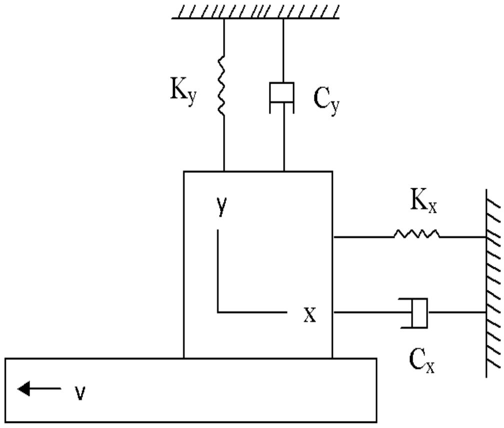

The equations of motion for this system can be written as:

$m\ddot{x} + c_x\dot{x} + k_x x = F_{x0} + F_x$ (1)

$m\ddot{y} + c_y\dot{y} + k_y y = F_{y0} + F_y$ (2)

Where,

F_{x0} = Constant (3)

F_{y0} = Constant (4)

Now,

$F_x = \mu(v_r)\, F_y sgn(v_r)$ (5)

Where, v_r is relative velocity (i.e. $v_r = \dot{x} - v$).

The following model has been used for the friction:

$$\mu(v_r)\, F_{contact-y}\, \mathrm{sgn}\,(v_r) = \begin{cases} \mu & \text{if } v_r > 0 \\ 0 & \text{if } v_r = 0 \\ -\mu & \text{if } v_r < 0 \end{cases} \qquad (6)$$

Also,

$F_y = -k_f\, \dot{y}$ (7)

Where,

$k_f = \frac{K\, VB^2}{v}$ (8)

VB = wear land on mass

v = velocity of belt (constant)

K = constant

Also,

$$F_y = \begin{cases} -k_f\,\dot{y} & \text{for } t_1 + nT_p \le t \le t_2 + nT_p \quad n = 0,1,2,3... \\ 0 & \text{otherwise} \end{cases}$$

Where,

$T_p = 2\pi/\omega$ (ω is frequency of mass vibration)

$t_1 = T_p/4$
$t_2 = 3t_1$

So, using equations (3)-(8), equations of motion can be re-written as,

$$m\ddot{x} + c_x\dot{x} + k_x x = F_{x0} + \mu(v_r)\left(\frac{K\,VB^2}{v}\,\dot{y}\right) sgn(v_r) \tag{9}$$

$$m\ddot{y} + c_y\dot{y} + k_y y = F_{y0} + \frac{K\,VB^2}{v}\,\dot{y} \tag{10}$$

Now I have to solve these equations and also have to obtain the relationship between VB and time.