ME 314 W2022 - 1/3/2022

Fastener Selection

ordering information

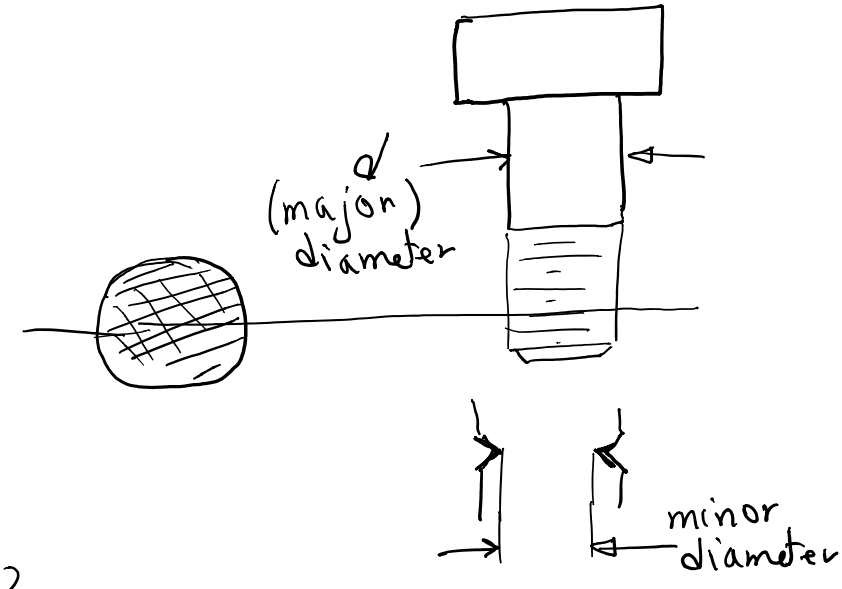
→ Thread Selection (Table 8-2)

example #12-24

$d = 0.216$

$pitch = p = \frac{1}{24} = 0.0416$ ← pitch

(24 threads per inch)



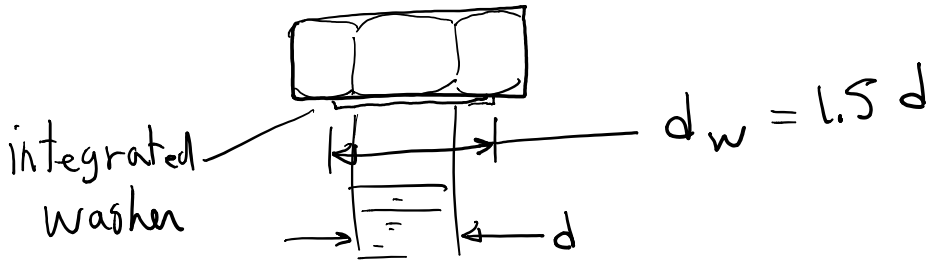
tensile area A_t

From Table 8-2

$A_t = 0.0242$ in^2

(...) in tension

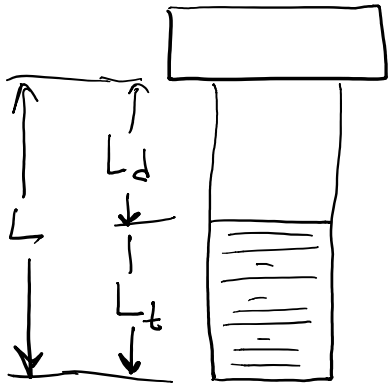
(Load bearing area) in tension



$d_w = 1.5\,d$

$d_w = 0.324$ "

→ Total length L



example $L = 1^{in}$

(#12-24 UNC)

$L_t = 2d + 1/4$

$L_t = 2(0.216) + 0.25$

$L_t = 0.682$

And $L_d = L - L_t = 1 - 0.682 = 0.318$

$L_d = 0.318$

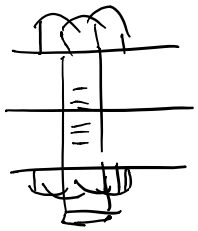
Couple of Points

" Fasteners are not Precision Components

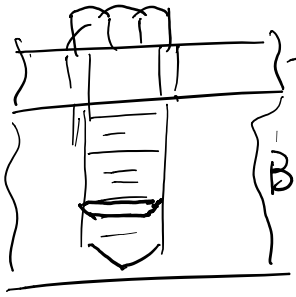
* Fasteners are not Precision Components
All geometry values are approximate

* Distinction between a bolt and a screw

Bolts : used with nuts
Screws : used with tapped plates



Bolt



→ Head type (Figures 8-9, 8-10, 8-11)

→ material (Strength)

in this class (Steel bolts)

example : $\frac{1}{2}$ in UNC 13 Grade 5.2

Strength (Table 8-9 SAE Standard)
(minimum strengths)

