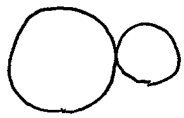


motor gear

same distance

$$\Rightarrow V_m \cdot R_m = V_g \cdot R_g$$

$$\frac{V_m}{V_g} = 75 = \frac{R_g}{R_m}$$

Same force (Newton's third law)

∵ $T = F \cdot R$

$$\Rightarrow \frac{T_m}{T_g} = \frac{R_m}{R_g} = \frac{1}{75}$$

$$T_m = \frac{T_g}{75}$$ only 95% efficiency

$$\Rightarrow T_{m,e} = \frac{T_g}{75} \cdot \frac{1}{0.95} \cdot 2$$ ← 2 gears

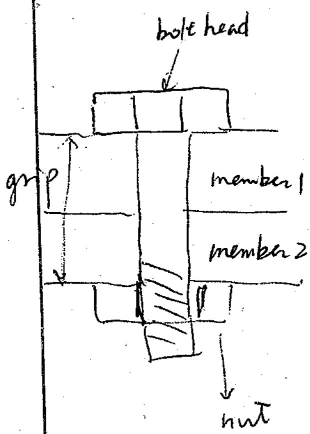
$$\text{Horse Power} = HP = \frac{T \cdot n}{63000}$$ → rev/min

$$= \frac{\left(\frac{753}{75} \cdot \frac{1}{0.95} \cdot 2\right) \cdot 1720}{63000}$$

$$= 0.58\ HP$$

bolt joint

go back P49 figure.



F_i : "preload" produced by tightening nut

- members are "compressed" by force F_i
- member stretch to give bolt "tensile" force F_i

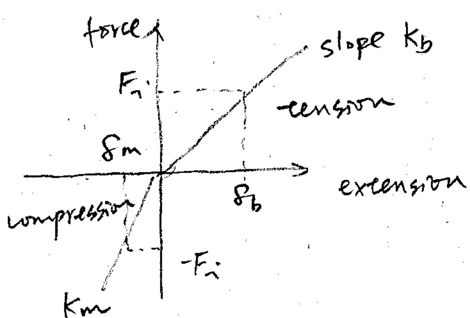
note stress concentration

1) junction of bolt head & shank
2) junction of threaded & unthreaded portions of shank
3) first thread inside nut

bolt will usually fail at one of these positions

Let

- F_b, δ_b — bolt force, extension
- F_m, δ_m — member force, extensions



If there is no external load on the joint

$$F_b = F_i, \quad F_m = -F_i$$

now, if we try to pull the joint apart with an external tensive force P

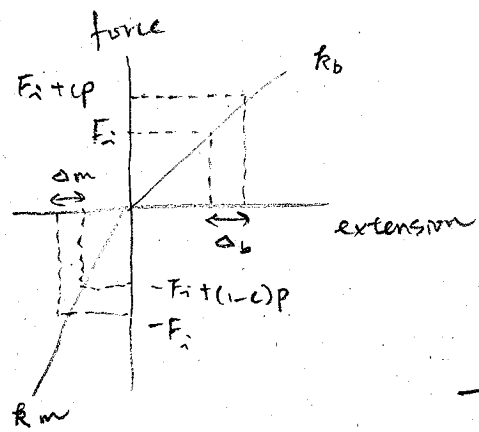
$P \begin{cases} C \\ 1-C \end{cases}$ portion of P acting upon $\begin{cases} \text{bolt} \\ \text{members} \end{cases}$

we want to determine C

$$\begin{cases} F_b = F_i + cP \\ F_m = -F_i + (1-c)P \end{cases}$$

Let Δ_b = increase in extension of bolt due to cP

Δ_m = decrease in compression of members due to $(1-c)P$



$cP = k_b \Delta_b$

$(1-c)P = k_m \Delta_m$

as long as $F_m < 0$

$\rightarrow$ the joint remains intact

we must have $\Delta_m = \Delta_b$

$$\rightarrow \frac{cP}{k_b} = \frac{(1-c)P}{k_m}$$

$$\rightarrow c = \frac{k_b}{k_b + k_m}$$

$C \longrightarrow$ fraction of P acts on bolt

called "joint constant"

Note: $c \ll 1$ if $k_b \ll k_m$: most extended load P acts on <u>members</u>

to minimize load on bolt, we desire stiffness of bolt to be small compare to stiffness of members.

<u>Condition for joint to remain intact</u>

$F_m < 0 \rightarrow$ members will not separate & joint in intact

$c = \frac{k_b}{k_b + k_m}$ into $F_m = -F_i + (1-c)P$

$F_m < 0 \implies P < \frac{k_b + k_m}{k_m} F_i$ max. allowed P for preload F_i

or $F_i > \frac{k_m}{k_b + k_m} P$ min. preload F_i for given P