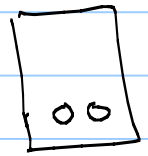
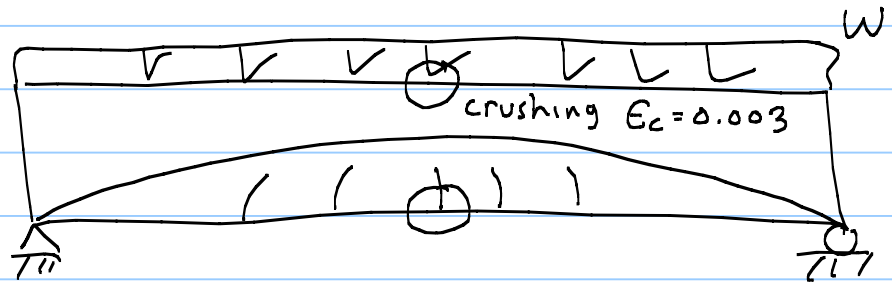
Note Title 4/9/2007

HW # 7 2.2, 2.26, 2.36 Due 4/17

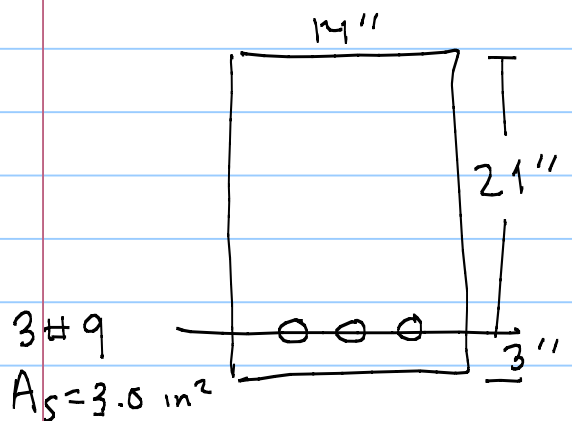
Read Ch 2 (2.1, 2.2, 2.4)





first cracking of the tensile concrete M_{cr}
reach ultimate (nominal) capacity M_n

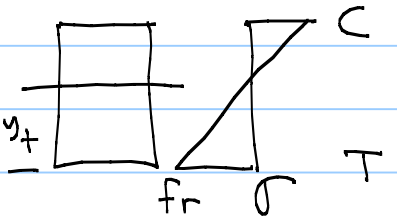
Ex. 2.6



$f'_c = 3\ ksi$

$f_y = 60\ ksi$

$$\sigma = \frac{My}{I}$$



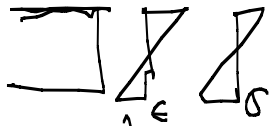
$$M_{cr} = \frac{f_r I_g}{y_t}$$

$$f_r = 7.5\sqrt{f'_c} = 7.5\sqrt{3000\ psi} = 411\ psi$$

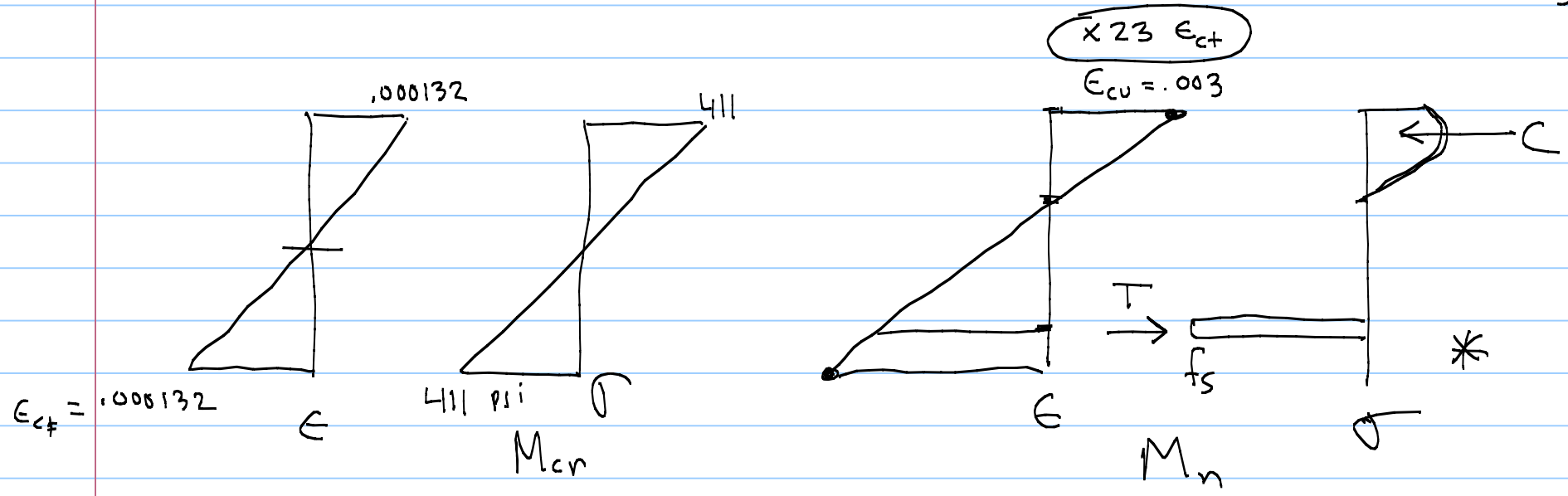
$$I_g = bh^3/12 = (14)(24)^3/12 = 16{,}128\ in^4$$

