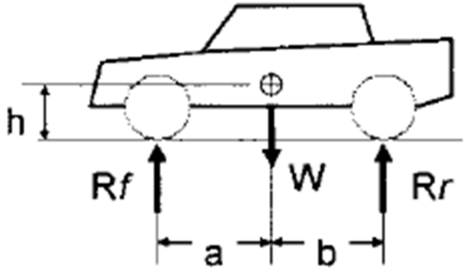
Figure 2.16 (1)

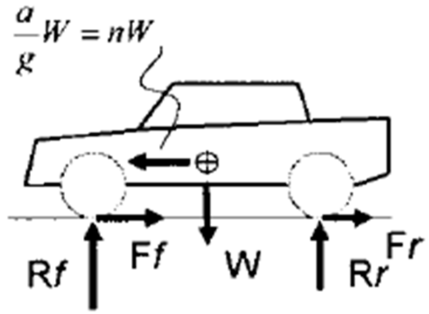
static



$$\begin{cases} 2\left(R_f + R_r\right) = W \\ bR_r - aR_f = 0 \rightarrow b\left(\dfrac{W}{2} - R_f\right) - aR_f = 0 \end{cases}$$

$$\rightarrow \begin{cases} R_f = \left(\dfrac{b}{a+b}\right)\dfrac{W}{2} \\ R_r = \left(\dfrac{a}{a+b}\right)\dfrac{W}{2} \end{cases}$$

braking

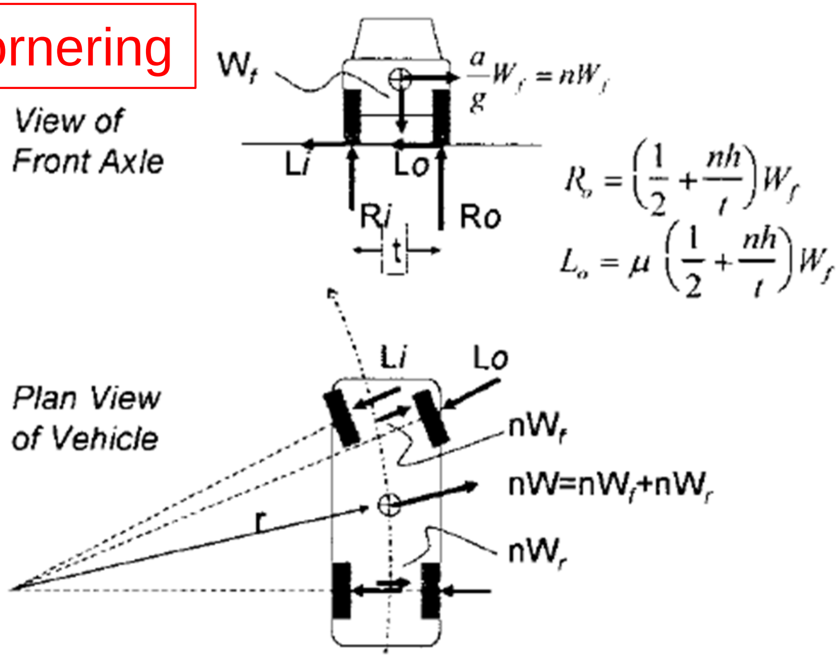


$$\begin{cases} 2\left(F_f + F_r\right) = 2\mu\left(R_f + R_r\right) = nW \rightarrow R_r = \dfrac{nW}{2\mu} - R_f = \left(\dfrac{n}{\mu} - \dfrac{b+nh}{a+b}\right)\dfrac{W}{2} \\ 2R_f\left(a+b\right) = nWh + Wb \rightarrow R_f = \left(\dfrac{b+nh}{a+b}\right)\dfrac{W}{2} \end{cases}$$

$$\rightarrow \begin{cases} F_f = \mu R_f = \mu\left(\dfrac{b+nh}{a+b}\right)\dfrac{W}{2} \\ F_r = \mu R_r = \mu\left(\dfrac{n}{\mu} - \dfrac{b+nh}{a+b}\right)\dfrac{W}{2} \end{cases}$$

Figure 2.16 (2)

cornering



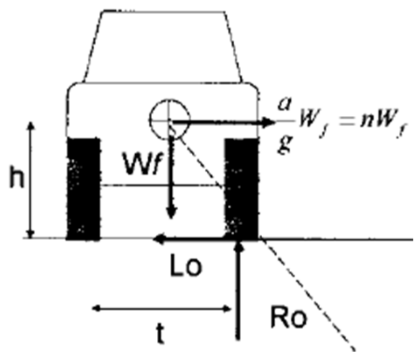
$$\begin{cases} R_i + R_o = W_f \\ L_i + L_o = nW_f \\ L_i = \mu R_i, L_o = \mu R_o \\ \frac{t}{2}(R_o - R_i) - h(L_i + L_o) = 0 \end{cases}$$

$$\rightarrow \frac{t}{2}(R_o - W_f + R_o) - h(nW_f) = 0$$

$$\rightarrow tR_o = \left(\frac{t}{2} + nh\right)W_f$$

$$\rightarrow R_o = \left(\frac{1}{2} + \frac{nh}{t}\right)W_f \rightarrow L_o = \mu\left(\frac{1}{2} + \frac{nh}{t}\right)W_f$$

