

## Engineering

Engineering may be defined as the application under constraints of scientific principles to the planning, design, construction & operation of structural equipment and systems for the benefit of society.

According to ECPD (Engineering Council for professional Development)

Engineering is the profession in which knowledge a mathematical and natural sciences gained by study, experiment and practice is applied with judgment to develop ways to utilize economically the materials and forces of nature for the benefit of mankind.

### Water Supply situation in Bangladesh

- Without taking into account the presence of arsenic, 99% of the urban population and 97% of the rural population actually had access to an improved source of water supply (tubewell, dug well or tap).

- up to 70 million people still drink water which exceeds the WHO guidelines of 10 micrograms per liter of arsenic, and 30 million drink water containing more than the Bangladesh National Standard of 50 micrograms per liter

- In rural areas, more than 97% of the population relies on groundwater for its drinking water supply.

- The water supply in Dhaka city was first started with the establishment of Dhaka Water Works (DWW) by the Nawab Sir Abdul Gani in 1874

- The surface water treatment plants operated by Dhaka Water Supply and Sewerage Authority (DWASA) in Dhaka and Narayanganj produce about 40 million liters per day

- The Mohora surface water treatment plant in Chittagong is the largest surface water treatment plants in Bangladesh producing about 90 MLD of water

- In Dhaka, 82% of the water supply is abstracted from groundwater, while three surface water treatment plants provide the remaining 18%

- About 120 million people, which is 80% of the total population of Bangladesh depend on shallow tubewells for drinking water.

- The population exposed to arsenic contamination in excess of 50 g/L of tubewells has been estimated as 29.05 million

- In urban areas

- 23% piped inside dwelling
- 8% piped outside dwelling
- 68% tubewells

- In rural areas

- Less than 0.6% piped inside and outside dwelling
- 96% tubewells
- 1% dug wells
- More than 2% ponds, lakes and rivers

### Sanitation Situation in Bangladesh

- About 57.06% of rural families have hygienic latrine.
- About 74.08% of pourashavas families have hygienic latrine.
- About 74.63% of city corporations have hygienic latrine.
- About 59.53 % of total population have hygienic latrine.
- About 22% use so-called home made pit latrines.
- About 61% of total population have access to some form of latrine.
- Conventional sewerage systems are used only in parts of Dhaka and cover only 18% of the city's 8.5 million people.
- 110000 children under 5 die of diarrhea diseases every year.

### Objectives of Water Supply

- Supply water in adequate quantity
- Supply safe and wholesome water to the consumers.
- Make water easily available to consumers.

### Elements of water supply

The essential elements of a water supply are

1. Sources of supply
2. Collection system
3. Treatment and
4. Distribution system

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The elements of a surface water-based water supply system are shown in the figure

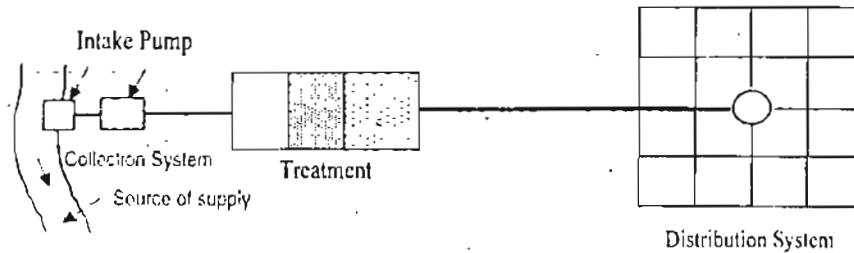


Figure: Essential elements of a surface water based water supply system

## 1. Water sources in Bangladesh

### a) Surface water

Surface water is highly polluted requires extensive treatment before drinking.

### b) Ground water (shallow GW and deep GW)

- Suitable for drinking purpose.
- Dissolve substance may need treatment before drinking.

### c) Rainwater

- Apparently suitable for drinking purpose.
- Purest water contains no minerals and very little dissolve substance.
- May be acidic/alkaline.

The main considerations for the selection of a source of water supply are

### a) Quantity

The quantity of water from source should be sufficient to satisfy the need of various use/demand such as domestic, industrial and public water uses.

### b) Quality

The quality of water should be wholesome safe and free from pollution of any kind such that requirement for treatment is minimum.

### c) Cost

The cost involved in development, operation and maintenance of water supply system should be reasonably affordable to the consumers.

## 2. Collection System

It depends on the source of water such as-

- a) For surface water; an intake with pumping facilities is required.
- b) For ground water; tubewell /dugwell is required.
- c) For rain water; a permanent roof or an uncontaminated ground surface is needed.

## 3. Treatment

The type and degree of treatment required is dependent on the quality of water.

- For surface water, the treatment processes may involve removal of turbidity, color, taste, odor and removal and destruction of pathogenic micro-organism.
- For ground water, the treatment processes may be removal of iron, hardness, arsenic, fluoride etc.

The most common methods used for treatment include boiling, screening, sedimentation, aeration, treatment with chemicals, filtration, demineralization and chemical disinfection.

## 4. Distribution system

A distribution system is needed to deliver water to individual consumers. The piped water supplies require distribution networks of pipes with storage reservoirs, pumping devices, stand posts, valves and other appurtenances.

