การประปาส่วนภูมิภาค
Provincial Waterworks Authority




PROVINCIAL WATERWORKS AUTHORITY

Water Distribution System

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Chief of planning section PWA

Water Distribution System

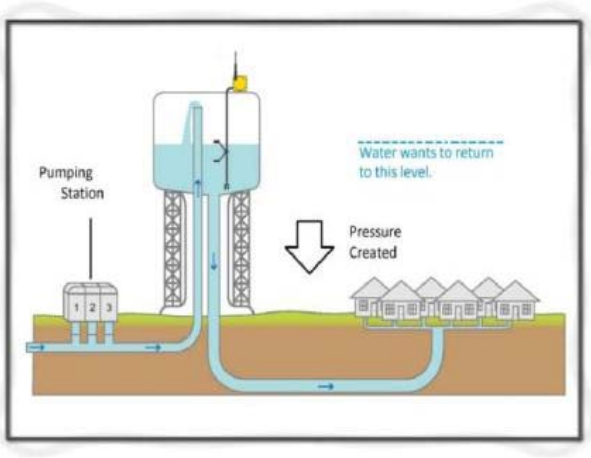
INTRODUCTION

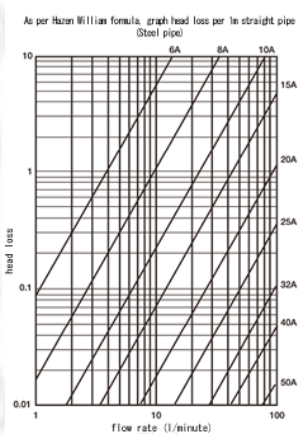
- The purpose of distribution system is to deliver water to consumer with appropriate quality, quantity and pressure.
- Distribution system is used to describe collectively the facilities used to supply water from its source to the point of usage.

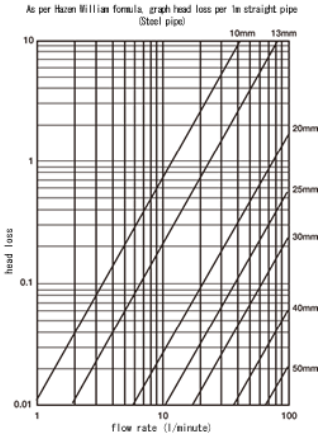
Water Distribution System

CONTENT

1. The distribution system components
2. Methods of water distribution system
3. Designing for water distribution system







The distribution system components

COMPONENTS

The distribution consists of four main components

1. Reservoir
2. Pump
3. Elevated reservoir
4. Distribution pipes

The distribution system components

RESERVOIR

The distribution system components

RESERVOIR

The distribution system components

RESERVOIR

It was construct for

1. *Balancing Reserve*. It is the quantity of water required for balancing the variations in the demand against the constant supply from the treatment plant.

The distribution system components

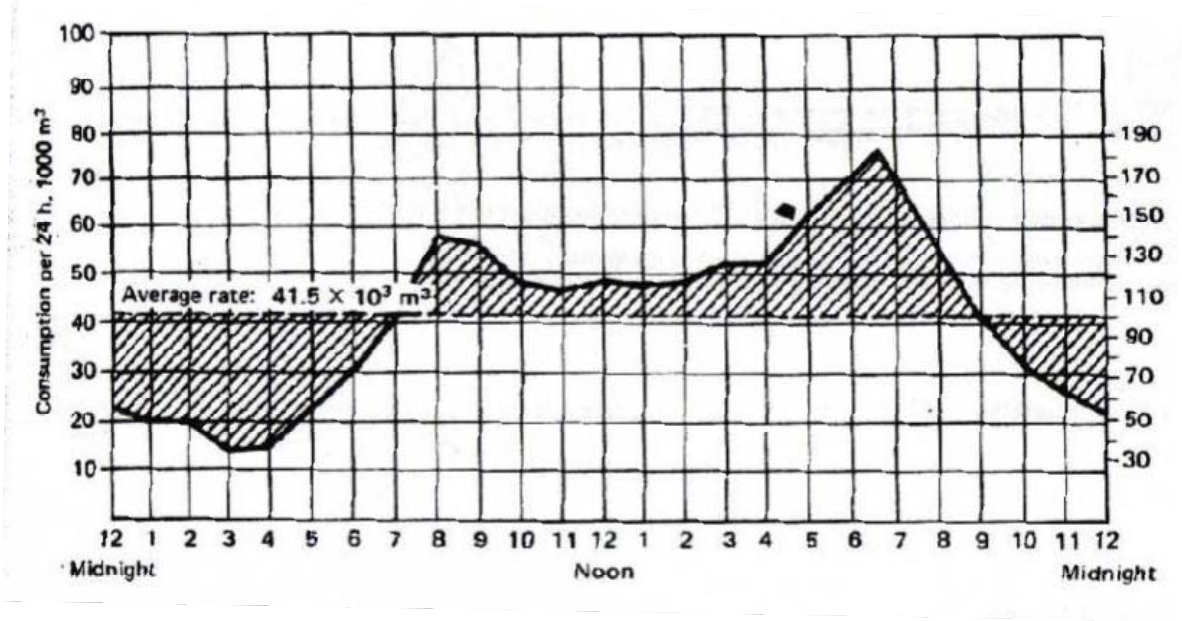
RESERVOIR

2. *Fire reserve.* The quantity of water required to be kept as reserve for fire-fighting.

The distribution system components

RESERVOIR

Capacity of reservoir must be enough for the purpose. It should be about 5 to 12 times of hourly maximum water demand.



