Environmental Engineering-I

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Water Demand and Supply

✓ Water Consumption and Water uses.
✓ Types of Variation in Demand
✓ Fire Demand
✓ Population Forecast
• Fire Demand

• Variations in Water Consumption
Fire Demand

• It is the amount of water required for fire fighting purposes.
• The actual amount of water used in a year for fire is VERY SMALL, but the RATE OF FLOW is LARGE.
• As compared to the total Water Consumption, it is meagre seldom more than 5 to 10 per cent.
Fire Demand

• Fire Demand is the function of population but with a minimum limit, because greater the population, greater the number of buildings and greater the risk of fire.

• Minimum limit of fire demand means the amount and rate of water supply required to extinguish the largest possible fire in the community.
Estimation of Fire Demand:

1. **INSURANCE SERVICES OFFICE FORMULA:**

\[ F = 223.18 \ C \sqrt{A} \]

Where

- \( F \) = Fire Demand in \textit{litre/min}.
- \( A \) = Area of Floors in \( m^2 \) (\textit{EXCEPT BASEMENT}).
- \( C \) = A constant with different values according to Construction.
Estimation of Fire Demand:

1. **INSURANCE SERVICES OFFICE FORMULA:**

   \[ F = 223.18 \ C \ \sqrt{A} \]

Values of C:

C = 1.5 for Wood Frame Construction.
C = 1 for Ordinary Construction.
C = 0.8 for non-combustible construction.
Estimation of Fire Demand:

2. National Board of Fire Underwriters Formula:

\[ Q \text{ (gallon US/min)} = 1020\sqrt{P} \left(1 - 0.01\sqrt{P}\right) \]

3. Freeman Formula:

\[ Q = 1136.5 \left(\frac{P}{5} + 10\right) \]

Where

\( Q = \) Fire Demand in \text{litre/min}.

\( P = \) Population in Thousands.
Drawback of above Formulae

- The above formulae are not related with the type of service areas. The probability of occurrence of fire with a give duration may be greater for industrial area than the residential areas. But these formulae give the same results.
Estimation of Fire Demand:

4. Kuichling’s Formula:

\[ Q = 3182\sqrt{P} \text{ (litres/min)} \]

- Demand rate is to be maintained at a minimum pressure at the hydrant of 1 to 1.5 kg/sq.cm even after continuously fighting for 4 to 5 hours.
Storage Requirement

Water Storage requirements for Fire Fighting vary with the size of City.

• Minimum Storage Req'd. is for Four (4) Hours.
• Maximum Storage Req'd. is for Ten (10) Hours.
## Required Fire Flow
*(As per National Board of Fire Underwriters)*

<table>
<thead>
<tr>
<th>Population</th>
<th>Required Fire Flow in average city (litres/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000</td>
<td>4500</td>
</tr>
<tr>
<td>2000</td>
<td>6750</td>
</tr>
<tr>
<td>4000</td>
<td>9000</td>
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<tr>
<td>6000</td>
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<tr>
<td>40000</td>
<td>27000</td>
</tr>
<tr>
<td>60000</td>
<td>31500</td>
</tr>
</tbody>
</table>
Required Fire Flow
(As per National Board of Fire Underwriters)

<table>
<thead>
<tr>
<th>Population</th>
<th>Required Fire Flow in average city (litres/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>80000</td>
<td>36000</td>
</tr>
<tr>
<td>100000</td>
<td>40500</td>
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<tr>
<td>125000</td>
<td>45000</td>
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<tr>
<td>150000</td>
<td>49500</td>
</tr>
<tr>
<td>200000</td>
<td>54000</td>
</tr>
</tbody>
</table>

- National Board of Fire Underwriters requires provision for 5 hours fire-flow in places of less than 2500 population and provision for 10 hours flow in larger places.
Variations in Water Consumption

• An average amount of water per day over a period of year that the community on the basis of one person will require, does not remains uniform throughout the year but it varies from season to season, even from hour to hour. Variation in demand may be termed as:

1. Seasonal or Monthly Variations.
2. Daily Variation.
3. Hourly Variation.
Seasonal Variation:

• The water demand varies from season to season. Seasonal variation are prominent in tropical countries like India, Pakistan.

• The rate of consumption reaches a maximum during the summer season owing to greater use of water for street and lawn sprinkling etc.

• It goes down during the succeeding months and becomes minimum during winter season.

• The fluctuation in the rate of consumption may be as much as 150 per cent of the average annual consumption.
Daily Variation:

• The rate of demand for water may vary from day to day also. This is due to habits of consumers, climate conditions, holidays etc.

• Water demand on Sundays is generally more than other days of the week w.r.t. domestic use. On Sunday, everybody takes bath leisurely, washes his clothes etc.

• Moreover on the day of mass marriages as well as on hot and dry day, water consumption will be more as compared to a rainy day.
Hourly Variation:

• The rate of demand for water during 24 hours does not remain uniform and it varies according to hours of the day.

• On Sundays and other holidays the peak hours may be about 8am due to late awakening whereas it may be 6am on other working days.

• The peak flows may be between 6am to 10am and 4pm to 8pm and minimum between 12M.N. to 4 am.
Hourly Variations
Hourly Variations