### Slip Factor

Under certain circumstances, the angle at which the fluid leaves the impeller may not be the same as the actual blade angle. This is due to a phenomenon known as fluid slip, which finally results in a reduction in $V_{w2}$ the tangential component of fluid velocity at impeller outlet. One possible explanation for slip is given as follows.

In course of flow through the impeller passage, there occurs a difference in pressure and velocity between the leading and trailing faces of the impeller blades. On the leading face of a blade there is relatively a high pressure and low velocity, while on the trailing face, the pressure is lower and hence the velocity is higher. This results in a circulation around the blade and a non-uniform velocity distribution at any radius. The mean direction of flow at outlet, under this situation, changes from the blade angle at outlet $\beta_2$ to a different angle $\beta_2'$ as shown in Figure 34.2 Therefore the tangential velocity component at outlet $V_{w2}$ is reduced to $V_{w2}'$ , as shown by the velocity triangles in Figure 34.2, and the difference $\Delta V_w$ is defined as the slip. The slip factor $\sigma_s$ is defined as

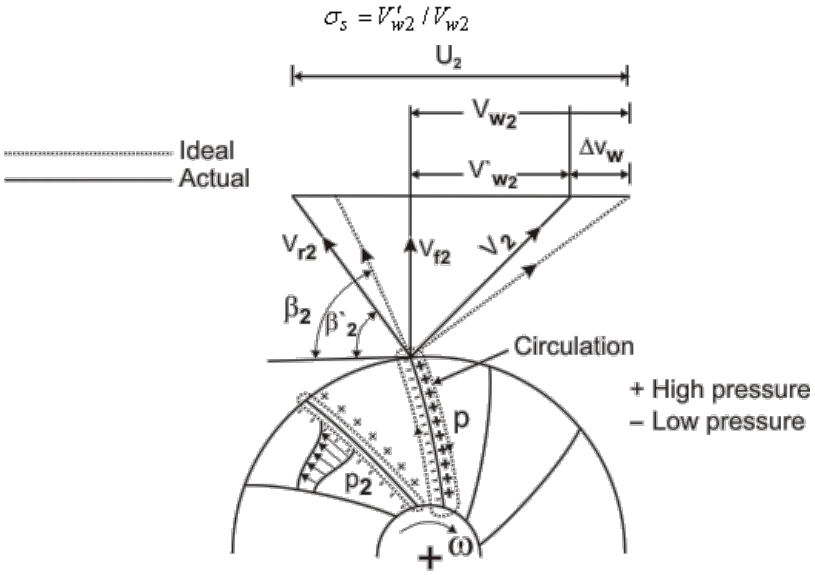


**Figure 34.2 Slip and velocity in the impeller blade passage of a centrifugal pump**

With the application of slip factor $\sigma_s$, the work head imparted to the fluid (Euler head) becomes $\sigma_s V_{w2} U_2 / g$ . The typical values of slip factor lie in the region of 0.9.

### Losses in a Centrifugal Pump

- Mechanical friction power loss due to friction between the fixed and rotating parts in the bearing and stuffing boxes.

- Disc friction power loss due to friction between the rotating faces of the impeller (or disc) and the liquid.

- Leakage and recirculation power loss. This is due to loss of liquid from the pump and recirculation of the liquid in the impeller. The pressure difference between impeller tip and eye can cause a recirculation of a small volume of liquid, thus reducing the flow rate at outlet of the impeller as shown in Fig. (34.3).

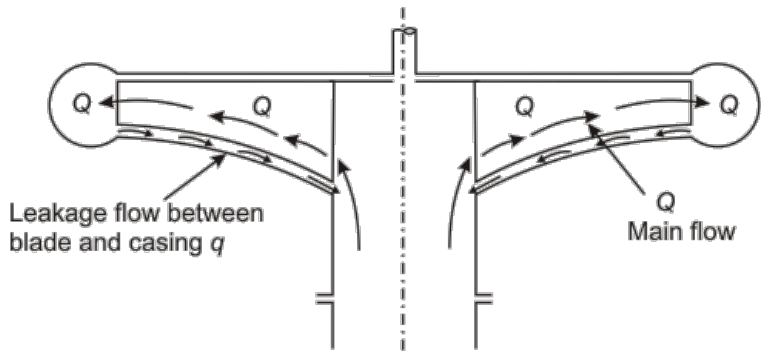


**Figure 34.3 Leakage and recirculation in a centrifugal pump**