The distribution system components

PUMP

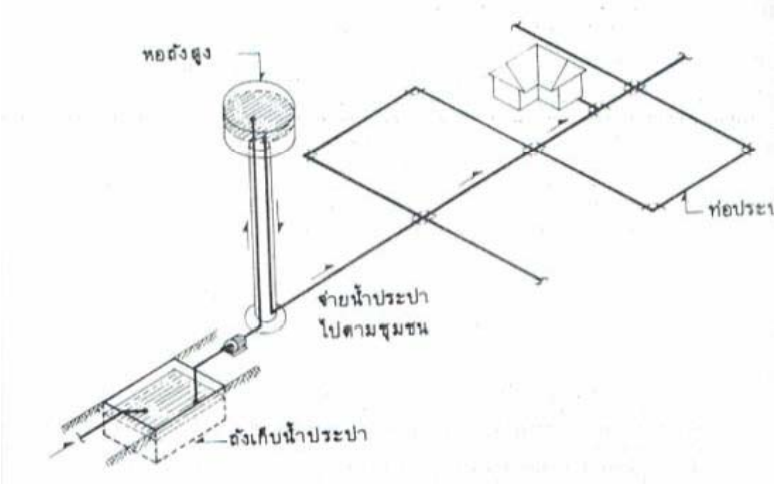
The distribution system components

PUMP

The distribution system components

PUMP

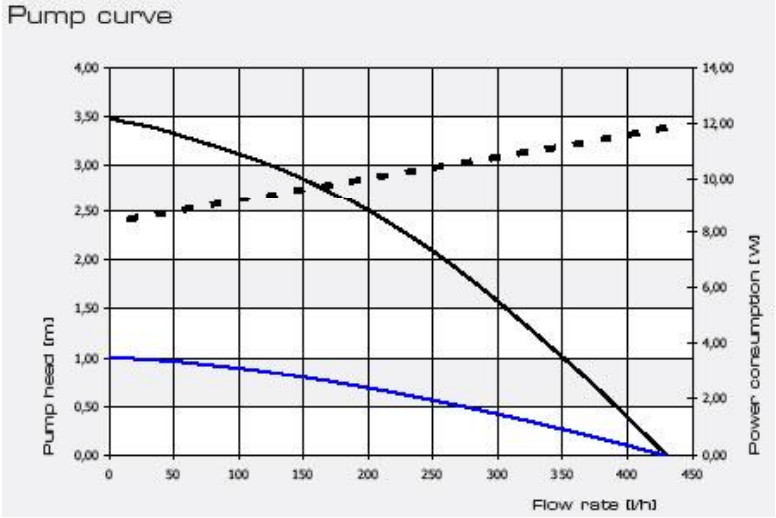
Delivering water supply from surface reservoir to elevated reservoir used pump as sender. In some case, pump directly send water supply into distribution pipes.

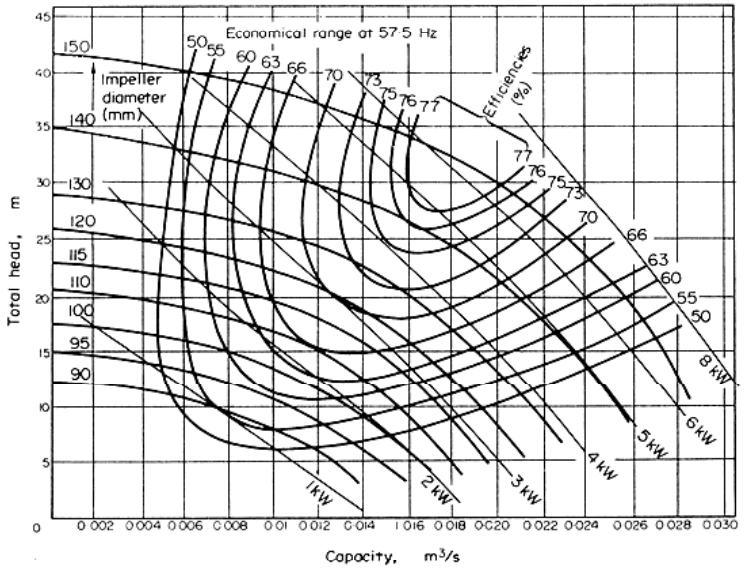


The distribution system components

PUMP

Head of pump depend on hight of elevated reservoir. Pump rate must be design equal to 1 times of hourly maximum water demand.





The distribution system components

ELEVATED RESERVOIR

The distribution system components

ELEVATED RESERVOIR

The main functions :

- To maintain the constant pressure in the distribution network.
- Capable to deliver water to user at the longest pipe.
- Water stored can be supplied during emergencies or pump maintenance.

The distribution system components

ELEVATED RESERVOIR

Capacity of elevated reservoir should be about 1 to 3 times of hourly maximum water demand. Consideration in during fires, elevated reservoir can also support the event.

In the other way, elevated reservoir can use for backwash process in treatment plant.

The distribution system components

DISTRIBUTION PIPES

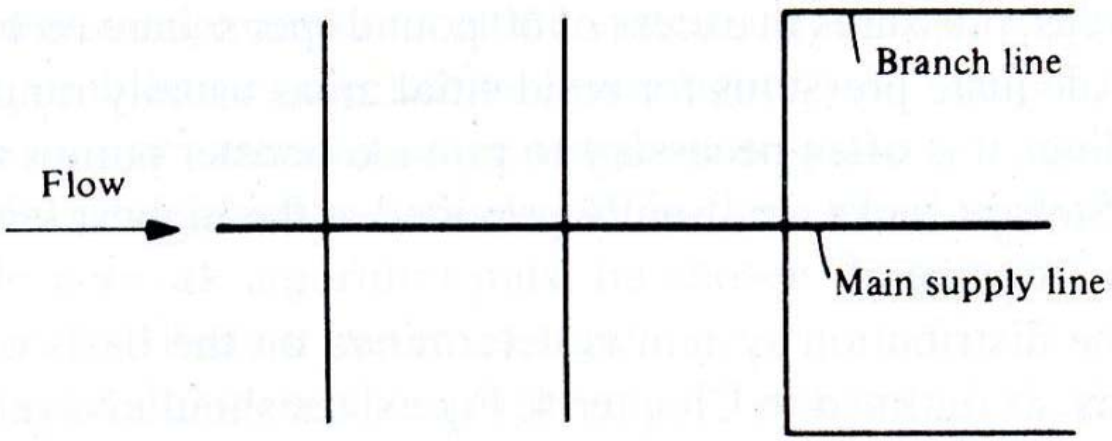
There are three differrent types.

