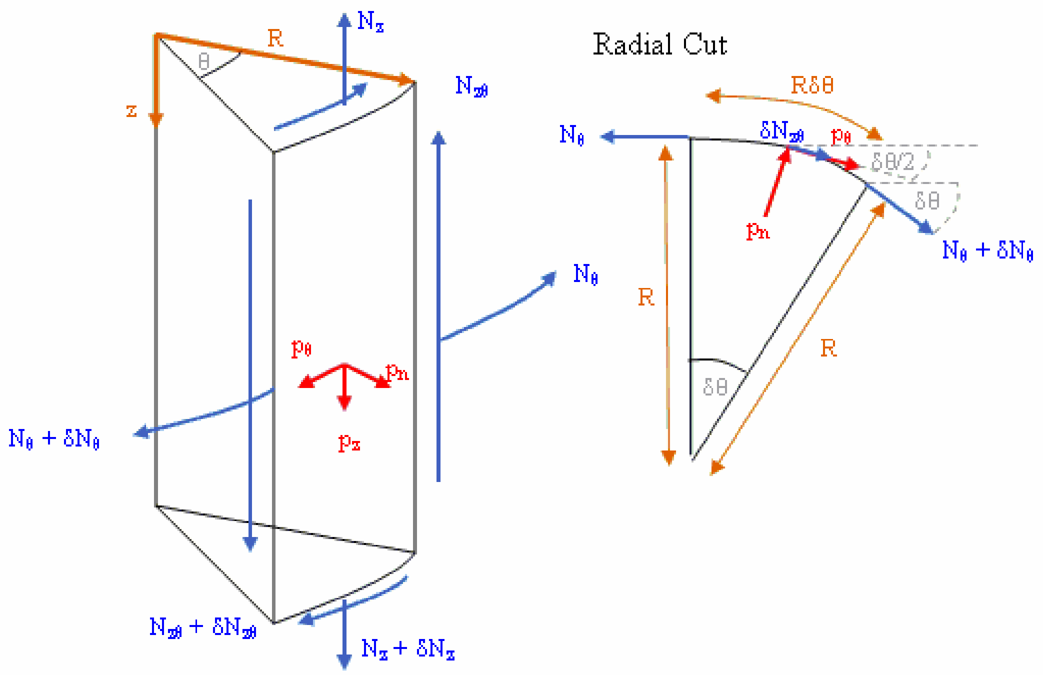

Use small angle approximation: As $\partial\theta \to 0$, $\cos\partial\theta \to 1$ and $\sin\partial\theta \to \partial\theta$,
and also $\partial\theta^2 \approx 0$, $\partial N_\theta \approx 0$.

Radial Equilibrium:

$$p_n R\partial\theta \cos\frac{\partial\theta}{2}\partial z = (N_\theta + \partial N_\theta)\sin\partial\theta\partial z + p_\theta R\partial\theta \sin\frac{\partial\theta}{2}\partial z + R\partial\theta\sin\frac{\partial\theta}{2}\partial N_{z\theta}$$

$$p_n R\partial\theta\partial z = (N_\theta)\partial\theta\partial z$$

$$\therefore\ p_n R = N_\theta \qquad ...(1)$$

Circumferential Equilibrium:

$$N_\theta\partial z = R\partial\theta\partial N_{z\theta}\cos\frac{\partial\theta}{2} + p_n R\partial\theta\sin\frac{\partial\theta}{2}\partial z + (N_\theta + \partial N_\theta)\cos\partial\theta\partial z + p_\theta R\partial\theta\cos\frac{\partial\theta}{2}\partial z$$

$$N_\theta\partial z = R\partial\theta\partial N_{z\theta} + (N_\theta + \partial N_\theta)\partial z + p_\theta R\partial\theta\partial z$$

$$0 = R\partial\theta\partial N_{z\theta} + \partial N_\theta\partial z + p_\theta R\partial\theta\partial z$$

$$\frac{\partial N_{z\theta}}{\partial z} + \frac{\partial N_\theta}{R\partial\theta} + p_\theta = 0$$

But from equation 1, $p_n R = N_\theta$.

$$\therefore\ \frac{\partial N_{z\theta}}{\partial z} = -\frac{\partial p_n}{\partial\theta} - p_\theta \qquad ...(2)$$

Axial Equilibrium:

$$N_z R\partial\theta + N_z\theta\partial z = p_z R\partial\theta\partial z + (N_z + \partial N_z)R\partial\theta + (N_{z\theta} + \partial N_{z\theta})\partial z$$

$$0 = p_z R\partial\theta\partial z + \partial N_z R\partial\theta + \partial N_{z\theta}\partial z$$

$$0 = p_z + \frac{\partial N_z}{\partial z} + \frac{\partial N_{z\theta}}{R\partial\theta}$$

$$\therefore\ \frac{\partial N_z}{\partial z} = -\frac{\partial N_{z\theta}}{R\partial\theta} - p_z \qquad ...(3)$$