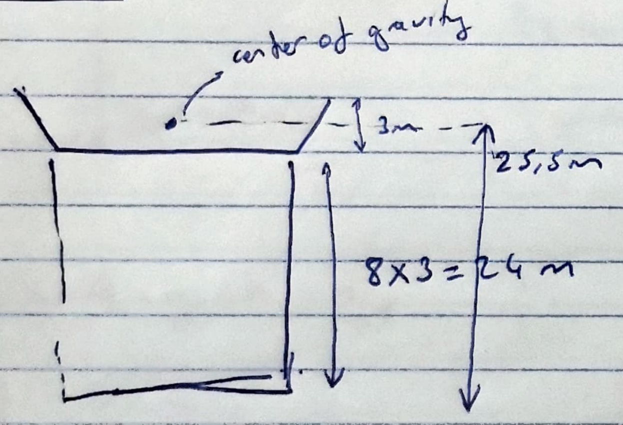
Question /

There is a pool on top of 8 floor building.
Every floor and the pool has a height of 3 meters.
Building base area = $100 m^2$

a) what is the potential energy of water if the pool is full

b) If we use a turbine to convert the energy to electricity, what is the price of electricity if we sell it to grid.
Price = 10 cents / kwh

Solution /



a) $PE = mgh$ $\quad m = V \times \rho$ (volume, density)

Volume = $3 \times 100 m^2 = 300 m^3$

$\rho = 1000 \ kg/m^3$

$m = 300.000 \ kg$

$g = 9.81 \ (N/kg)$

$h = 25,5 \ m$

$PE = 300.000 \times 9,81 \times 25,5$

$PE = 75 \times 10^6 \ J$

b)

$E = \text{efficiency} \times PE = \%80 \times 75 \times 10^6 J = 60 \times 10^6 J =$

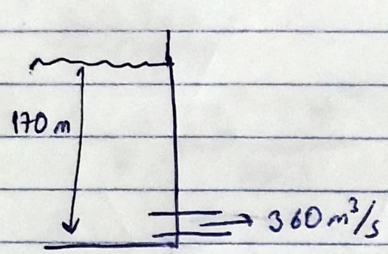
$1 \ kwh = 3,6 \times 10^6 J$ $\quad = 60/3,6 = 16,7 \ kwh$

Price = $16,7 \ kwh \times 10 \ cents/kwh = 1,67 \ \$$

Question /

A dam is constucted in front of Fırat river. As a result of dam constuction, a head of 170 meter is avaılable for the energy generation. Assume that the river has a flow rate of 360 m^3/s. Calculate the power generation potential of the dam by assuming reasonable efficiency values for the penstock, turbine and electrical generator.

Solution /.



$\eta_{penstock} = \%95$

$\eta_{turbine} = \%90$

$\eta_{generator} = \%95$

$\eta_T = \eta_p \times \eta_t \times \eta_g$

$\eta_T = 0{,}9 \times 0{,}9 \times 0{,}95$

$\eta_T = 0{,}7695$

(T ↑ total)

$P = \rho \times Q \times g \times h \times \eta_T$

$\rho = 1000\ kg/m^3$

$Q = 360\ m^3/s$

$g = 9{,}81\ m/s^2$

$h = 170\ m$

$\eta_T = 0{,}7695$

$\Rightarrow$

$P = 9{,}81 \times 1000 \times 360 \times 170 \times 0{,}7695$

$P = 461{,}986{,}254$

$\Rightarrow P \cong 462\ mW$

Question /

In the blacksea average wave height is 1 meter. and wave duration is 18 hours per day. If the wave energy conversion device has a 20% efficiency, and an average home spends 10 kWh energy per day, how many kilometers of the shore should be covered with wave energy device to generate all the energy of Rize which has approximately 100.000 houses? Assume that wave period is 7 seconds.

Solution /:

$$P_{avg} = \frac{\rho g^2 T H^2}{32\pi} \qquad \rho = 1025\ kg/m^3 \qquad g = 9,81\ m/s^2 \qquad T = 7s \qquad H = 1\ m$$

$$\Rightarrow P_{avg} = \frac{1025 \times (9,81)^2 \times 7 \times 1^2}{32 \times 3,14} = 6,87\ kW/m$$

$$P_{device} = P_{avg} \times \eta = 6,87 \times \%20 = 1,38\ kW/m$$

Energy required = # houses x avg. consumption = 100.000 x 10 kwh

$\Rightarrow E_R = 1000.000$ kwh

Length needed = $\frac{\text{Energy required}}{\text{Energy wave device per meter}}$

Energy of wave device per meter = P_{device} x duration = 1,38 kW/m x 18 h
= 24,7 kWh/m

$$\text{Length needed} = \frac{1000.000\ kwh}{24,7\ kwh/m} = 40.485\ m$$

$\Rightarrow L \cong 40,5$ km