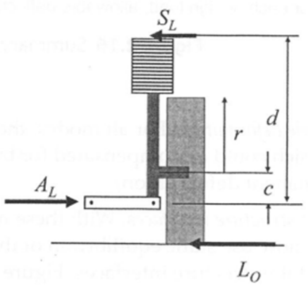
Incipient rollover

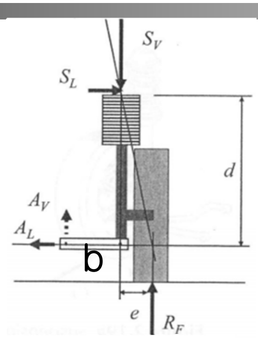


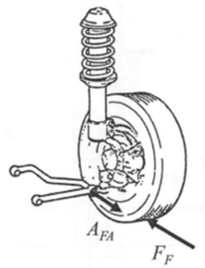
$$\begin{cases} R_i = 0, R_o = W_f \\ L_o = nW_f \\ \frac{t}{2}R_o - hL_o = 0 \rightarrow L_o = \frac{t}{2h}R_o \end{cases}$$

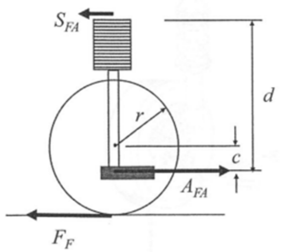
$$\rightarrow n = \frac{t}{2h}$$

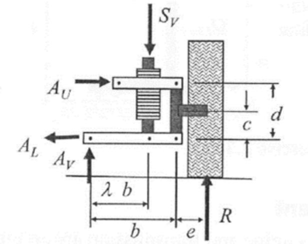
2.5 Struct vs.SLA



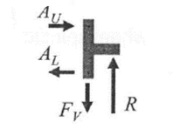




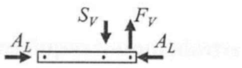




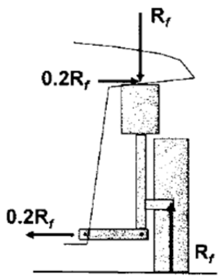
Suspension free body: front view

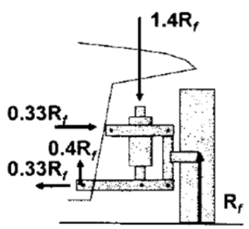


Knuckle free body



Lower arm free body





Struct

For the maximum lateral tire patch load during rollover mode

$$M_{@A_L}: S_L d-(r-c)L_0=0$$

$$\rightarrow S_L=\left(\frac{r-c}{d}\right)L_0$$

$$M_{@S_L}: A_L d-(d+(r-c))L_0=0$$

$$\rightarrow A_L=\left(\frac{r-c}{d}+1\right)L_0$$

For the maximum fore-aft tire patch load during braking mode

$$M_{@A_{FA}}: F_F(r-c)-dS_{FA}=0$$

$$\rightarrow S_{FA}=\left(\frac{r-c}{d}\right)F_F$$

$$M_{@S_{FA}}: A_{FA}d-(d+(r-c))F_F=0$$

$$\rightarrow A_{FA}=\left(\frac{r-c}{d}+1\right)F_F$$

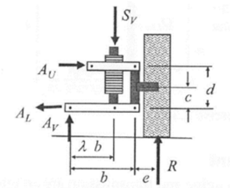
For the maximum vertical tire patch load during bump mode

$$F_x: A_L-S_L=0\rightarrow S_L=A_L$$

$$F_y: R_F-S_V-A_V=0\rightarrow S_V=R_F-A_V$$

$$if\ A_V=0\,(or\ S_V\gg A_V),\ S_V=R_F$$

SLA



Suspension free body: front view

1) S_V

$$F_x: A_U-A_L=0\rightarrow A_U=A_L$$

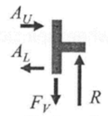
$$F_y: S_V-A_V-R=0\rightarrow S_V=R+A_V$$

$$M_{@lowerarm,F_V}: bA_V-(b-\lambda b)S_V=0\rightarrow A_V=(1-\lambda)S_V$$

$$\rightarrow S_V-R=(1-\lambda)S_V\ \rightarrow S_V=\frac{1}{\lambda}R$$

2) A_U

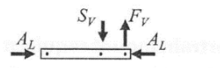
$$M_{@knuckle,F_V}: eR-dA_U=0\rightarrow A_U=\frac{e}{d}R$$



Knuckle free body

3) A_L, A_V

$$A_L=A_U=\frac{e}{d}R$$



Lower arm free body

$$A_V=A_V=(1-\lambda)S_V=(1-\lambda)\frac{1}{\lambda}R$$

$$=(\frac{1}{\lambda}-1)R$$

$\lambda=0.7$ 인 경우

$$\text{Strut}: S_V=R,\ \ \text{SLA}: \frac{1}{\lambda}R=\frac{1}{0.7}R\approx 1.43R$$

SLA가 Struct보다 Sv (spring-shock maximum load)가 1.43배 커서 우수함