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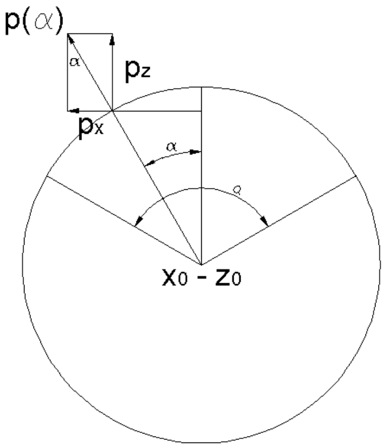
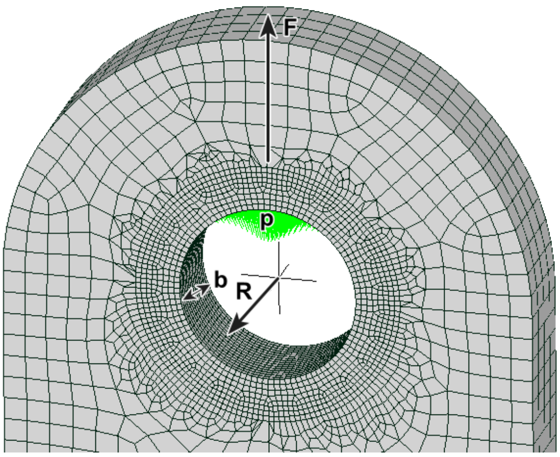
1 Parabolic distribution

Pressure distribution $$p(\alpha)=p_{max}\cos^2\left(\frac{\pi}{a}\alpha\right)$$

Vertical component $$p_z(\alpha)=p_{max}\cos^2\left(\frac{\pi}{a}\alpha\right)\cos(\alpha)$$

Horizontal component $$p_x(\alpha)=p_{max}\cos^2\left(\frac{\pi}{a}\alpha\right)sen(\alpha)$$





R Hole radius (D- diameter)
b Plate thickness
a Contact arc opening (° or rad)
F Total vertical force

Hypotheses:

- Vertical force (along z)
- Constant distribution on axial direction

$$dF_z(\alpha)=p_{max}bRd\alpha\cos^2\left(\frac{\pi}{a}\alpha\right)\cos(\alpha) \qquad F=p_{max}bR\int_{-a/2}^{a/2}\cos^2\left(\frac{\pi}{a}\alpha\right)\cos(\alpha)d\alpha$$

Integral solution: $$\int_{-a/2}^{a/2}\cos^2\left(\frac{\pi}{a}\alpha\right)\cos(\alpha)d\alpha=\frac{4\pi^2\times sen(a/2)}{4\pi^2-a^2}$$

Determination of p_{max} $$p_{max}=\frac{F}{bR}\frac{4\pi^2-a^2}{4\pi^2\times sen(a/2)}=\frac{2F}{bD}\frac{4\pi^2-a^2}{4\pi^2\times sen(a/2)}$$

Cartesian coordinates:

$$\cos^2\left(\frac{\pi}{a}\alpha\right)=\cos^2\left[\frac{\pi}{a}\times\arccos\left(\frac{z-z_0}{R}\right)\right];\ \cos(\alpha)=\left(\frac{z-z_0}{R}\right);\ sen(\alpha)=\left(\frac{x-x_0}{R}\right);$$

Vertical component $$p_z(\alpha)=p_{max}\cos^2\left[\frac{\pi}{a}\times\arccos\left(\frac{z-z_0}{R}\right)\right]\left(\frac{z-z_0}{R}\right)$$

Horizontal component $$p_x(\alpha)=p_{max}\cos^2\left[\frac{\pi}{a}\times\arccos\left(\frac{z-z_0}{R}\right)\right]\left(\frac{x-x_0}{R}\right)$$

2 Co-sinusoidal distribution

Pressure distribution $p(\alpha)=p_{max}\cos\left(\frac{\pi}{a}\alpha\right)$

Vertical component $p_z(\alpha)=p_{max}\cos\left(\frac{\pi}{a}\alpha\right)\cos(\alpha)$

Horizontal component $p_x(\alpha)=p_{max}\cos\left(\frac{\pi}{a}\alpha\right)\mathrm{sen}(\alpha)$

$dF_z(\alpha)=p_{max}bRd\alpha\cos\left(\frac{\pi}{a}\alpha\right)\cos(\alpha)$ $\quad F=p_{max}bR\int_{-a/2}^{a/2}\cos\left(\frac{\pi}{a}\alpha\right)\cos(\alpha)d\alpha$

Integral solution: $\int_{-a/2}^{a/2}\cos\left(\frac{\pi}{a}\alpha\right)\cos(\alpha)d\alpha=\frac{2\pi a\cos(a/2)}{\pi^2-a^2}$ $\quad a\neq180°$ $\quad a\neq\pi$

Determination of p_{max} $\quad p_{max}=\frac{F}{bR}\frac{\pi^2-a^2}{2\pi a\cos(a/2)}=\frac{2F}{bD}\frac{\pi^2-a^2}{2\pi a\cos(a/2)}$ $\quad a\neq180°$ $\quad a\neq\pi$

$\cos\left(\frac{\pi}{a}\alpha\right)=\cos\left[\frac{\pi}{a}\times\arccos\left(\frac{z-z_0}{R}\right)\right];\ \cos(\alpha)=\left(\frac{z-z_0}{R}\right);\ \mathrm{sen}(\alpha)=\left(\frac{x-x_0}{R}\right);$

Vertical component $p_z(\alpha)=p_{max}\cos\left[\frac{\pi}{a}\times\arccos\left(\frac{z-z_0}{R}\right)\right]\left(\frac{z-z_0}{R}\right)$

Horizontal component $p_x(\alpha)=p_{max}\cos\left[\frac{\pi}{a}\times\arccos\left(\frac{z-z_0}{R}\right)\right]\left(\frac{x-x_0}{R}\right)$

$a\neq180°$ $\quad a\neq\pi$

Integral solution: $\int_{-\pi/2}^{\pi/2}\cos^2(\alpha)d\alpha=\frac{\pi}{2}$ $\quad a=180°$

Determination of p_{max} $\quad p_{max}=\frac{F}{bR}\frac{2}{\pi}=\frac{4F}{\pi bD}$ $\quad a=180°$

Vertical component $p_z(\alpha)=p_{max}\left(\frac{z-z_0}{R}\right)^2$

Horizontal component $p_x(\alpha)=p_{max}\left(\frac{z-z_0}{R}\right)\left(\frac{x-x_0}{R}\right)$
