EWCE 432

Environmental Engineering Design Sessional

Pump Capacity and Pumping Schedule

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Design of Water Supply System

Water supply system includes:

1. Pumping Devices
2. Various pipes that convey water to the consumers

Design of Pumping Devices

- Pump is a primary unit of water distribution system.
- Pump and pumping machineries lift water from the source to overhead tank so that water can flow by gravity to the distribution system.

Types of Pumps:

- Submersible Pump
- Turbine Pump
- Centrifugal Pump etc.

Each type of pump has certain advantages and disadvantages. Here we will use submersible pump

Design of pumping devices includes

a) Determining pump capacity

b) Pumping Schedule

a) Determining Pump Capacity

1. Divide the whole plan area in some zones like residential zone, industrial zone etc.

2. Calculate the number of well/pump required for each zone.

3. Determine the capacity of each pump

Number of well/pump required for each zone

Type	Present Water Demand L/day	Present Tubewells Requirements	Future Water Demand L/day after 10 Years	Tubewells Requirements after 10 Years	Future Water Demand L/day after 20 Years	Tubewells Requirements after 20 Years
Residential	1859865	2	2158449	3	2478031	3
Industrial	572530	1	629783	1	715663	1
Common Facility	722392	1	794631	1	902990	1
Total	*3154787*	*4*	*3582863*	*5*	*4096684*	*5*

Pump Capacity:

i) Working Horse Power,

WHP= HQ/3960

Where,

H= Total head or lift of the pump (ft)

Q= Yield of well (gpm)

