Electrical Power Engineering

Load Duration Curve:

The load elements of load curve are arranged in the order of descending magnitudes.

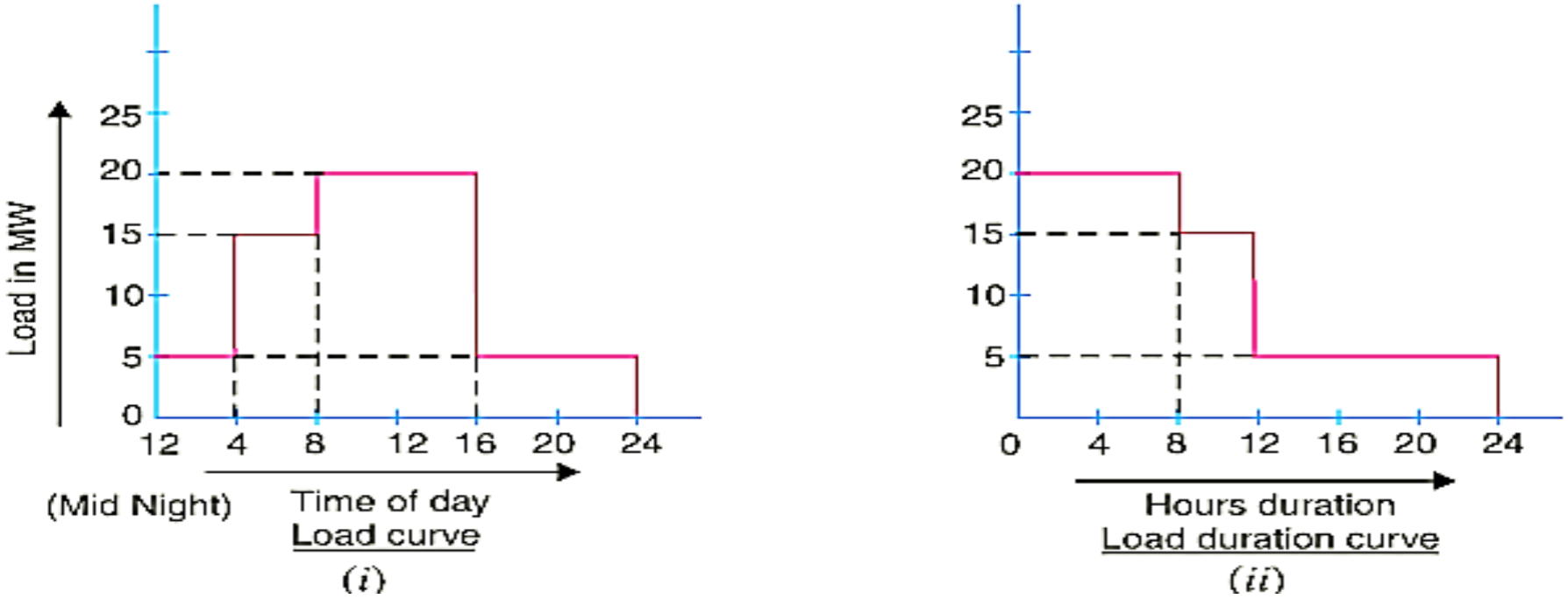

Figure (11) load duration curve

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Example .1. *The maximum demand on a power station is 100 MW. If the annual load factor is 40% , calculate the total energy generated in a year.*

Solution.

$$\begin{aligned}\text{Energy generated/year} &= \text{Max. demand} \times \text{L.F.} \times \text{Hours in a year} \\ &= (100 \times 10^3) \times (0{\cdot}4) \times (24 \times 365)\ \text{kWh} \\ &= 3504 \times 10^5\ \text{kWh}\end{aligned}$$

Example .2. *A generating station has a connected load of 43MW and a maximum demand of 20 MW; the units generated being $61{\cdot}5 \times 10^6$ per annum. Calculate (i) the demand factor and (ii) load factor.*

Solution.

$$(i) \qquad \text{Demand factor} = \frac{\text{Max. demand}}{\text{Connected load}} = \frac{20}{43} = 0{\cdot}465$$

$$(ii) \qquad \text{Average demand} = \frac{\text{Units generated / annum}}{\text{Hours in a year}} = \frac{61{\cdot}5 \times 10^6}{8760} = 7020\ \text{kW}$$

$$\therefore \qquad \text{Load factor} = \frac{\text{Average demand}}{\text{Max. demand}} = \frac{7020}{20 \times 10^3} = 0{\cdot}351 \text{ or } 35{\cdot}1\%$$

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Example 3. *A 100 MW power station delivers 100 MW for 2 hours, 50 MW for 6 hours and is shut down for the rest of each day. It is also shut down for maintenance for 45 days each year. Calculate its annual load factor.*

Solution.

Energy supplied for each working day

$$= (100 \times 2) + (50 \times 6) = 500 \text{ MWh}$$

$$\text{Station operates for} = 365 - 45 = 320 \text{ days in a year}$$

$$\therefore \quad \text{Energy supplied/year} = 500 \times 320 = 160.000 \text{ MWh}$$

$$\text{Annual load factor} = \frac{\text{MWh supplied per annum}}{\text{Max. demand in MW} \times \text{Working hours}} \times 100$$

$$= \frac{160.000}{(100) \times (320 \times 24)} \times 100 = 20{\cdot}8\%$$

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Example 4. *A generating station has a maximum demand of 25MW, a load factor of 60%, a plant capacity factor of 50% and a plant use factor of 72%. Find (i) the reserve capacity of the plant (ii) the daily energy produced and (iii) maximum energy that could be produced daily if the plant while running as per schedule, were fully loaded.*

Solution.

(*i*) $$\text{Load factor} = \frac{\text{Average demand}}{\text{Maximum demand}}$$

or $$0{\cdot}60 = \frac{\text{Average demand}}{25}$$

$\therefore$ $$\text{Average demand} = 25 \times 0{\cdot}60 = 15 \text{ MW}$$

$$\text{Plant capacity factor} = \frac{\text{Average demand}}{\text{Plant capacity}}$$

$\therefore$ $$\text{Plant capacity} = \frac{\text{Average demand}}{\text{Plant capacity factor}} = \frac{15}{0{\cdot}5} = 30 \text{ MW}$$

$\therefore$ Reserve capacity of plant = Plant capacity – maximum demand

= 30 – 25 = **5 MW**

(*ii*) Daily energy produced = Average demand × 24

= 15 × 24 = **360 MWh**

(*iii*) Maximum energy that could be produced

$$= \frac{\text{Actual energy produced in a day}}{\text{Plant use factor}}$$

$$= \frac{360}{0 \cdot 72} = \textbf{500 MWh/day}$$

Example 5. *A diesel station supplies the following loads to various consumers :*

Industrial consumer = 1500 kW ; Commercial establishment = 750 kW

Domestic power = 100 kW; Domestic light = 450 kW

If the maximum demand on the station is 2500 kW and the number of kWh generated per year is 45×10^5*, determine (i) the diversity factor and (ii) annual load factor.*

Solution.

(*i*) $$\text{Diversity factor} = \frac{1500 + 750 + 100 + 450}{2500} = \textbf{1·12}$$

(*ii*) $$\text{Average demand} = \frac{\text{kWh generated / annum}}{\text{Hours in a year}} = 45 \times 10^5/8760 = 513 \cdot 7 \text{ kW}$$

$\therefore$ $$\text{Load factor} = \frac{\text{Average load}}{\text{Max. demand}} = \frac{513 \cdot 7}{2500} = 0 \cdot 205 = \textbf{20·5\%}$$

Thanks