Distribution Works

Distribution Works:

1-High lift pumps and boosters pumps

purpose:

Raise the water from the ground tanks to the water network distribution system in the city.

- Pumps works 24 hours with constant rate.
- Pumps works 24 hours with two different rates.
- Pumps works 12 hours with constant rate.

2-Elevated Tanks:

Purpose: (with regard to water quantity)

A) Cover the fluctuation in water consumption through a day.

B) Cover 20 % of the fire demand.

Purpose: (with regard to pressure)

1- Near H.L.P:

a) fix the head of the pumps so it works with max. Efficiency

b) protect the pumps from water hummer

2- In the middle of the city:

a) improve the pressure of the city max consumption

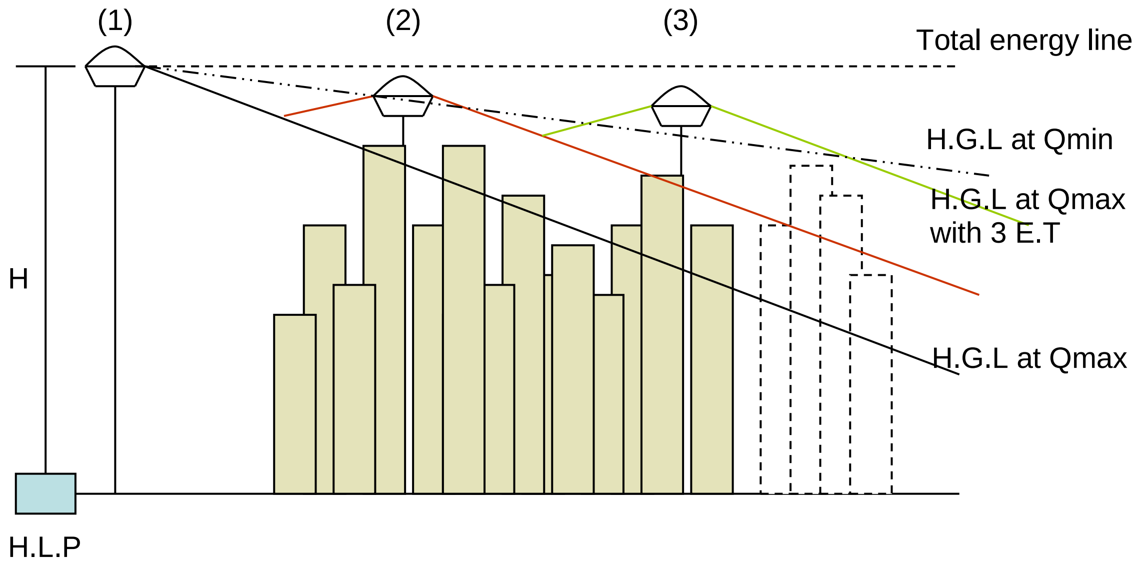
3- At the end of the city:

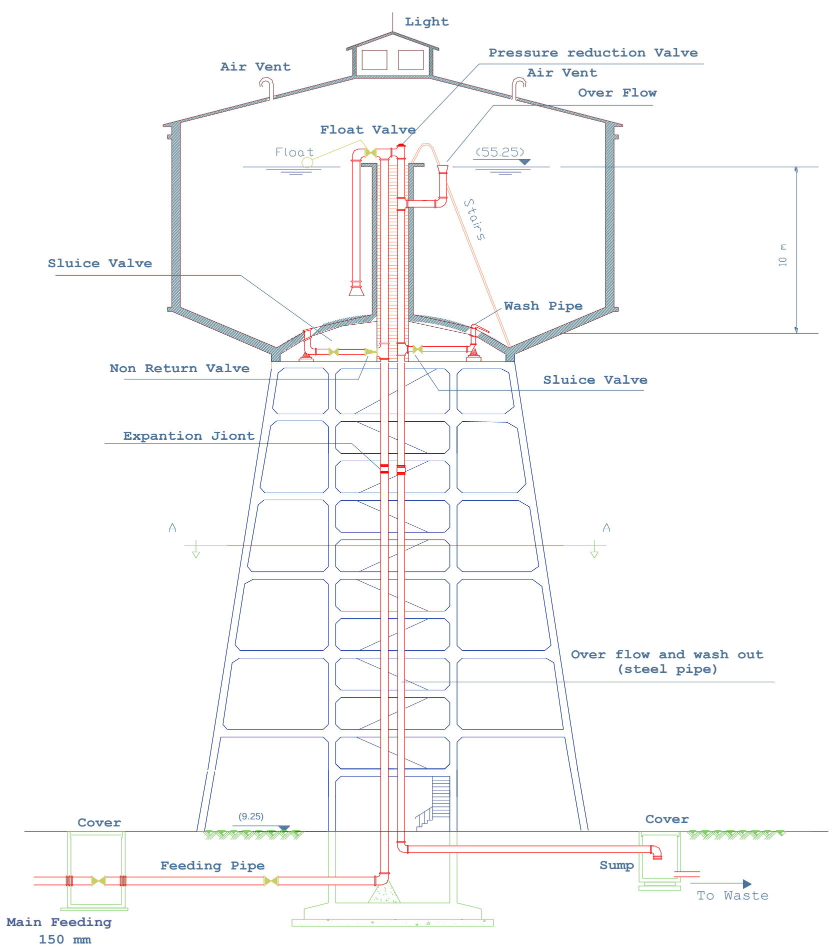
a) improve the pressure at the end of the city