### Planning and design considerations

- The quality of the water supplied should not deteriorate below certain acceptable level during the period for which the system has been designed.
- Water in adequate quantity should be provided at all times and at a convenient location.
- In the selection of sources, traditional sources should be given consideration for development of water supply systems.
- Construction, operation maintenance and repair should be within the competence of

local technical staff.

-The equipment used shall be hardy, reliable, and preferably available locally and the use of equipment should be minimum.

-Construction and operation cost should be minimum and imported materials should be avoided.

-The use of pumping and chemicals should be minimum,

-Skill attendance should be avoided.

-Steps should be taken to consult the women, to understand their needs and involve them in local management to encourage their interest in keeping the system functional.

-An appropriate in-built system should be made to monitor the performance of the treatment system.

-Provisions should be made to prevent or deal with possible deterioration of quality of raw water or breakdown of the system.

-Sustainability of the system should be given preference in the planning, design and pricing of water supply.

### Water quantity for various domestic purposes

Water is required by a community for domestic and other purpose. The estimations of quantity of water required by a community is important for the design of a water supply system. A water supply system is designed for a future population. The total quantity of water required by the community is computed by:

$$Q_r = P_r \times q$$

Where  $Q_r$  = quantity of water requirement per day

$P_r$  = projected population

$q$  = rate of water consumption per capita per day

### Design Life

The number of years for which a provision is made in designing the capacities of the various components of the water supply scheme is known as design life.

### Factors governing the design life

- i) Useful life of component structures and the chances of their becoming old and obsolete.
- ii) Easy and difficulty that is likely to be faced in explanation.
- iii) Amount and availability of additional investment.
- iv) Anticipated rate of population growth, industries and commercial establishments.

### Various Types of consumption

#### 1. Domestic Water Demand

This include the water required for household activities such as drinking, cooking, bathing , washing, sanitary purposes etc. this demands depends on habits, social status climate condition, pressure in distribution system, population ,sewerage system.

#### 2. Commercial & Industrial Water Demand

This includes the water required for manufacturing process, cooling operation, stream generation, food processing & sanitary purpose etc. It also includes the water requirements of institution such as hospitals, hotels, restaurants, schools and colleges, railway stations, offices etc. It depends on types of industry or institution, sources of water supply.

#### 2. Demand for Public Uses

This includes the quantities of water required for public utility purposes such as watering of public parks, gardening, washing and sprinkling on roads use in public fountains etc.

#### 3. Fire fighting Demand

Big cities generally maintain full fire fighting squads. Fire fighting personnel require sufficient quantity of water so as to throw it over the fire at high speeds.

#### 4. Loss and wastage

Unaccounted for

- Errors in metering
- Unauthorized connection
- Leaks in the distribution system.

### Organizations

WASA (Water supply and Sewerage Authority), DWASA, CWASA, DPHIE (Department of Public Health Engineering) , City Corporation. Etc.

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$$\text{Per Capita Water Consumption (L/C/day)} = \frac{\text{Total consumption/day}}{\text{Total Population}}$$

### Factors Affecting Per Capita Water Consumption

**i) Population Distribution**

The distribution of the population of a community in age, groups, religion, sex, socio-economic conditions, profession etc, influences average water consumption.

**ii) Climate conditions**

More water is used in warm and dry climates than in humid and cold climates. Water consumption on a summer day is 30-50% higher than the average daily demand.

**iii) Quality of water**

The consumption of good quality water is higher because of a good taste, a feeling of safety and its suitability for all domestic purposes.

**iv) Pressure of water**

In the case of pipes water, the rate of water use increases with the pressure in the distribution system mainly because of loss through leaks and wastage through open faucets.

**v) Water rates and metering**

If the cost of water is high, people become more conservative in water use.

**vi) Nature of Supply**

In piped water supply, the rate of water use with intermittent supply is much less than the use with continuous supply.

**vii) Water Source**

The distance between the source of water and the point of consumption play important role in water consumption.

**viii) Availability of an alternative source**

Availability of alternative sources of water such as a river, ponds, lakes, etc, greatly influences the use of a source of water supply.

Types of water supply	Water consumption range, lpcd	Typical water consumption, lpcd
<b>Village open / tubewell and stand post</b>		
Distance > 1000m	5-10	7
Distance, 500-1000m	10-15	12
Distance, 250-500m	10-20	15
Distance, 50-250m	15-40	25
Distance < 50m	20-50	35
<b>Water supply sources in yard</b>		
Well in yard	20-60	40
Single tap in yard	30-80	50
<b>House connection</b>		
Single tap	30-60	50
Multiple tap	70-250	150

Table 1 : Water requirement for domestic purposes

Nature of consumption	Range of consumption, lpcd	Average consumption, lpcd
Commercial use	10-150	40
Industrial use	30-450	120
Public uses	10-100	25
Livestock	10-35	20
Loss and wastage	20-150	40

Table 2 : Water requirement for other purposes

Areas	Water consumption, lpcd
Rural areas	50
Upazila towns	100
Zilla town	120
City corporation	180

Table 3: Water requirement in rural and urban areas in Bangladesh