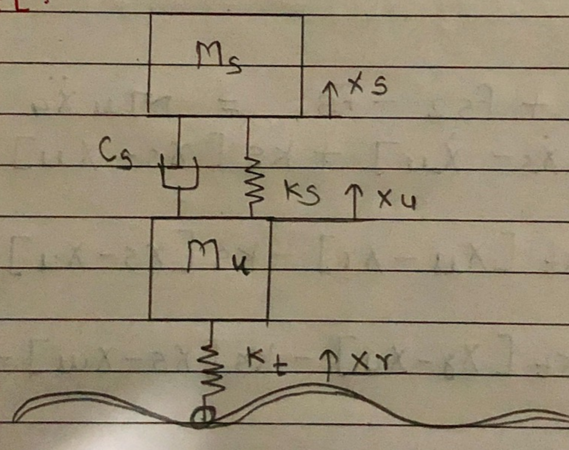
SUSPENSION SYSTEM

PROBLEM STATEMENT

The suspension system for one wheel of an old-fashioned pickup truck is illustrated in fig.2 The mass of the vehicle is M1 and the mass of wheel is M2. The suspension spring has a spring constant K1 and the tire had the spring constant K2. The damping constant of the shock absorber is b. obtain the mathematical model.

MODEL:



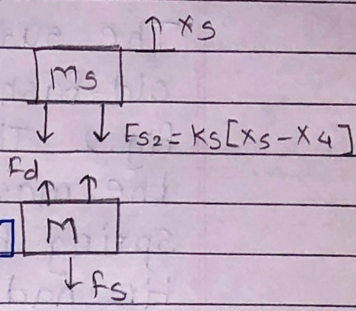
VALUES:

$M_s = 600$ kg
$M_u = 90$ kg
$K_s = 36000$ N/m
$C_s = 1000$ N-s/m
$K_t = 204034.4$ N/m

① DERIVATION :

Applying Newton's 2nd law of motion to Ms,

$\Sigma F = -F_d - F_{s2} = M_s \ddot{x}_s$



$M_s \ddot{x}_s = -C_s[\dot{x}_s - \dot{x}_u] - k_s[x_s - x_u]$

$0 = M_s \ddot{x}_s + C_s[\dot{x}_s - \dot{x}_u] + k_s[x_s - x_u]$

$\therefore M_s \ddot{x}_s + C_s[\dot{x}_s - \dot{x}_u] + k_s[x_s - x_u] = 0$

Applying Newton's 2nd law of motion to Mass Mu,

$\Sigma F = F_d + F_{s2} - f_{s1} = M_u \ddot{x}_4$

$M_u \ddot{x}_u = C_s[\dot{x}_s - \dot{x}_u] + k_s[x_s - x_u] - k_t[x_u - x_r]$

$\therefore M_u \ddot{x}_u + k_t[x_u - x_r] - k_s[x_s - x_u] - C_s[\dot{x}_s - \dot{x}_u] = 0$

$M_u \ddot{x}_u - k_t[x_r - x_u] - k_s[x_s - x_u] - C_s[\dot{x}_s - \dot{x}_u] = 0$

$\therefore$ Rewriting equation,

$M_u \ddot{x}_u + k_t[x_u - x_r] + k_s[x_u - x_s] + C_s[\dot{x}_u - x_s] = 0$

$M_s \ddot{x}_s + C_s[\dot{x}_s - \dot{x}_u] + k_s[x_s - x_u] = 0$

Required equation for simulink,

$$\boxed{\ddot{x}_s = \frac{1}{M_s}\left[C_s[\ddot{x}_u - \dot{x}_s] + k_s[x_u - x_s]\right]} \quad (I)$$

$$m_u \ddot{x}_u = k_t[x_r - x_u] + k_s[x_s - x_u] + c_s[\dot{x}_s - \dot{x}_u]$$

$$\boxed{\therefore \ddot{x}_u = \frac{1}{m_u}\left[k_t[x_r - x_u] + k_s[x_s - x_u] + c_s[\dot{x}_s - \dot{x}_u]\right]}$$

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