1. Dead end or Tree-system or Branching system
2. Grid-Iron system or loop system
3. Combination system

The distribution system components

DISTRIBUTION PIPES

Dead end or Tree-system or Branching system



The distribution system components

DISTRIBUTION PIPES

Dead end or Tree-system or Branching system

Advantages

- Cheap in Initial cost
- Easy determination of pipe diameter, valves size etc

The distribution system components

DISTRIBUTION PIPES

Dead end or Tree-system or Branching system

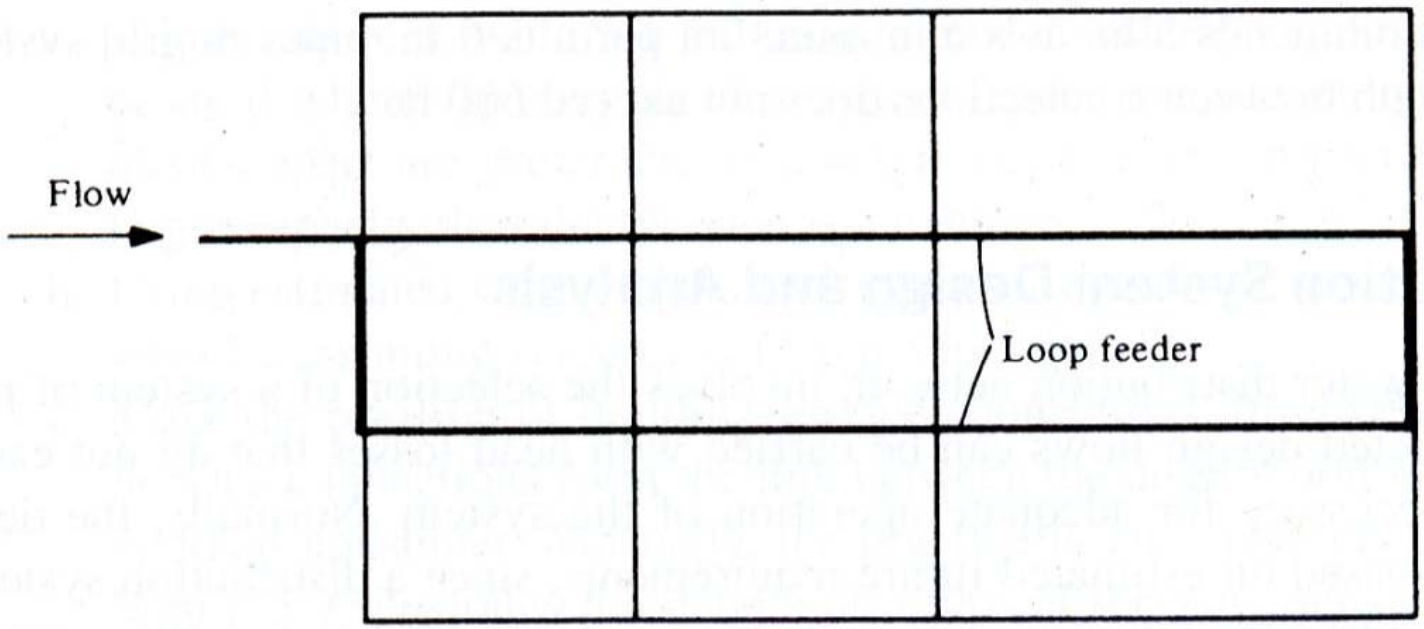
Disadvantage

- If pipe breaks down or is closed for repair, the whole locality beyond the point goes without water.

The distribution system components

DISTRIBUTION PIPES

Grid-Iron system or loop system



The distribution system components

DISTRIBUTION PIPES

Grid-Iron system or loop system

Advantages

- Very small area will be effected during repair.
- The friction losses and the sizes of the pipe are reduced.

The distribution system components

DISTRIBUTION PIPES

Grid-Iron system or loop system

Advantages

- No stagnation and change of pollution is reduce to minimum.
- In case of fire, more quantity of water can be diverted towards the effected area.

