SPECIFIC ENERGY AND SPECIFIC ENERGY CURVE

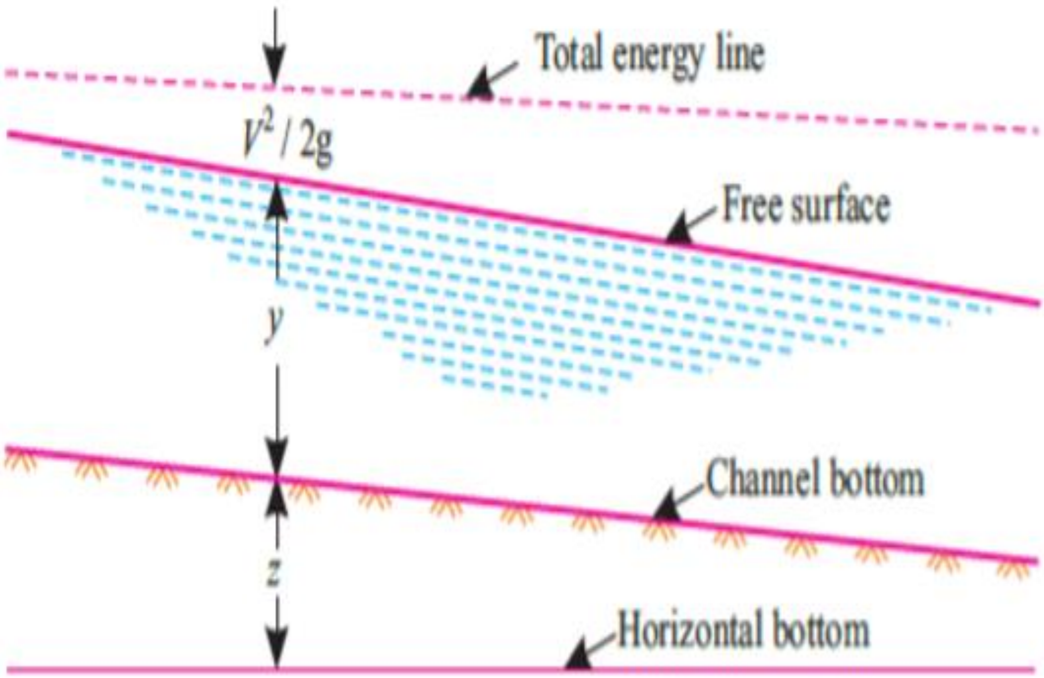
The total energy of flow per unit weight of liquid is given by:

Total energy = $z + y + V^2/2g$

where, z = Elevation of the channel bottom above the horizontal bottom,

y = Depth of flow, and

V = Average velocity of flow.



If the channel bottom itself is taken as the datum (Fig. 16.22), then total energy for unit weight of liquid,

$E = y + V^2/2g$ ----- (16.29

The energy E given by eqn. (16.29) is known as specific energy. Thus specific energy is defined as the energy per unit weight of flowing liquid above the channel bottom. Although the total (or Bernoulli's) energy is reduced by friction, the specific energy can increase or decrease from section to section if the bed elevation changes; however, for uniform flow the specific energy remains constant along the flow.

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(i) Potential energy of flow (Ep), y, and

(ii) Kinetic energy of flow (Ek), $V^2/2g$, i.e. $E = y + V^2/2g = E_p + E_k$

For the sake of simplicity let us consider a channel of rectangular section.

Let, b = Width of channel,

y = Depth of flow, and

Q = Discharge through the channel.