b) give the ability to make extension to the city

c

Photographs of elevated tanks





Elevated tank

Design criteria:

1- Capacity = equalizing storages + 0.2 (120 x population/10000)

2- Capacity = A x d = n x π ($\Phi^2 o$ - $\Phi^2 i$) /4 x d

3- Φi = 1 - 3 m

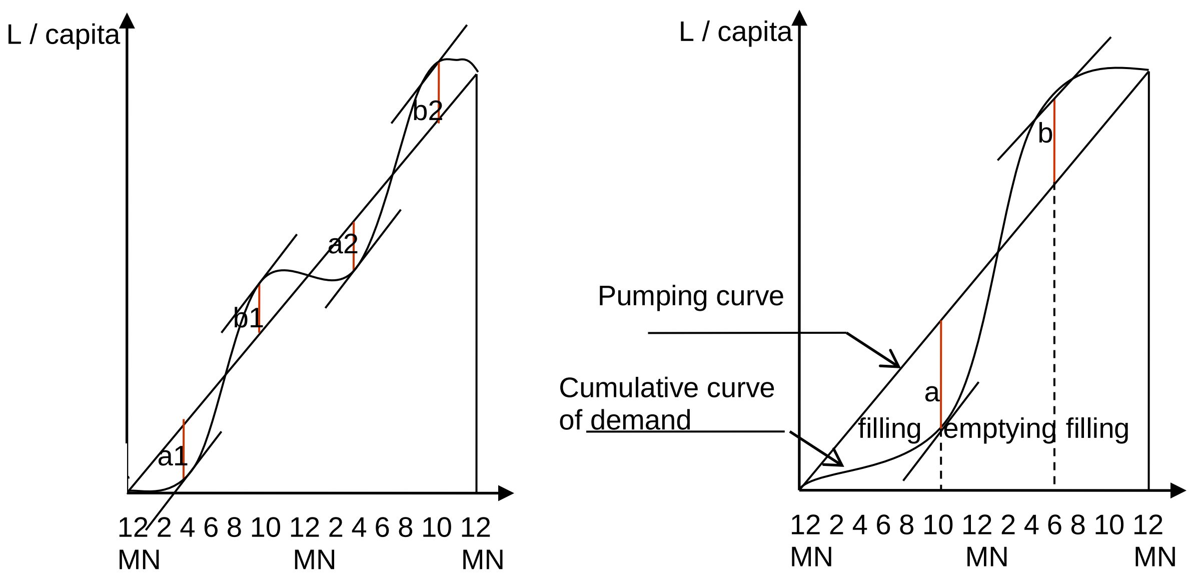
4- d = 10 m

5- n ≥ 2

6- Φo ⩽ 35 m

The pumps are working with constant rate.