The distribution system components

DISTRIBUTION PIPES

Grid-Iron system or loop system

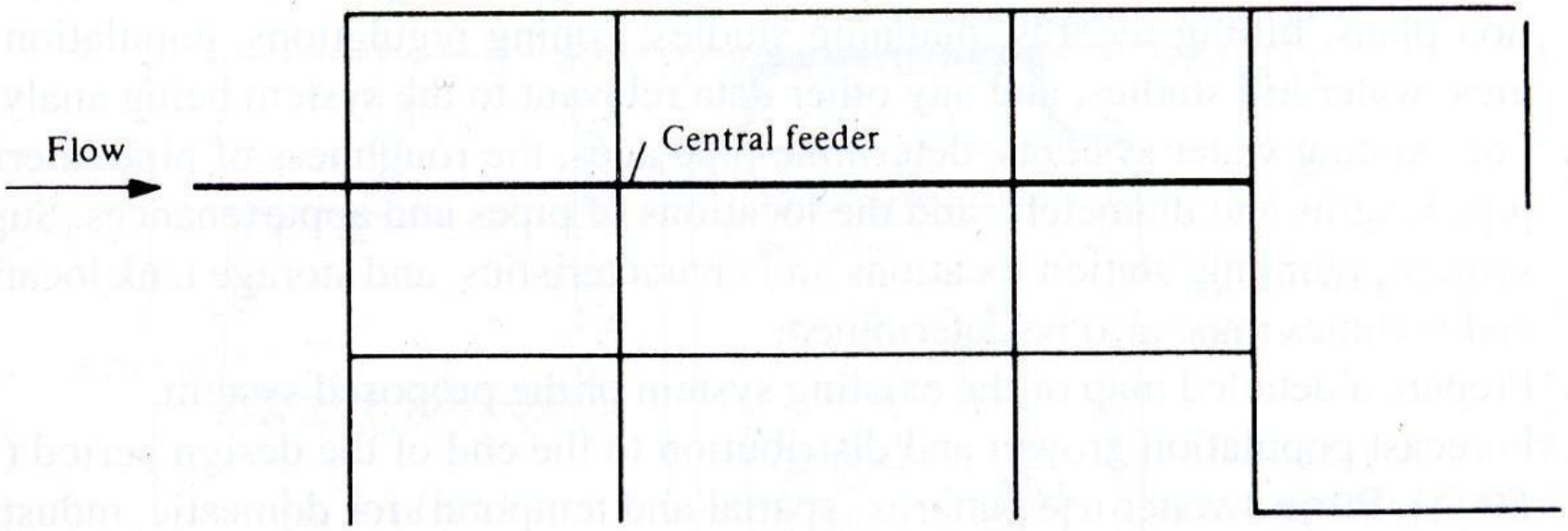
Disadvantage

- More number of valves increased in the overall cost.
- If one section is to be repaired more number of valve are required to close.
- The design is difficult and costlier.

The distribution system components

DISTRIBUTION PIPES

Combination system



The distribution system components

DISTRIBUTION PIPES

Combination system

- Combine betaween Branching system and Grid system.
- It design with appropiate usage for each area.
- Addition in the existing distribution network

Methods of water distribution system

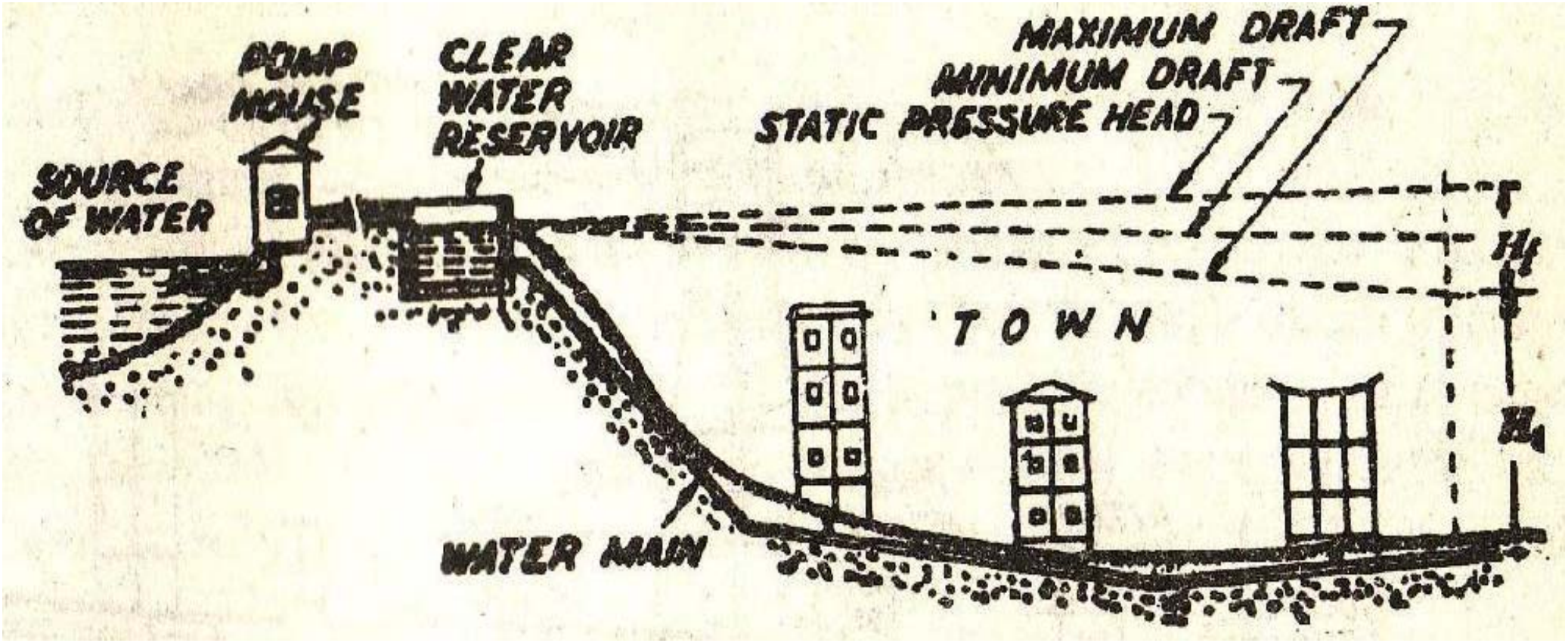
TYPES

Depending upon the level of source, topography of the area and other local conditions the water may be forced into distribution system by following ways -