ii) Breaking Horse Power,

BHP= WHP/η

Where,

η= Pump Efficiency = 75%

Total Head / Total Lift of Pump

= Static head + Velocity head + Friction head

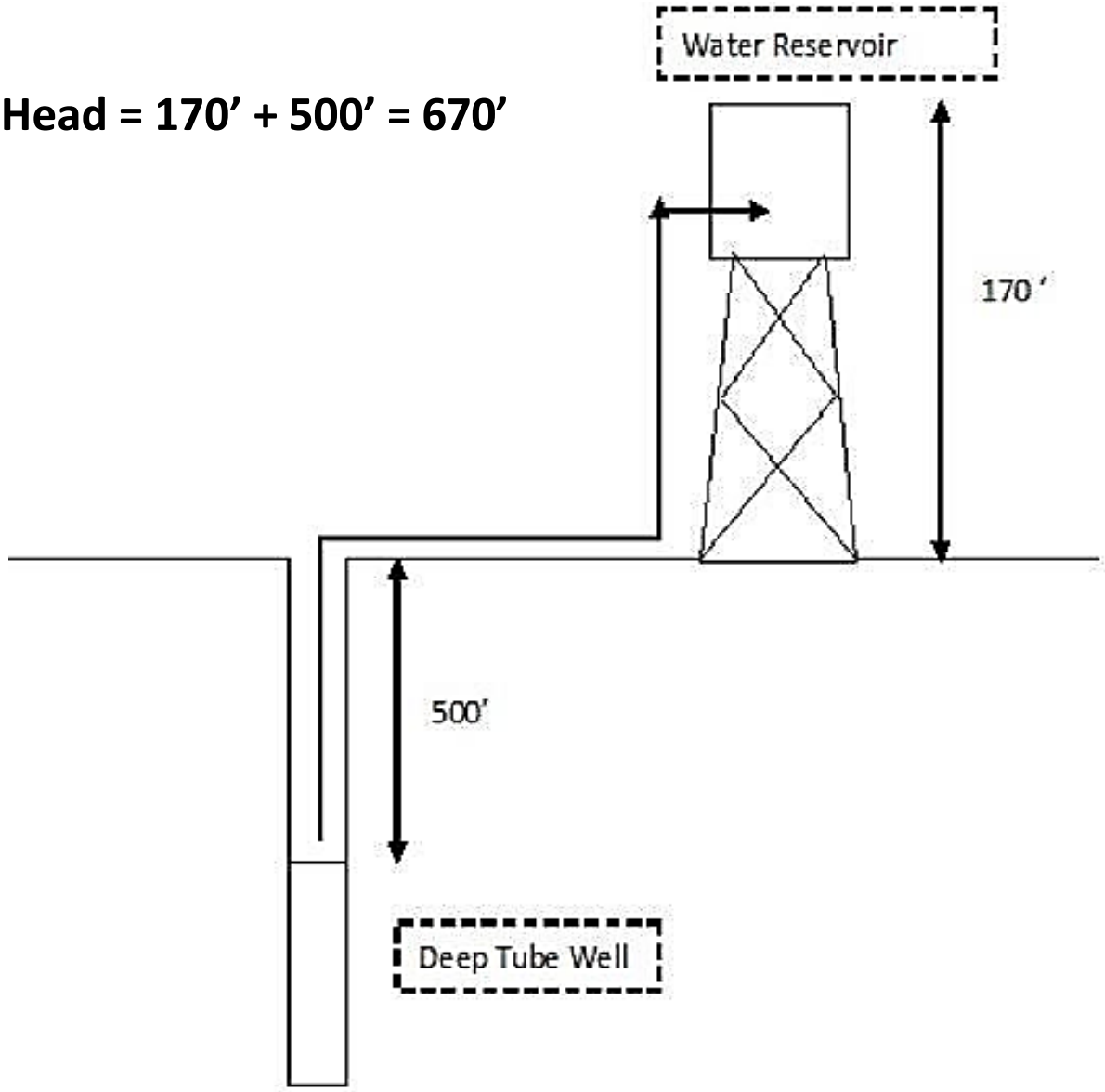
Static Head

= Suction head (h_s) + Delivery head (h_d)

Suction head, $h_s = 0$ (for submersible pump)

Delivery head, h_d = Static water level + Max building height

Delivery Head = 170’ + 500’ = 670’



Velocity Head

$h_v = v^2 / 2g$

Assume, *Velocity of water supply = 3 fps*

Friction Head

- Friction loss is assumed to be 10% of maximum pipe length
- Maximum pipe length

= Maximum horizontal distance + Maximum height of the building + Height of rooftop tank

$$\text{Total Head, } H = h_s + h_d + h_v + h_f$$

Pump	Pipe length	Friction Head	Static Head	Velocity Head	Total Head	Yield of Well	WHP	BHP
		hf	hS	hv	H	Q		
	ft	ft	ft	ft	ft	gpm	HP	HP
Pump 1	2743	274.30	335.00	0.14	609.4	237	36	49
Pump 2	2818	281.80	335.00	0.14	616.9	237	37	49
Pump 3	3721	372.10	335.00	0.14	707.2	237	42	56
Pump 4	2134	213.40	335.00	0.14	548.5	237	33	44
Pump 5	4046	404.60	335.00	0.14	739.7	237	44	59

b) Pumping Schedule

- Calculate the total present and future water demand for each zone.
- Prepare demand curves for each zone
- Prepare pumping chart

Method of Supply:

