

Solution to the hydro- potential assignment



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Solution to the hydro-potential assignment. Part The water stored at Bhakra has a tremendous potential of generating hydroelectric power. Situated about 13 km upstream from Nangal township, in the northern part of India. The lowest altitude is 252 meters above sea level.

Around 53% of the area lies above 300 meters than the lowest level.

The total annual rainfall on this area equals 5 million kiloliters of water. The water falls through a height of 310 meters.

The potential energy per year given up by this mass of water if it all ran down to the lowest level would therefore be:

Potential Energy {P. E} in Joules= mgh ,

where m = mass {kg} = density {kg/m³} volume {m³}

g = acceleration due to gravity {m/sec²}

h = height above the earth's surface {m}

1 liter = 0.001 m³

Therefore, converting the volume of water to cubic meters gives;

5 million kiloliters of water = 5109 liters =

The calculating the mass of water by multiplying the density of water (assumed 1000kg/m³) by the volume calculated above;

Mass =

Thus giving the potential energy as;

Taking note that 1 Watt= 1 Joule/sec, and that there are seconds in a year which gives;

= = 4.8167 Megawatts.

Part 2.

The power estimate given above can be rationalized by allowing for the following factors:

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Not all the rain that falls appears as surface runoff;

Not all the runoff appears in streams that are worth damming;

If the descent is at too shallow a slope, piping difficulties limit available head.

It has been estimated that around 34% of the rainfall is wasted and uncollected as surface runoff at Bhakra.

Out of the remaining 66%, around 12% of the water run off in streams is not worth damming.

Therefore, a net amount of 54% of the annual rainfall is estimated to be utilized for the production of hydroelectricity.

The total annual rainfall, which is termed as utilized, would be:

=

Therefore, the actual annual production would be,

P. E. = mgh ,

m =

This gives the potential energy as P. E. = which then gives,

=

Part 3.

Bhakra Dam is a concrete gravity-arch dam. The dam was part of the larger multipurpose Bhakra Nangal Project whose aims were to prevent floods in the Sutlej-Beas river valley, to provide irrigation to adjoining states and to provide hydro-electricity.

Construction of the Bhakra Dam was started in the year 1948 and was completed in 1963. It is 740 ft. (226 m) high above the deepest foundation and is the highest Concrete Gravity dam in Asia and Second Highest in the world (compare Hoover Dam at 732 ft).

There are two power houses namely Left Bank Power Plant and Right Bank Power Plant. The power houses are connected on either side by underground cable galleries with the switch yard from where transmission lined take off. The two power houses have a total capacity of 1000 MW and a smaller subsidiary dam, called the Nangal Dam is located a little downriver. This annual production of electricity is around of 1000MW is significantly different when compared to the estimated value given in Parts 1 and 2. The reason for this disparity has been attributed to the fact that the Bhakra Nangal dam is fed by a perennial river and as such there is a much larger inflow of water than what can be obtained from rainfall alone.

The 166 km Gobindsagar Reservoir, named after Guru Gobind Singh, is created by this dam. The dam provides irrigation to 10 million acres (40, 000 km) of fields in Delhi, Haryana, Punjab, Rajasthan and Himachal Pradesh.

References:

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