1. Gravity system
2. Pumping system
3. Combined gravity and pumping system

Methods of water distribution system

GRAVITY SYSTEM



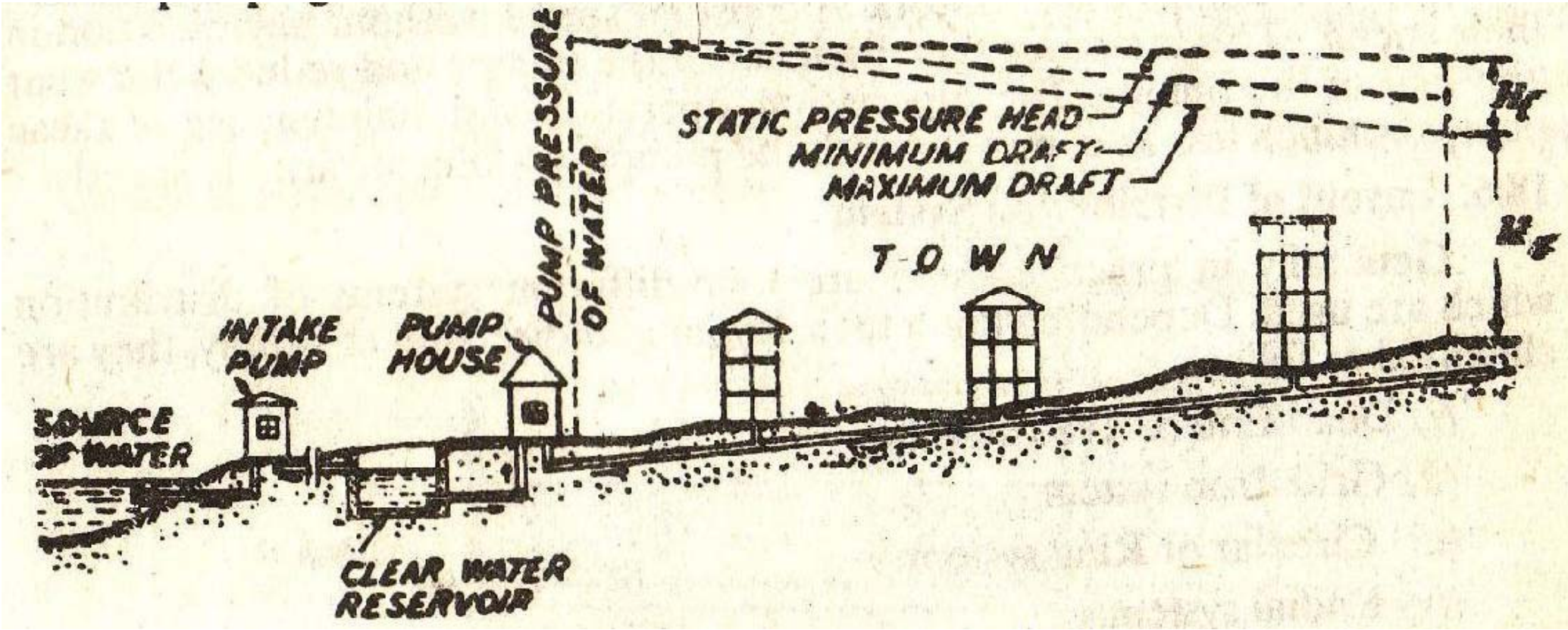
Methods of water distribution system

GRAVITY SYSTEM

- Suitable when source of supply is at sufficient height.
- Most reliable and economical distribution system.
- The water head available at the consumer is just minimum required.
- The remaining head is consumed un the frictional and other losses.