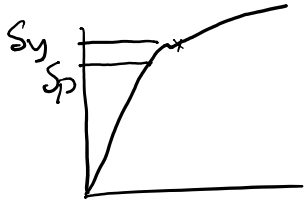
For Grade 5.2

For Grade 5.2

$S_y = 92$ ksi

$S_{ut} = 120$ ksi

$S_p = 85$ ksi Proof strength

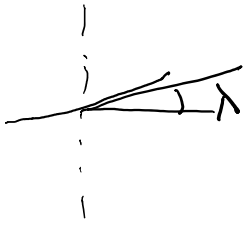


$E = 30 * 10^6$ Psi

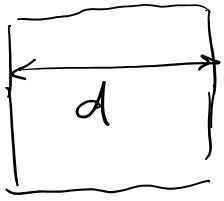
$G = 11.5 * 10^6$ Psi

Common questions

Question: For a $\frac{1}{2}$ in UNC 13
what is the lead angle λ



Paper



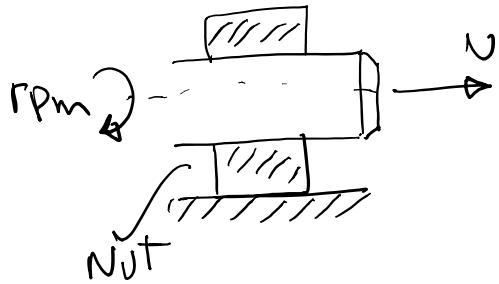
$$\tan \lambda = \frac{p}{\pi d}$$

where $p = 1/13$ and $d = 0.5$

$\Rightarrow \lambda \cong 2.8$ degrees

Question: if we use a $\frac{1}{2}$ in UNC 13 to move
[illegible] bolt at 60 rpm,

Question: If we use a 1/2 in [illegible] a load and spin the bolt at 60 rpm, how fast the load moves in in/sec?



$$\omega = \frac{rpm}{60} \equiv \text{cyc/s}$$

$$v = \omega \cdot p \quad \text{in/s}$$

$$v = 1\left(\tfrac{1}{13}\right) = 0.0769 \quad \text{in/s}$$

Question: How fast to spin the bolt to get $v = 0.5$ in/s.

$$v = \omega p \Longrightarrow 0.5 = \omega\,(0.0769)$$

$$\Rightarrow \omega = 6.5 \quad \text{cyc/s}$$

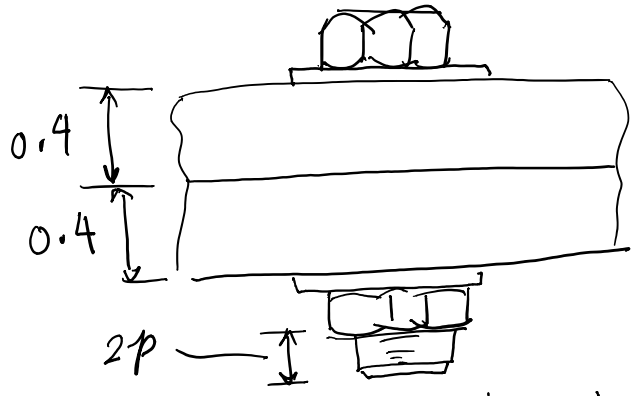
$$rpm = 60\,\omega = 60(6.5) = \underline{390} \quad \text{rpm}$$

Questions

We want to clamp two 0.4" Plates using a $\frac{1}{2}$ in UNC 13 bolt with a Hex nut and Two external washers, where:

$$t_{nut} = 0.328$$
$$t_w = 0.062$$

Allow at least 2p length bolt end to nut overlap



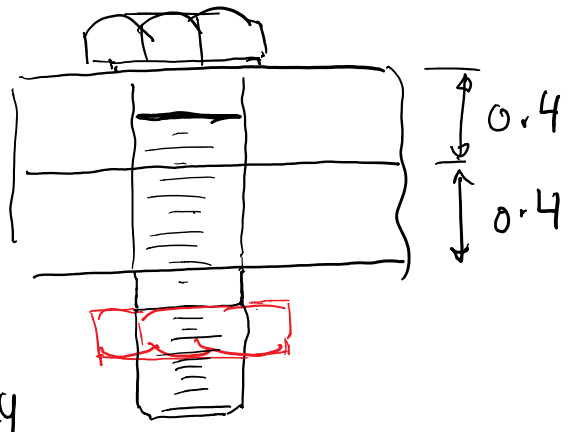
* what is the minimum adequate length for the bolt ?
* what is the bolt length selection

$$L_{min} = 0.4 + 0.4 + 2(0.062) + 0.328 + 2(1/13)$$

$$L_{min} = 1.405''$$ ←

$$L_{sel} = 1.5''$$ ←

Question: A bolt can be too short or too long is the $L = 1.5''$ too long for the clamping of plates in the last question



