Degree of reaction

It has been shown that the 50% reaction compressor stage (with constant V_f) has symmetrical blading.

The same is true for the 50% reaction turbine stage. As the change in static enthalpy is same in both stator and rotor blades, the change in kinetic energy relative to each blade row must be the same. The velocity diagram for a 50% reaction stage with a constant axial velocity is shown in Fig 14.2.
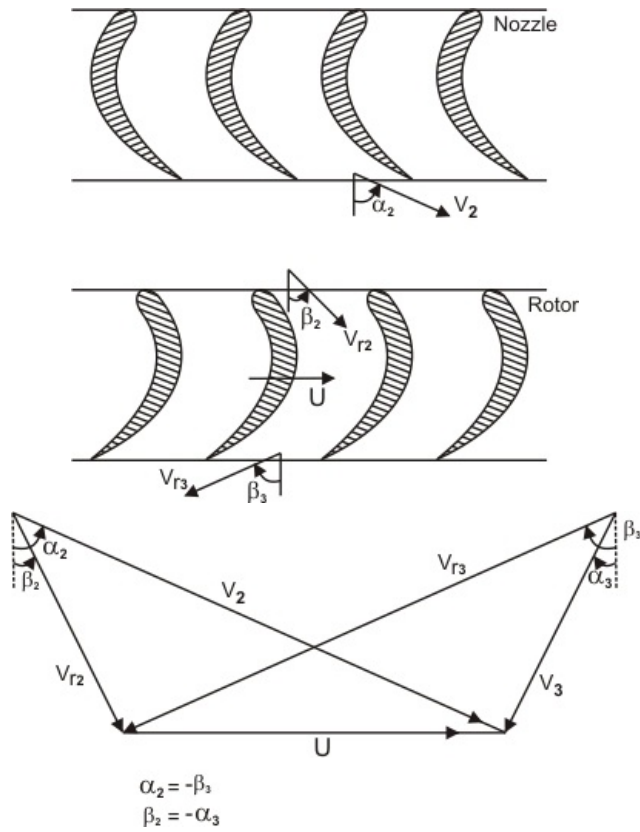

$$\alpha_2 = -\beta_3$$
$$\beta_2 = -\alpha_3$$

Figure 14.2 Fifty -percent reaction turbine with constant axial velocity

Since the velocity diagram is symmetrical,

$$V_{r_{w2}} = V_{w_2} - U$$

$$= -V_{w_3}$$

i.e $$V_{w_3} = -(V_{w_2} - U)$$

or, $$V_{w_2} - V_{w_3} = 2V_{w_2} - U$$

or, $$\psi = \frac{V_{w_2} - V_{w_3}}{U}$$

$$= 2\frac{V_f}{U}\tan\alpha_2 - 1$$

or, $$\psi = 2\phi\tan\alpha_2 - 1 \qquad\qquad (14.3)$$