Methods of water distribution system

PUMPING SYSTEM



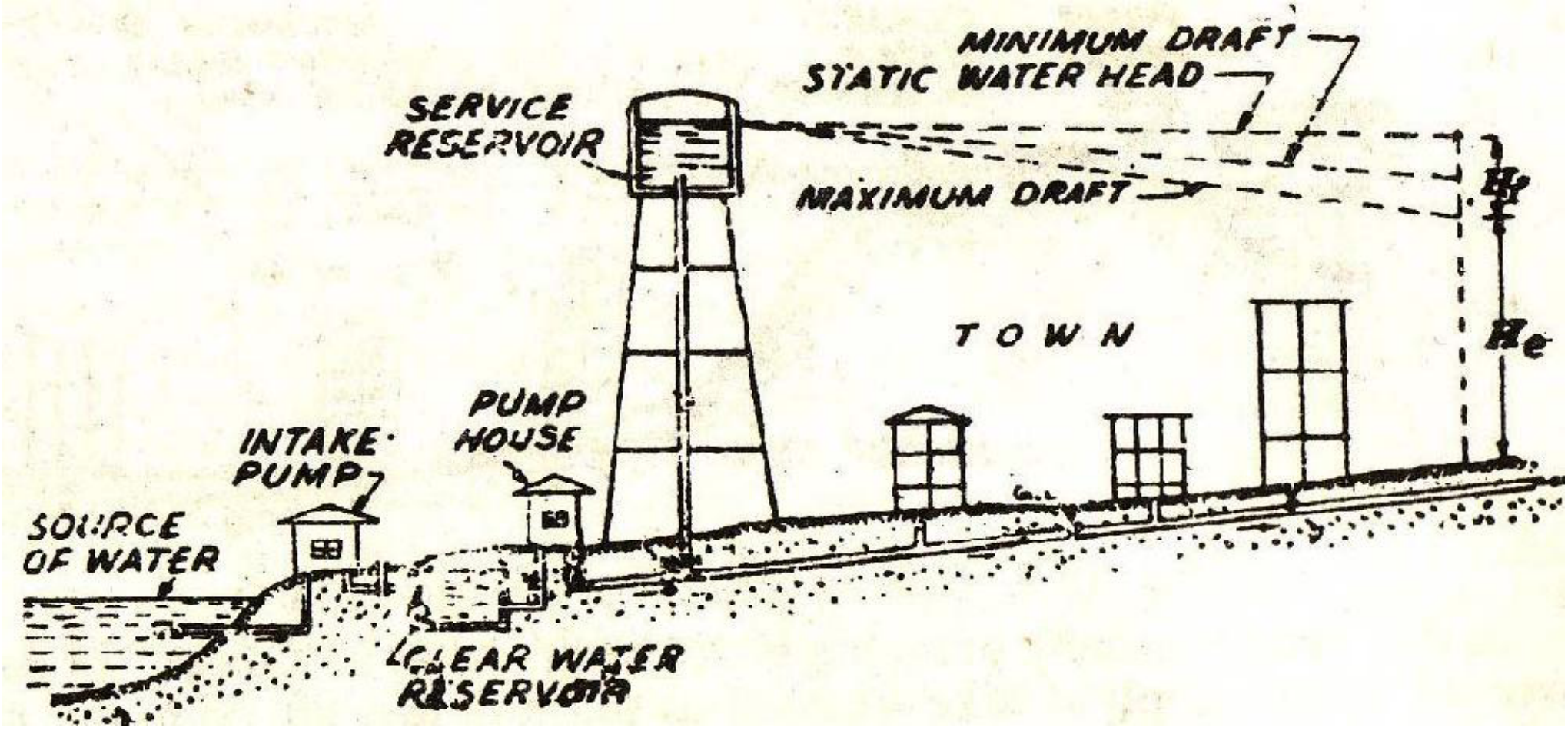
Methods of water distribution system

PUMPING SYSTEM

- Treated water is directly pumped in to the distribution main without storing.
- High lifts pumps are requried.
- If power supply fails, complete stoppage of water supply.
- This method is not geneally used.

Methods of water distribution system

COMBINED GRAVITY AND PUMPING SYSTEM



Methods of water distribution system

COMBINED GRAVITY AND PUMPING SYSTEM

- The balance reserve in the storage reservoir will be utilized during fire.
- Economical, efficient and reliable.
- Has the advantage that during power failure.
- The pump work at constant speed, without any variation speed.

Designing for water distribution system

DESIGN

In designing of distribution system, it consider to -

1. Pipe materials
2. Equipments
3. Design size of pipe

Designing for water distribution system

PIPE MATERIALS

- Carrying capacity of the pipe.
- Durability and life of the pipe.
- Type of water to be conveyed and its possible corrosive effect on the pipe material.
- Availability of funds.
- Maintenance cost, repair etc.

Designing for water distribution system

PIPE MATERIALS

Types of pipes are commonly used in Thailand:

1. Asbestos cement pipe (AC)
2. Steel pipe (S)
3. Galvanized steel pipe (GS)
4. High density polyethylene pipe (HDPE)

Designing for water distribution system

PIPE MATERIALS

5. Polybuthylene pipe (PB)

6. Polyvinyl chloride pipe (PVC)

7. Fibreglass pressure pipes

Designing for water distribution system

PIPE MATERIALS

Asbestos cement pipe (AC)

Designing for water distribution system

PIPE MATERIALS

Asbestos cement pipe (AC)

Advantages

- Low cost

Disadvantage

- Short life time
- Break or crack easily

Designing for water distribution system

PIPE MATERIALS

Steel pipe (S)

Designing for water distribution system

PIPE MATERIALS

Steel pipe (S)

Advantages

- Withstand high pressure
- Break or crack not easily

Disadvantage

- High cost in construction and maintenance

Designing for water distribution system

PIPE MATERIALS

Galvanized steel pipe (GS)

For pipe diameter lower than 150 mm.

Designing for water distribution system

PIPE MATERIALS

High density polyethylene pipe (HDPE)

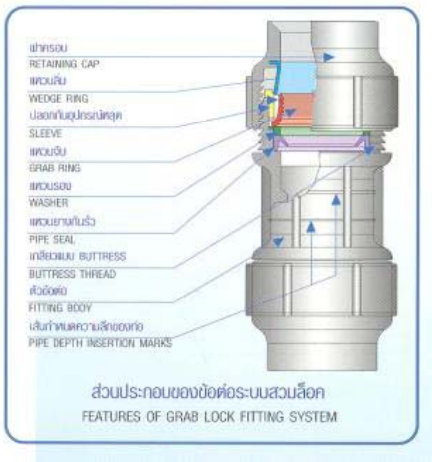
Designing for water distribution system

PIPE MATERIALS

Polybuthylene pipe (PB)

For pipe diameter

lower than 100 mm.



Designing for water distribution system

PIPE MATERIALS

Polyvinyl chloride pipe (PVC)

Designing for water distribution system

PIPE MATERIALS

Polyvinyl chloride pipe (PVC) are widely used in Thailand. Generally polyvinyl chloride pipe is resistant to most inorganic acid, allkalines and salts, as well as many organic chemicals. Rigid PVC pipes for water supply are normally available in shades blue.

Designing for water distribution system

PIPE MATERIALS

Fibreglass pressure pipes

Designing for water distribution system

EQUIPMENTS

Valves

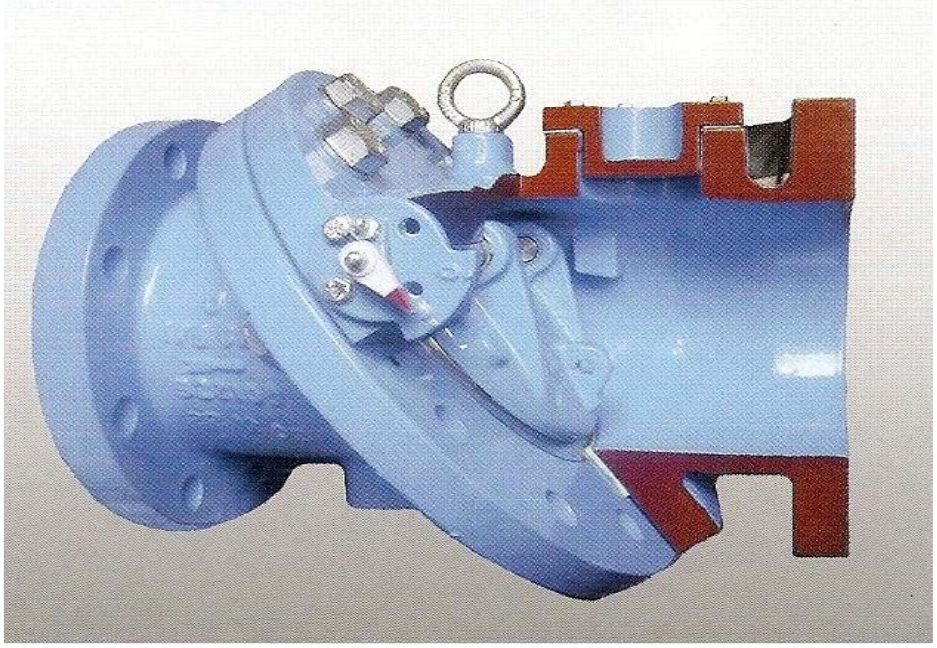
Gate Valve

Generally to use for distribution system. It use for size of pipe diameter less than 400 mm.