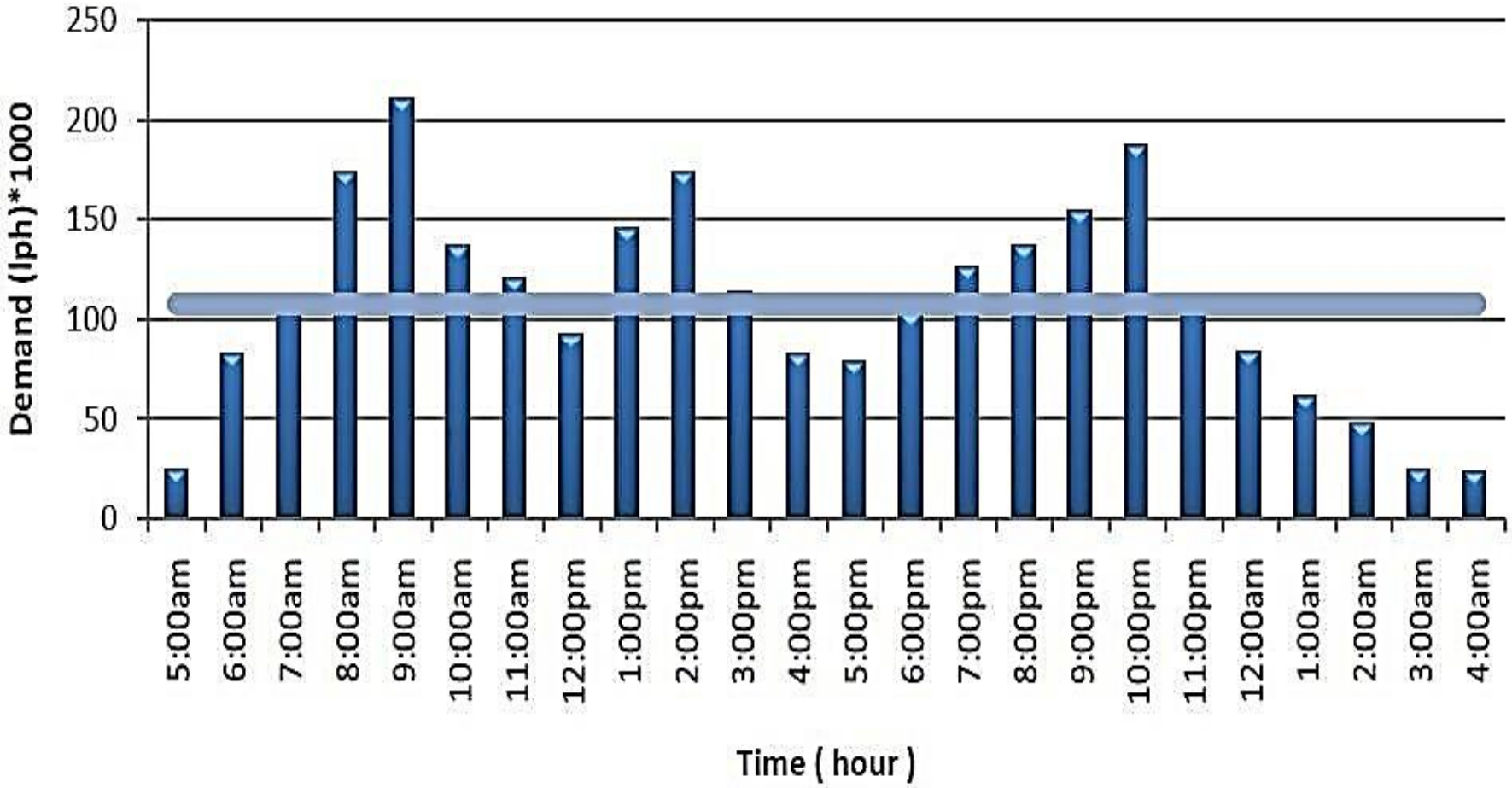
1. Continuous supply
2. Intermittent supply

Method of Distribution:

- System with pumping and storage
- Economic operation but high initial cost
- Required pressure can be maintained in the line under varying water consumption

Methodology:

1. The total present and future water demand for each zone is calculated in previous chapter.
2. Pumping Charts needs to be prepared according to this demand and pumping hour.
3. In every pumping schedule, fire demand adequacy has to be ensured.


250
200
150
100
50
0
Demand (lph)*1000
5:00am
6:00am
7:00am
8:00am
9:00am
10:00am
11:00am
12:00pm
1:00pm
2:00pm
3:00pm
4:00pm
5:00pm
6:00pm
7:00pm
8:00pm
9:00pm
10:00pm
11:00pm
12:00am
1:00am
2:00am
3:00am
4:00am
Time (hour)

Pumping Schedule for Residential Zone(Present)

Time		Demand (lph)*1000	Supply (lph)*1000	Net Storage (lph)*1000	Pumping Required	Remarks
				15+10		
4:00 AM	5:00 AM	10	50	65	Yes	Pump-1
5:00 AM	6:00 AM	10	50	105	Yes	pump-1
6:00 AM	7:00 AM	15	0	90		
7:00 AM	8:00 AM	40	0	50	Yes	
8:00 AM	9:00 AM	45	100	105	Yes	Pump-1+2
9:00 AM	10:00 AM					
10:00 AM	11:00 AM					
11:00 AM	12:00 PM					
12:00 PM	1:00 PM					
1:00 PM	2:00 PM					
2:00 PM	3:00 PM					
3:00 PM	4:00 PM					
4:00 PM	5:00 PM					
5:00 PM	6:00 PM					
6:00 PM	7:00 PM					
7:00 PM	8:00 PM					
8:00 PM	9:00 PM					
9:00 PM	10:00 PM					
10:00 PM	11:00 PM					
11:00 PM	12:00 AM					
12:00 AM	1:00 AM					
1:00 AM	2:00 AM					
2:00 AM	3:00 AM					
3:00 AM	4:00 AM			Approx 25		
Summation		680				

Pump	*Pumping Hours*		
	Present	*After 10 years*	*After 20 years*
Pump 1	16 hours	14 hours	16 hours
Pump 2	17 hours	15 hours	16 hours
Pump 3	16 hours	14 hours	15 hours 35 minutes
Pump 4	10 hours 55 minutes	12 hours	13 hours 35 minutes
Pump 5	0 hours	12 hours	17 hours