Expanding out ⇒

36 cont

$$z = v_0 t + A\cos\delta\left[\cos\frac{v_0\pi}{l}t - 1\right] - A\sin\delta\sin\frac{v_0\pi}{l}t$$

or

$$\boxed{z = v_0 t - \frac{v_x^\circ\, l}{\pi v_0}\left[\cos\frac{v_0\pi}{l}t - 1\right] + \frac{(v_z^\circ - v_0)\, l}{\pi v_0}\sin\frac{v_0\pi}{l}t}$$

$$x = A\sin\delta\left[1 - \cos\frac{v_0\pi}{l}t\right] - A\cos\delta\sin\frac{v_0\pi}{l}t$$

or

$$\boxed{x = \frac{(v_0 - v_z^\circ)\, l}{\pi v_0}\left[1 - \cos\frac{v_0\pi}{l}t\right] + \frac{v_x^\circ\, l}{\pi v_0}\sin\frac{v_0\pi}{l}t}$$

Solve again for t_l

$$l = v_0 t_l - \frac{v_x^\circ\, l}{\pi v_0}\left[\cos\frac{v_0\pi}{l}t_l - 1\right] + \frac{(v_z^\circ - v_0)\, l}{\pi v_0}\sin\frac{v_0\pi}{l}t_l$$

or

$$t_l = \frac{l}{v_0}\left[1 + \frac{v_x^\circ}{\pi v_0}\left[\cos\frac{v_0\pi}{l}t_l - 1\right] + \frac{(v_0 - v_z^\circ)}{\pi v_0}\sin\frac{v_0\pi}{l}t_l\right]$$

1st approx ⇒ $t_l = \frac{l}{v_0}$

2nd approx ⇒ $t_l = \frac{l}{v_0}\left[1 - \frac{2 v_x^\circ}{\pi v_0}\right]$