Now, Velocity of flow, V = Discharge/ Area

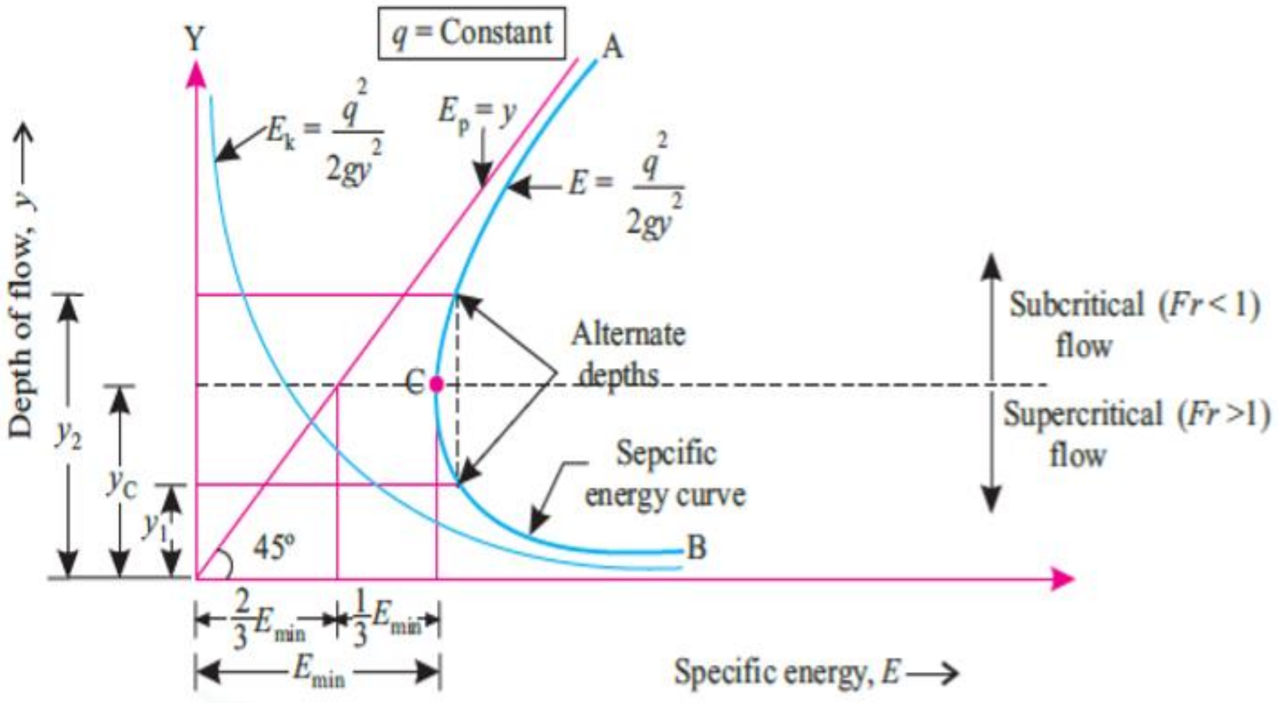
Q / b x y = q/y

(where q = discharge per unit width)

∴ Specific energy, $E = y + (q/y)^2 / 2g$;

$E = y + (q/2gy)^2 = E_p + E_k$---16.31)

For a given channel section and discharge, eqn. (16.31) can be represented graphically as a plot of specific energy E against the depth of flow. Such a plot is called the specific energy curve/ diagram and it consists of a family of similar curves each representing a given unit discharge.



The specific energy plot of Fig. 16.23 entails the following information:

(*i*) The curve for potential energy (*i.e.* $E_p = y$) is a *straight line* passing through the origin, making an angle of 45° with each of the two axes (*X* and *Y*),

(*ii*) The *curve* for kinetic energy is a *parabola*. Plot for *specific energy is obtained by adding kinetic energy to potential energy*.

(*iii*) Specific energy is asymptotic to the horizontal axis for small values of y and asymptotic to 45° line for high values of y.

(*iv*) At a certain depth y_c, called the *critical depth*, the specific energy curve has a point of *minimum specific energy*, the corresponding flow velocity is called the critical velocity V_c.

(*v*) For every value of specific energy other than minimum there are two possible depths of flow (y_1 and y_2), one greater and other less than critical depth y_c; these two depths (for same specific energy) are referred to as *alternate or conjugate depths*.