Designing for water distribution system

EQUIPMENTS

Valves



Check Valve

In system of pump, check valve is inserted before pump for protect pump from water hammer.

Designing for water distribution system

EQUIPMENTS

Valves

Butterfly Valve

It use for big size of pipe and for system of pump, because it easier to open than gate valve.

Designing for water distribution system

EQUIPMENTS

Valves

Air relief Valve

To relief air in pipe system, air relief valve will be insert at highest in line of pipe to avoid air lock and cause to break point.

Designing for water distribution system

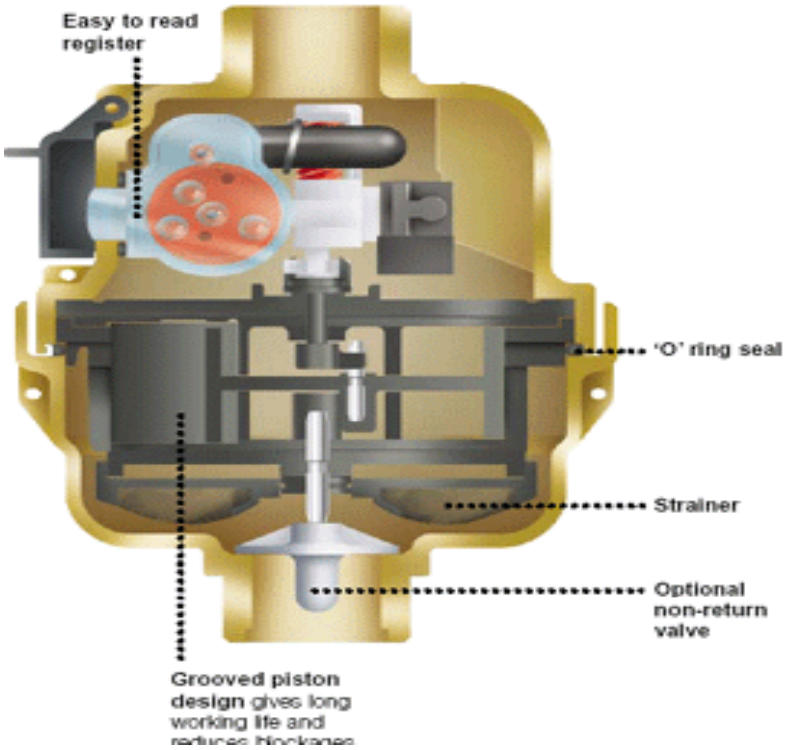
EQUIPMENTS

Fire hydrant

Designing for water distribution system

EQUIPMENTS

Water meter



Type of PWA meter which provided for consumer can be classified as:

1. Piston type or Volumetric type
2. Vane type

Designing for water distribution system

DESIGN SIZE OF PIPE

1. Water pressure for usage
2. Water velocity
3. Capable to demand on peak hour and increasing of consumer in the future
4. Design equation
5. Simulate program for distribution system

Designing for water distribution system

DESIGN SIZE OF PIPE

Water pressure for usage

Minimum pressure is not less than 1 ksc (0.1 bars) in peak hour. Enough to serve demand of consumer and fire hazard.

Designing for water distribution system

DESIGN SIZE OF PIPE

Water velocity

Velocity of water in pipe should not over 1.5 m/s. Because high velocity will make more friction force inside of pipe and break pipe in long term.

Designing for water distribution system

DESIGN SIZE OF PIPE

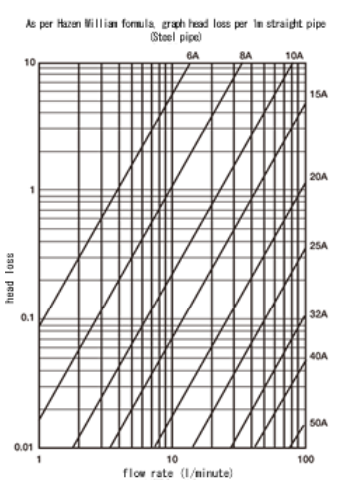
Design Equation

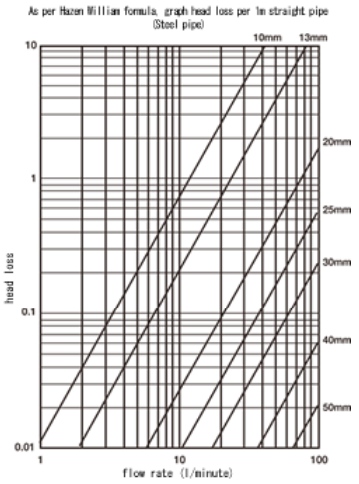
Principle equation is Hazen-williams equations which can set in table or graph to use easily for user.