Condition for bolt being too long

$$L_d^c > 0.4 + 0.4$$

Checking L_d

$$L = L_d + L_t$$

where

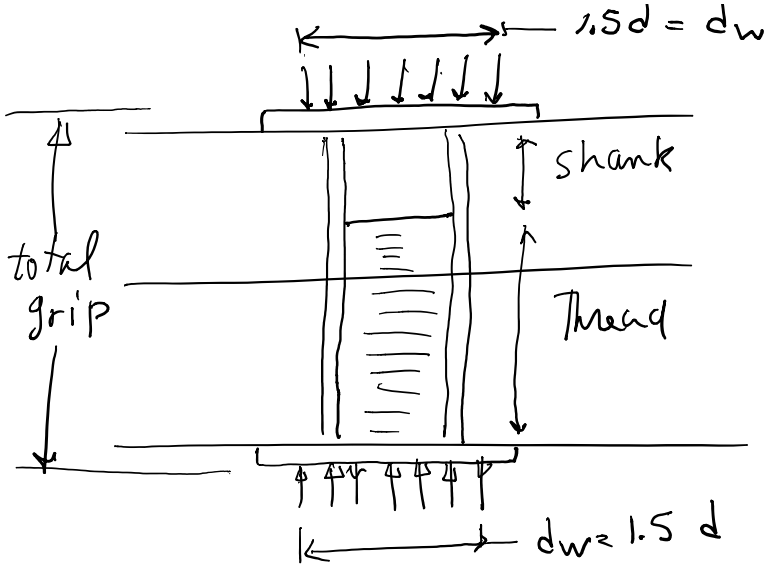
$L = 1.5$

$L_t = 2d + 1/4 = 2(0.5) + 1/4 = 1.25$

$\Rightarrow L_d = 1.5 - 1.25 = 0.25$

since $L_d < L_d^c$, the bolt is not too long

Question For previous question, calculate the total length of "grip" . . .



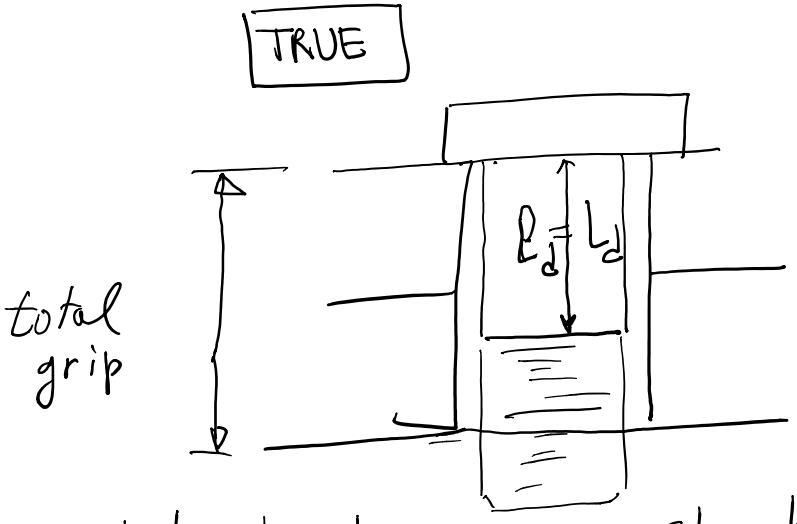
$\ell \equiv$ total grip

$\ell = 0.4 + 0.4 + 2(0.062)$

$\ell = 0.924$

Question: For a bolt to grip properly, the entire bolt shank must be within grip

TRUE



Question: Calculate the length of shank

within grip (l_d) and the length of thread within grip l_t

$$l = l_t + l_d$$

$$l_d = L_d = 0.25$$

$$\Rightarrow 0.924 = l_t + 0.25$$

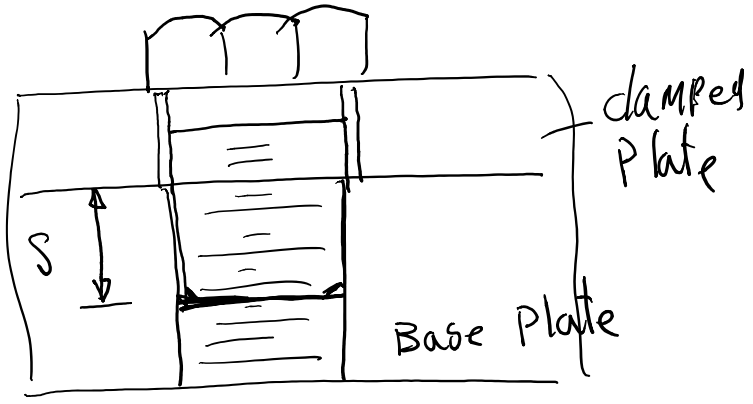
$$l_t = 0.674''$$

Cap Screws

$$S_{min} = 1.5\,d$$

$$S_{min} = 1.5\,(0.5)$$

$$= 0.75''$$



Question: Calculate minimum screw length for proper clamping (w/o washers)

$$L_{min} = 0.4 + 0.75 = 1.15$$

Selection $L = 1.5''$

Question: is this screw too long

is $L_d > 0.4$?

$L = 1.5 = L_T + L_d = 1.25 + L_d$

$\Rightarrow L_d = 0.25 \Rightarrow$ screw is not too long