravity of 1.4 removed in a tank having a surface area of 300 m^2 and treating 20 million liters of water per day. Assume temperature of 20° C with kinematic viscosity of 1.01 centistokes.

4. A settling tank is designed for an overflow rate 4000 lit/hr/m^2. What percentage of particles of diameters:
   a. 0.05 mm
   b. 0.02 mm will be removed in the tank at 10 °C. Take Ss = 2.65 for both sizes.

5. What percentage of particles of diameter 0.03 mm will be removed in a tank at 15 °C? Given: Ss = 2.65 and overflow rate is 100 m/day.

6. Design a plain sedimentation tank for the following data.
   Volume of water to be treated = $3*10^6$ lit/day
   Detention time = 4 hrs.
   Velocity of flow = 10 cm/min

7. Find the quantity of alum required in a treatment plant of capacity 12 million lit/day. If optimum dose of alum is 3.0 mg/l.

8. Find the chlorine dose and chlorine-demand for the water supply of 25000 m3/day which need 9 kg/day. The proposed residual chlorine is 0.2 ppm after the contact time 20 min.

9. A settling tank is designed for an overflow rate of 3000 liters per m^2 per hour. What percentage of particles of diameter 0.025 mm having specific gravity 2.65 will be removed at 20° C?

10. Find the settling velocity of spherical silica particles of specific gravity 2.65 in water at 21 °C, kinematic viscosity, υ =1.001 centistokes, if the diameter of particle is:

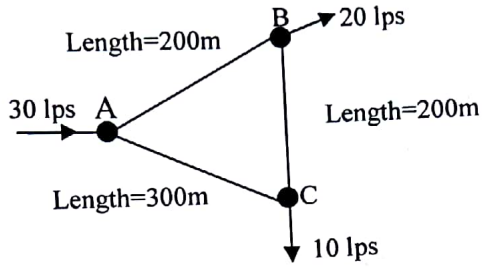
a.0.05 mm
b.0.4 mm
c.1.0 mm

8. Design a set of six slow sand filter beds from the following data and show the arrangements of bed in plan:
(i) population to be served = 50,000 persons
(ii) Quantity of water to be supplied = 200 lpcd
(iii) Rate of filtration = 300 litres per square meter per day
(iv) Length of each bed = twice the breadth

9. Design a set of rapid gravity filters for treating water required for a population of 40,000; the rate of water supply being 135 litres per head per day. The filters are rated to work at 5200 litres per square meter per day. Assume necessary data.

10. Design slow sand filter beds from the following data:
(a) Population to be served = 55,000
(b) Avg. Rate of demand = 112 lpcd
(c) Rate of filtration = 165 litres per square meter per day
(d) Length of each bed = Twice the breadth
(e) Assume max. Demand as 1.8 x average daily demand
(f) Assume that one unit will be kept as standby

Assume Hazen William's co-efficient as 100 for all the pipes.

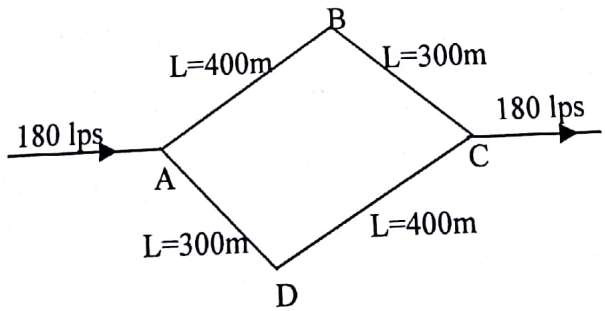


Assume that RL of points A, B and C is same. The pressure available at A is 15kg/cm^2 and the minimum pressure required at B and C is 1.5 Kg/cm^2.

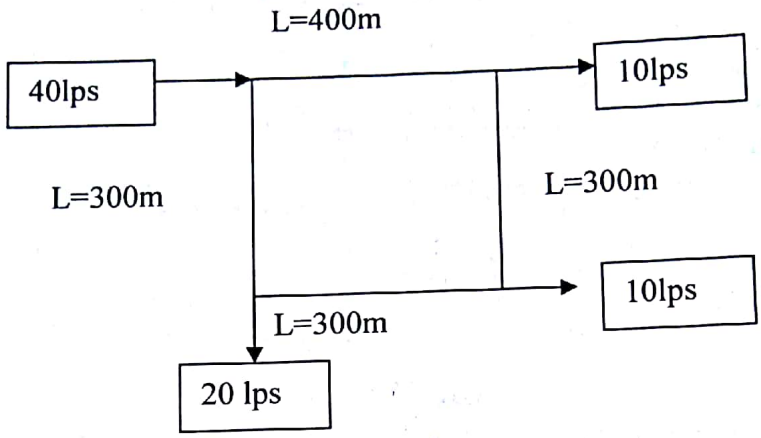
2. Water supply lines are to be laid in a dead end type network as shown in figure below. The figure also shows the various zones of the town and the population to be served in each zone. The average water requirement of the town is 175 lpcd. Design the pipes of distribution system AB and BC with the following data.

   RL of the bottom of the overhead tank =290 m
   RL of B = 260m
   RL of C =240m
   Length of pipe AB =800m
   Length of pipe BC =600m
   Peak factor =2.5
   Hazen William's coefficient, C=100.
   Minimum pressure to be maintained at any point in the distribution system =1.5 Kg/cm^2.

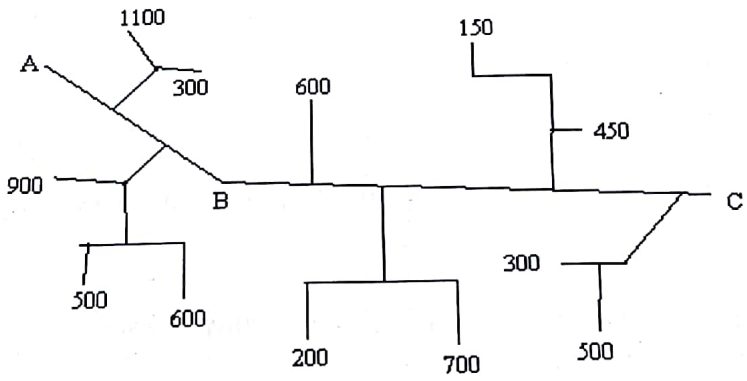
3. Calculate the discharge in pipes AB, BC, CD and AD for the water distribution system as shown below. Assume C=100.



method. Where C=100 and diameter of pipe
losses.



5. A typical layout of pipes in dead end pattern is given in figure below. The average water requirement is 150 lpcd and the population in different residential blocks is given in the figure itself. The elevated storage tank is fixed at point A. The R.L. of bottom of the elevated storage tank is 150.0m and the R.L. points A, B and C are 140, 130 and 121 meters respectively. If the minimum pressure head of water is to be maintained at 10.0m. Design suitable size of pipes AB and BC whose lengths are 900 and 600 meters respectively. Assume Hazen Williams' coefficient C as 100 and maximum demand as 2.7 times the average demand.



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