Example Pipe Friction Loss

Flow (GPM)	Polyethylene (PE): PSI per 100 ft.					
	½ in.	¾ in.	1 in.	1 ¼ in.	1 ½ in.	2 in.
1	0.49	0.12	0.04	0.01	0.00	0.00
2	1.76	0.45	0.14	0.04	0.02	0.01
3	3.73	0.95	0.29	0.08	0.04	0.01
4	6.35	1.62	0.50	0.13	0.06	0.02
5	9.60	2.44	0.76	0.20	0.09	0.03
6	13.46	3.43	1.06	0.28	0.13	0.04
7	17.91	4.56	1.41	0.37	0.18	0.05
8	22.93	5.84	1.80	0.47	0.22	0.07
9	28.52	7.26	2.24	0.59	0.28	0.08
10	34.67	8.82	2.73	0.72	0.34	0.10
11	41.36	10.53	3.25	0.86	0.40	0.12
12	48.60	12.37	3.82	1.01	0.48	0.14
14	64.65	16.46	5.08	1.34	0.63	0.19
16	82.79	21.07	6.51	1.71	0.81	0.24
18	102.97	26.21	8.10	2.13	1.01	0.30
20	—	31.86	9.84	2.59	1.22	0.36
22	—	38.01	11.74	3.09	1.46	0.43
24	—	44.65	13.79	3.63	1.72	0.51
26	—	41.79	16.00	4.21	1.99	0.59
28	—	59.41	18.35	4.83	2.28	0.68
30	—	67.50	20.85	5.49	2.59	0.77
35	—	—	27.74	7.31	3.45	1.02
40	—	—	35.53	9.36	4.42	1.31
45	—	—	44.19	11.64	5.50	1.63
50	—	—	53.71	14.14	6.68	1.98
55	—	—	—	16.87	7.97	2.36

Source (includes tables for other pipe types):
www.hunterindustries.com/Resources/PDFs/Technical/Domestic/LIT091w.pdf





Designing for water distribution system

DESIGN SIZE OF PIPE

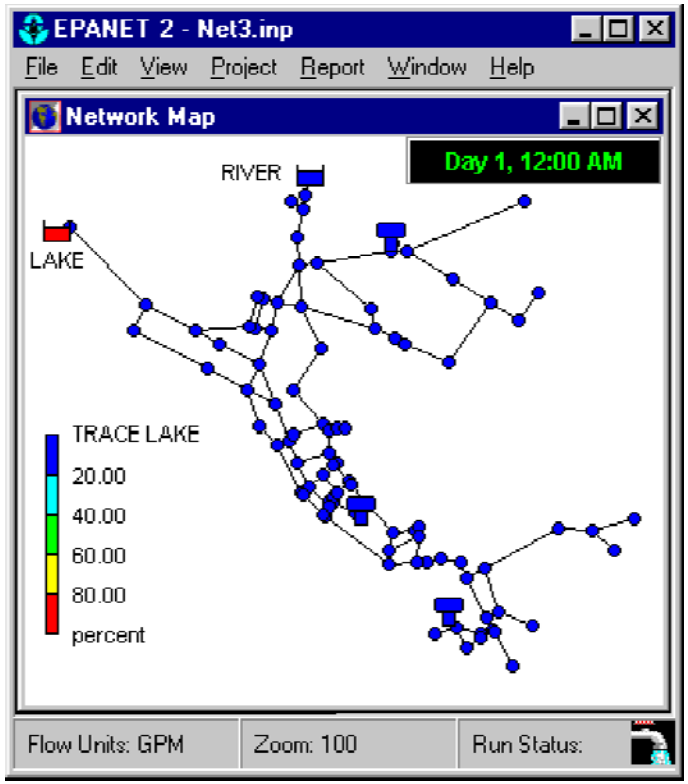
Simulation Program

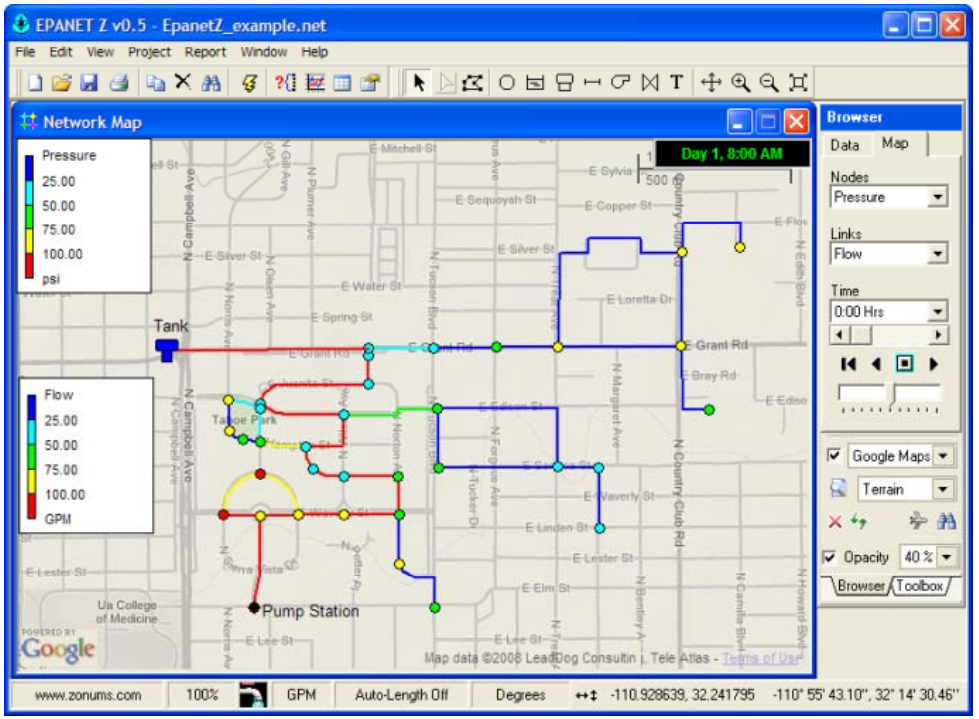
Epanet Program most favorite is used to simulate distribution network. It is easily to understand and not complicate. There are many function to setup system to similar with actual network.

Designing for water distribution system

DESIGN SIZE OF PIPE

Simulation Program (Epanet Program)






THANK YOU