Cumulative curve

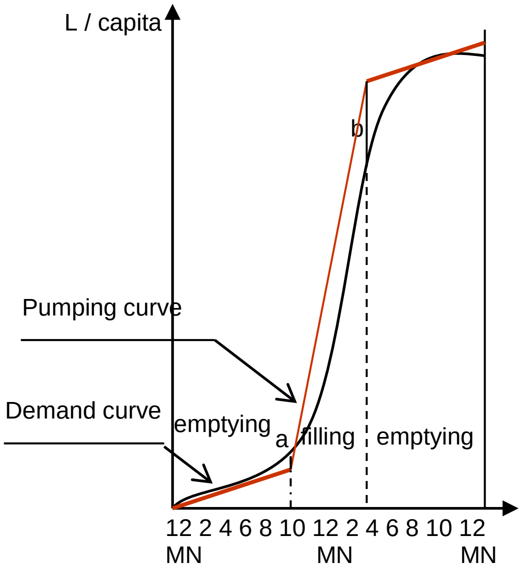


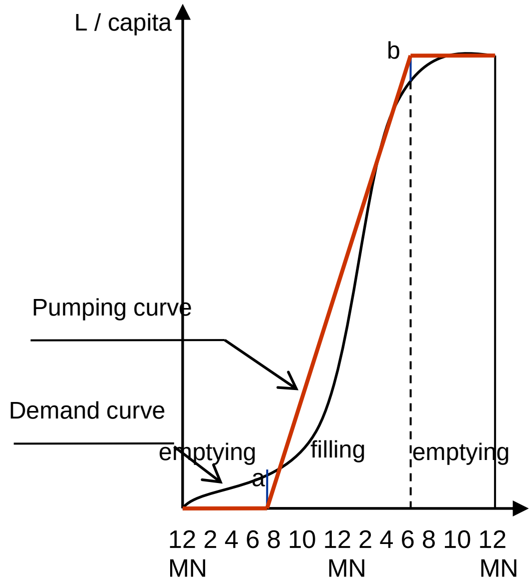
Equalizing storage = bigger of a + bigger of b   Equalizing storage = a + b

The elevated tank is filling when the slope of tangent of the demand curve is less than the slope of the pumping curve.

The elevated tank is emptying when the slope of tangent of the demand curve is bigger than the slope of the pumping curve.

Pumps are working with two different rates





Equalizing storage = a + b

Example:

A city has a population of 50000 capita. The given table shows the total water consumption for maximum daily water consumption for this city at two hours periods at the stated time, The high lift pumps are to operate in accordance with the following during 24 hours:

1- At 150 % of the average rate from 8.00 am to 8.00 pm.

2- At 50 % of the average rate for the other hours of the day.

It is required to:

Find the average daily water consumption for this city in l/c/d.

Design the elevated tanks.

How much water is in the elevated tanks at:

1- 8.00 am 2- 8.00 pm 3- Noon 4- Midnight

4- What are the filling and empting hours?

5- Determine the diameter of the water rise feeding the elevated tank.

Time (hrs)	2	4	6	8	10	12	14	16	18	20	22	24
Cumulative Water Consumption (m3)	600	1000	1800	2300	3500	5000	6500	7900	9300	10600	11300	12000

Solution:

$$Q_{ave} = \frac{12000 \times 1000}{50000} = 240\, l/c/d$$

$$Qp = \frac{12000}{24} = 500\, m^3/hr$$

$$150\%\ of\ Qp = \frac{500 \times 150}{100} = 750\, m^3/hr$$

$$50\%\ of\ Qp = \frac{500 \times 50}{100} = 250\, m^3/hr$$

Hours	Q_p	Q_c	Q_p-Q_c	Σ Q_p-Q_c	storage
0-1	250	300	-50	-50	250
1-2	250	300	-50	-100	200
2-3	250	200	50	-50	250
3-4	250	200	50	0	300
4-5	250	400	-150	-150	150
5-6	250	400	-150	-300	0
6-7	250	250	0	-300	0
7-8	250	250	0	-300	0
8-9	750	600	150	-150	150
9-10	750	600	150	0	300
10-11	750	750	0	0	300
11-12	750	750	0	0	300
12-13	750	750	0	0	300
13-14	750	750	0	0	300
14-15	750	700	50	50	350
15-16	750	700	50	100	400
16-17	750	700	50	150	450
17-18	750	700	50	200	500
18-19	750	650	100	300	600
19-20	750	650	100	400	700
20-21	250	350	-100	300	600
21-22	250	350	-100	200	500
22-23	250	350	-100	100	400
23-24	250	350	-100	0	300

The equalizing storage = 700 m^3
Capacity = equalizing storages + 0.2 (120 x population/10000)
= 700 + 0.2 (120 x 50000/10000) = 820 m^3
Capacity = A x d
= n x π ($\Phi^2 o$ - $\Phi^2 i$) /4 x d
820 = 2 π ($\Phi^2 o$ - 2^2) /4 x 10
Φo = 7.23 m
- At 8.00 am. the storage in the tank = 0
- At 8.00 am. the storage in the tank = 700 m^3
- At noon the storage in the tank = 300 m^3
- At midnight the storage in the tank = 300 m^3

<u>4- Filling hours:</u>
2-4
8-10
14-20
<u>Empting hours:</u>
0-2
4-6
20-24

<u>5- Design of the water riser feeding the elevated tank:</u>
Q = A x v
Q = 150 m^3/h
Assume the velocity = 1.5 m/s

$$\frac{150}{60\times 60}=\frac{\pi\phi^2}{4}\times 1.5$$

$$\phi = 0.19 \approx 200\,mm$$