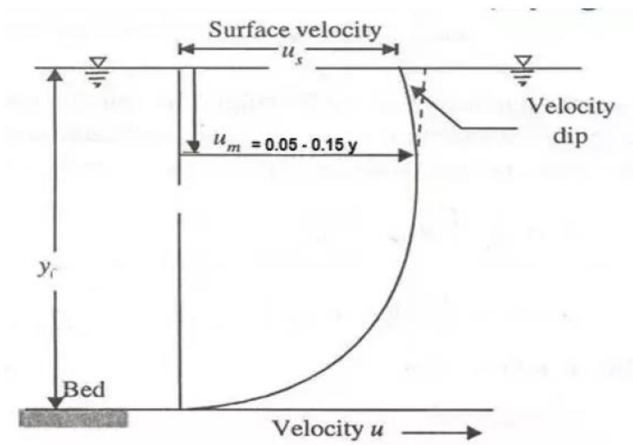
Experiment- To obtain the velocity distribution for an open channel and determine values of alpha, and beeta (energy and momentum correction factors)



Velocity profile in a narrow channel

NOTE : u_m = Maximum velocity of the channel

An open channel is a physical system in which water flows with a free surface at the atmospheric pressure. In other words the pressure is impressed on free surface. A channel can be classified as either natural or artificial channel according to its origin. Natural channels include all watercourses of varying sizes from tiny hillside rivulets, streams, small and large rivers to tidal estuaries that exist naturally on the earth. Subsurface streams carrying water with a free surface are also treated as natural open channels.

<u>Velocity measurement in free surface flows in laboratories:</u>

In general, in the laboratories and to an extent in the field, velocities can be measured using different devices such as Pitot tube (One dimensional), Pitot cylinder (Two dimensional) and Pitot Sphere (Three dimensional). However, these devices have their limitations and are restricted to low velocity fields.

Energy and Momentum Coefficients Generally, in the energy and momentum equations the velocity is assumed to be steady uniform and non-varying vertically. This assumption does not introduce any appreciable error in case of steady (or nearly uniform) flows. However, the boundary resistance modifies the velocity distribution. The velocity at the boundaries is less than the velocity at a distance

Further, in cases where the velocity distribution is distorted such as in flow through sudden expansions/contractions or through natural channels or varying cross sections, error is introduced. When the velocity varies across the section, the true mean velocity head across the section, varies.. Hence, a correction factor is required to be used for both in energy and momentum.

<u>Values of α and β for selected situations (after Chow, 1958)</u>

Channel	α			β		
	Minimum	Maximum	Average	Minimum	Maximum	Average
Regular channels, flumes, spillways	1.10	1.20	1.15	1.03	1.07	1.05
Natural streams and torrents	1.15	1.50	1.30	1.05	1.17	1.10
River under ice cover	1.20	2.00	1.50	1.07	1.33	1.17
River valley, over flooded	1.50	2.00	1.75	1.17	1.33	1.25

The kinetic energy correction factor α and momentum correction factor β can be expressed as (see box).

$$\alpha = \frac{\int_0^A \upsilon^3 dA}{\overline{V}^3 A} \approx \frac{\sum_{i=1}^{N} \upsilon_i^3 dA}{\overline{V}^3 A} \qquad i = 1.....N \qquad (4)$$

$$\beta = \frac{\int_0^A \upsilon^2 dA}{\overline{V}^2 A} \approx \frac{\sum_{i=1}^{N} \upsilon_i^2 dA}{\overline{V}^2 A} \qquad i=1,2....N \qquad (5)$$

Many investigators have done extensive investigations on the computation of α and β . Chow (1958) has summarised different equations for determination of α and β for various velocity distributions If the velocity distribution is along a vertical is logarithmic, then the relation between α and β , as shown by Bakhmateff, is that β exceeds unity by about one-third of the amount by which α exceeds unity.   Generally, the coefficients α and β are greater than one. They are both equal to unity when the flow is uniform across the section, and the farther, the flow departs from uniform, the greater the coefficients become. The form of Equations (4) and (5) makes it clear that α is more sensitive to velocity variation than β , so that for a given channel section, $\alpha > \beta$. Values of α and β can easily be calculated for idealized two-dimensional velocity distributions.

For more information on Alpha and Beeta, see the Link below

https://www.youtube.com/watch?v=F46af9EMaEU

For more information on velocity profiles across the width of channel and across depth of channel using a pitot tube, see the link below

https://www.youtube.com/watch?v=Ko1to7SoQZg