Again, combining Eq.14.5 and Eq.14.8, we have

$$R = \frac{1}{2}[1 - \phi(\tan\alpha_2 + \tan\beta_3)] \qquad (14.10)$$

Which is the expression for R in terms of the exit air angles. For the special case of symmetrical blading , $\alpha_2 = -\beta_3$ and we have $R = 1/2$. For the case of $V_{r_{w3}} = -V_{r_{w2}}$, we have $R = 0$. Now for the special case of zero exit swirl, $V_{w_3} = 0$ and it follows that $V_{r_{w3}} = V_f \tan\beta_3 = -U$, i.e. $\tan\beta_3 = -\frac{1}{\phi}$ and Eq. 14.10 because

$$R = 1 - \frac{1}{2}\phi\tan\alpha_2 \qquad (14.11)$$

Again for zero exit swirl, the blade loading capacity, Eq.13.5 reduces to

$$\psi = \phi\tan\alpha_2 \qquad (14.12) \text{ since } [\alpha_3 = 0]$$

Equations (14.11) and (14.12) have been used in plotting Fig (14.3), which pertains to design conditions only.

Here we see that for a given stator outlet angle, the impulse stage requires a much higher axial velocity ratio than does the 50% reaction stage. In the impulse stage all flow velocities are higher, and that is one reason why its efficiency is lower than that of the 50% reaction stage.

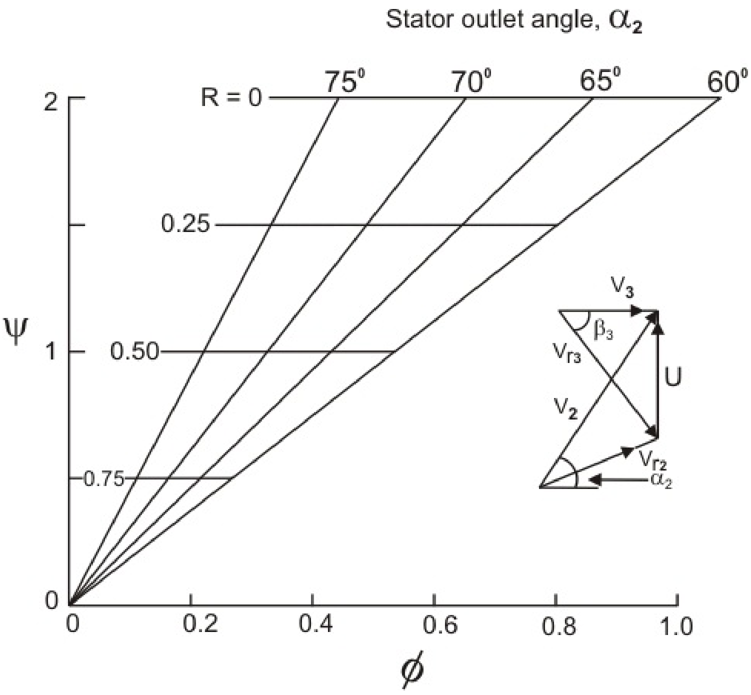

Figure 14.3 Work capacity Ψ and degree of reaction R of axial turbine stages design for zero exit swirl.