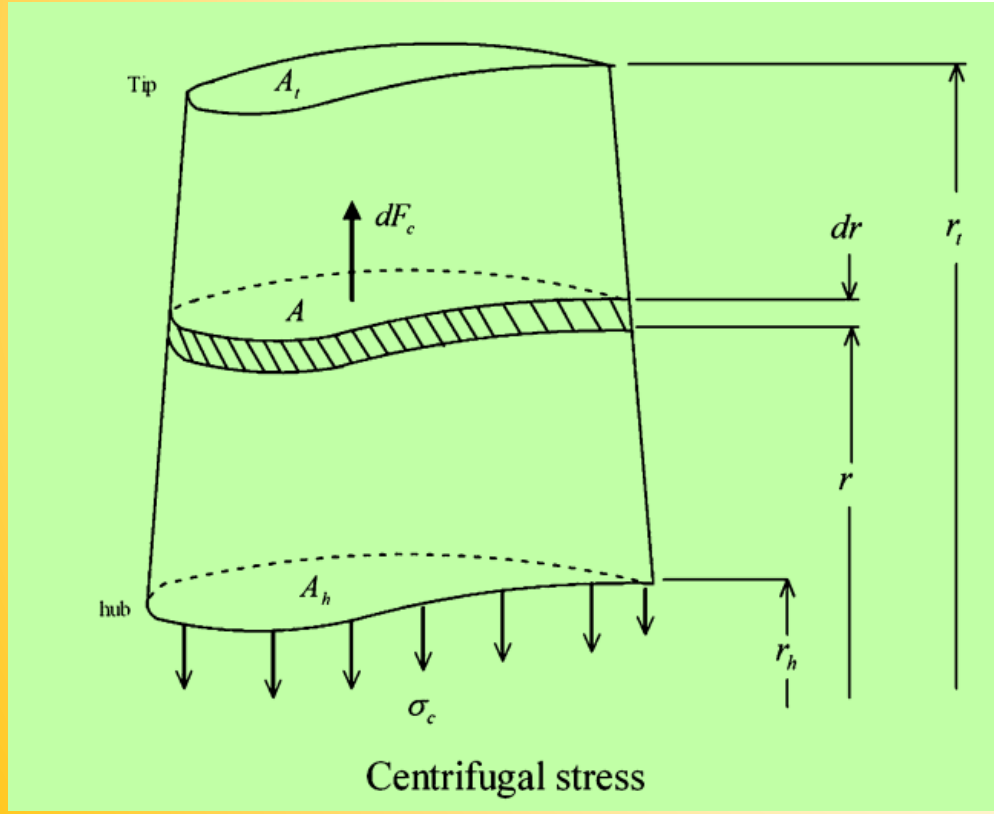
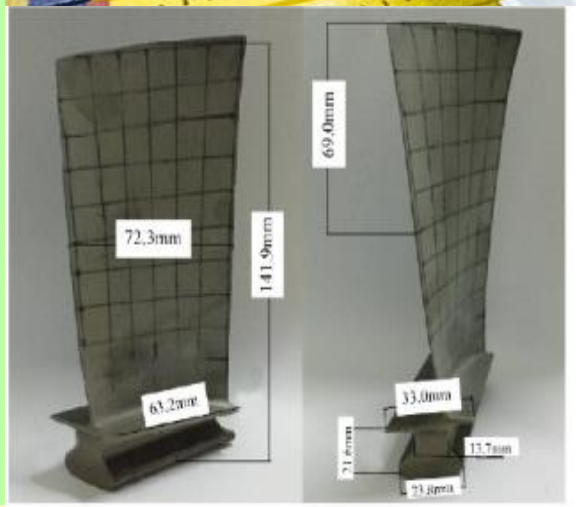
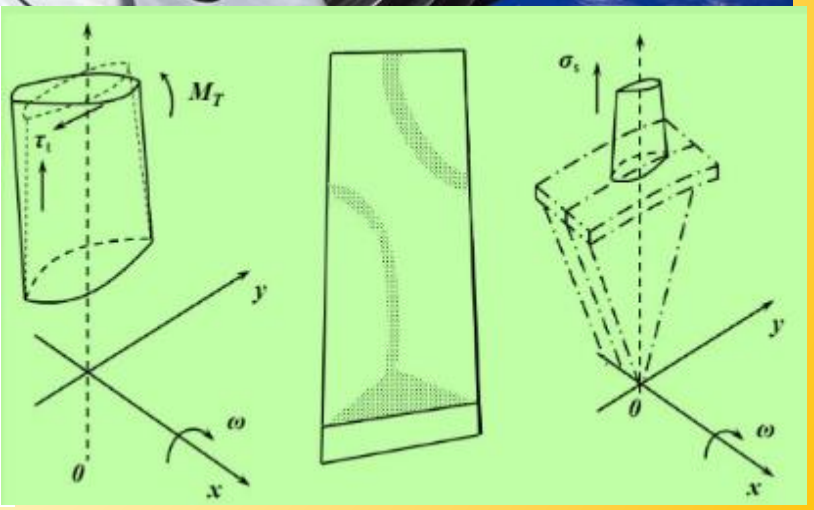
Topic: Calculation of centrifugal stress of the Axial compressor blade







$$dF_c = \omega^2 r \delta m$$

1

where (ω) and (r) are the rotational speed and the radius of any blade element having a mass of (δm) and length of (dr).

$$\delta m = \rho_b A dr$$

$$(\sigma_c)_{\max} = \frac{\rho_b}{2}(2\pi N)^2 (r_t^2 - r_r^2)$$

$$(\sigma_c)_{\max} = \frac{\omega^2}{A_{\text{root}}} \int_{rh}^{r_t} r\,\delta m$$

$$(\sigma_c)_{\max} = \frac{\rho_b \omega^2}{A_{\text{root}}} \int_{}^{rt} r A\, dr$$

2

For state of constant area in across of the blade

$$\sigma_{\max} = 2\pi N^2 \rho_b A$$

Where $A = \pi (r_t^2 - r_r^2)$ = annulus area

$$U_t = \omega r_t = 2\pi N r_t$$

$$(\sigma_c)_{\max} = \frac{\rho_b U_t^2}{2}\left[1 - \left(\frac{r_r}{r_t}\right)^2\right]$$

3

. For linear variation of cross sectional area with radius

$$(\sigma_{ct})_{\max} = \frac{\rho_b U_t^2}{2} (1 - \zeta^2) K$$

$$K = 1 - \frac{(1 - d)(2 - \zeta - \zeta^2)}{3(1 - \zeta^2)}$$

where $d = A_{\text{tip}}/A_{\text{root}}$ and $K = 0.55 - 0.65$ for tapered blades

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