Homework 2

RBE 3002

* Given :
$$V_r = \omega\left(R + \frac{b}{2}\right) \qquad - \textcircled{1}$$

$$V_l = \omega\left(R - \frac{b}{2}\right) \qquad - \textcircled{2}$$

$$R = \left(\frac{b}{2}\right)\left(\frac{V_r + V_l}{V_r - V_l}\right) \qquad - \textcircled{3}$$

$$\omega = \left(\frac{V_r - V_l}{b}\right) \qquad \cdot -\textcircled{4}$$

1.) from equation 4 → $V_r - V_l = \omega b$

$\therefore$ putting $V_r - V_l$ in equation $\textcircled{3}$

$$R = \frac{b}{2}\left(\frac{V_r + V_l}{\omega b}\right)$$

$$\frac{2\omega R}{\cancel{2}} = V_r + V_l$$

$$\cancel{\textcircled{3}} \quad \frac{\omega R}{\cancel{2}} \cancel{V_l}$$

$$V_r = 2R\omega - V_l$$

where $V_l = \omega\left(R - \frac{b}{2}\right)$

$$V_r = 2R\omega - \omega\left(R - \frac{b}{2}\right)$$

$$V_r = 2R\omega$$

$$V_r + V_l = 2R\omega$$

$$V_r + V_l + V_r - V_l = 2R\omega + V_r - V_l$$

$$2V_r = 2R\omega + \omega b$$

$$V_r = R\omega + \omega \frac{b}{2}$$

$$\boxed{V_r = \omega\left(R + \frac{b}{2}\right)}$$

$\therefore$ $V_r + V_l - V_r + V_l = 2R\omega - (V_r - V_l)$

~~$V_r + V_l$~~ $2V_l = 2R\omega - \omega b$

$$\boxed{V_l = \omega\left(R - \frac{b}{2}\right)}$$

② $\dfrac{V_r}{V_l} = \dfrac{\omega}{\omega}\left(\dfrac{R + b/2}{R - b/2}\right)$ $\qquad\qquad$ [$\because$ dividing ① & ②]

$\Rightarrow$ $RV_r - \dfrac{V_r b}{2} = RV_l + R\dfrac{V_l b}{2}$

$RV_r - RV_l = \dfrac{V_l b}{2} + \dfrac{V_r b}{2}$

$R[V_r - V_l] = \dfrac{b}{2}[V_r + V_l]$

$$\boxed{R = \dfrac{b}{2}\left[\dfrac{V_r + V_l}{V_r - V_l}\right]}$$

① − ②

$\therefore$ $V_r - V_l = \omega\left[R + \dfrac{b}{2} \neq R + \dfrac{b}{2}\right]$

$V_r - V_l = \omega b$

$$\boxed{\omega = \dfrac{V_r - V_l}{b}}$$