$$\sum M_A = Fc - M_N - M_f = 0 \qquad \Rightarrow \qquad F = \frac{M_N + M_f}{c} \qquad \text{➔ } (\textit{Self-de-energizing})$$

$$R_x = \frac{brp_{\max}}{\sin\theta_{\max}}(A + fB) - F_x$$

$$R_y = \frac{brp_{\max}}{\sin\theta_{\max}}(B - fA) - F_y$$

where:

$$A = \int_{\theta 1}^{\theta 2} \sin\theta \cos\theta \, d\theta = \left(\frac{1}{2}\sin\theta\right)_{\theta 1}^{\theta 2}$$

$$B = \int_{\theta 1}^{\theta 2} \sin^2\theta \, d\theta = \left(\frac{\theta}{2} - \frac{1}{4}\sin\theta\right)_{\theta 1}^{\theta 2}$$

Note: the reference is always in the center of the drum. The positive x-axis is taken through the hinge. The positive y-axis is always in the direction of the shoe.

Internal Shoe Drum Brake:

- Normally used in automotive rear wheel
- Energizing and de-energizing characteristics are determined by:
  1- Noting the direction of friction force acting upon the shoe surface
  2- Determining if this force tends to bring the shoe into or out of contact of the drum

For the left figure shown below:

Left shoe: self – energizing
Right shoe: self-de-energizing

In automotive brakes ➔ self-energizing is desired ➔ decrease pedal force
But self-locking must be avoided

Improved Design:

The shoes are inverted and each one is actuated by a separate cylinder.
This arrangement will increase the self- energizing action
➔ Both shoes are self-energizing in forward car motion.
➔ This arrangement is used in automotive front wheels.