$$M_{cr} = (411\ psi)(16{,}128\ in^4)/(12\ in) =$$

$$= 552{,}104\ in\text{-}lb = 552.1\ in\text{-}k = \boxed{46.0\ ft\text{-}k}$$



What is M_n – ultimate (nominal) moment capacity



$$E_c = 57{,}000\sqrt{f'_c} = 3{,}122{,}019 \text{ psi}$$

f'_c in psi (3000)

$\sigma = E\varepsilon$

$$\varepsilon_{ct} = {}^{411}/_{3{,}122{,}019}$$

$$\varepsilon_{ct} = 0.000132$$

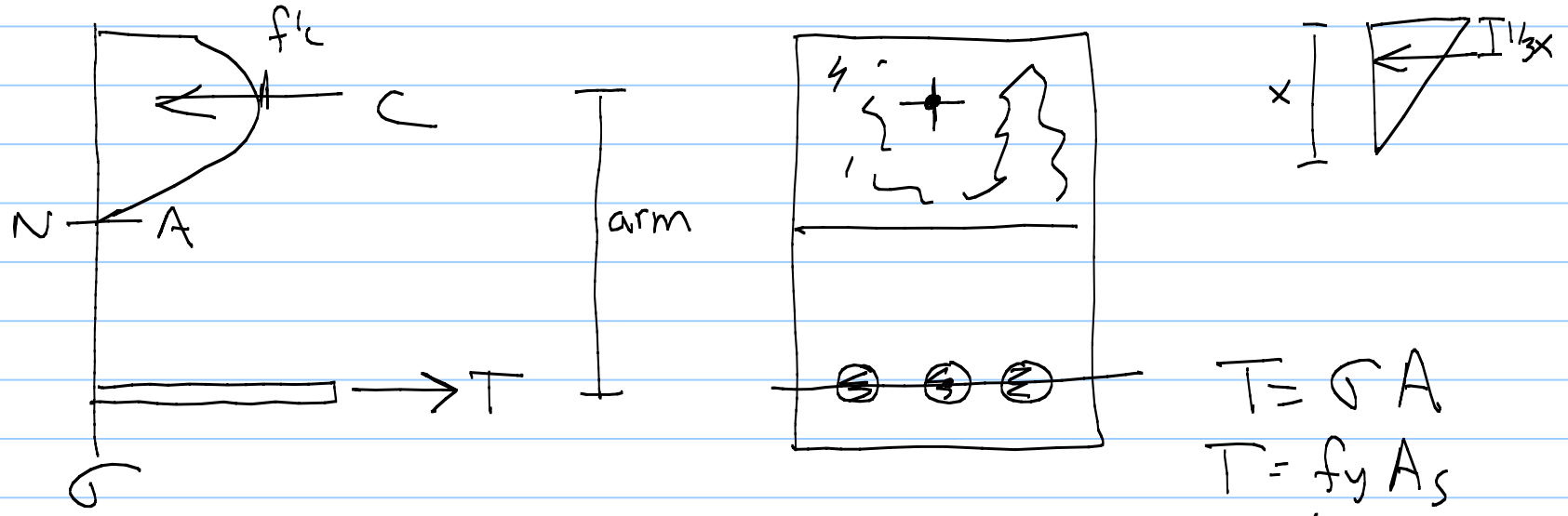
$\sigma = E\varepsilon$

$$\sigma_y = E_s \varepsilon_y$$

$$\varepsilon_y = {}^{60}/_{29{,}000}$$

$$\varepsilon_y = 0.00207$$

$C = T$



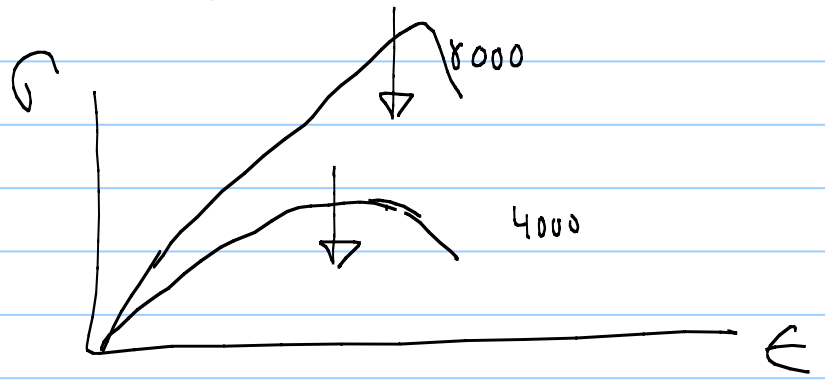
$T = \sigma A$

$T = f_y A_s$

$(60)(3) = 180k$

assumes steel yields

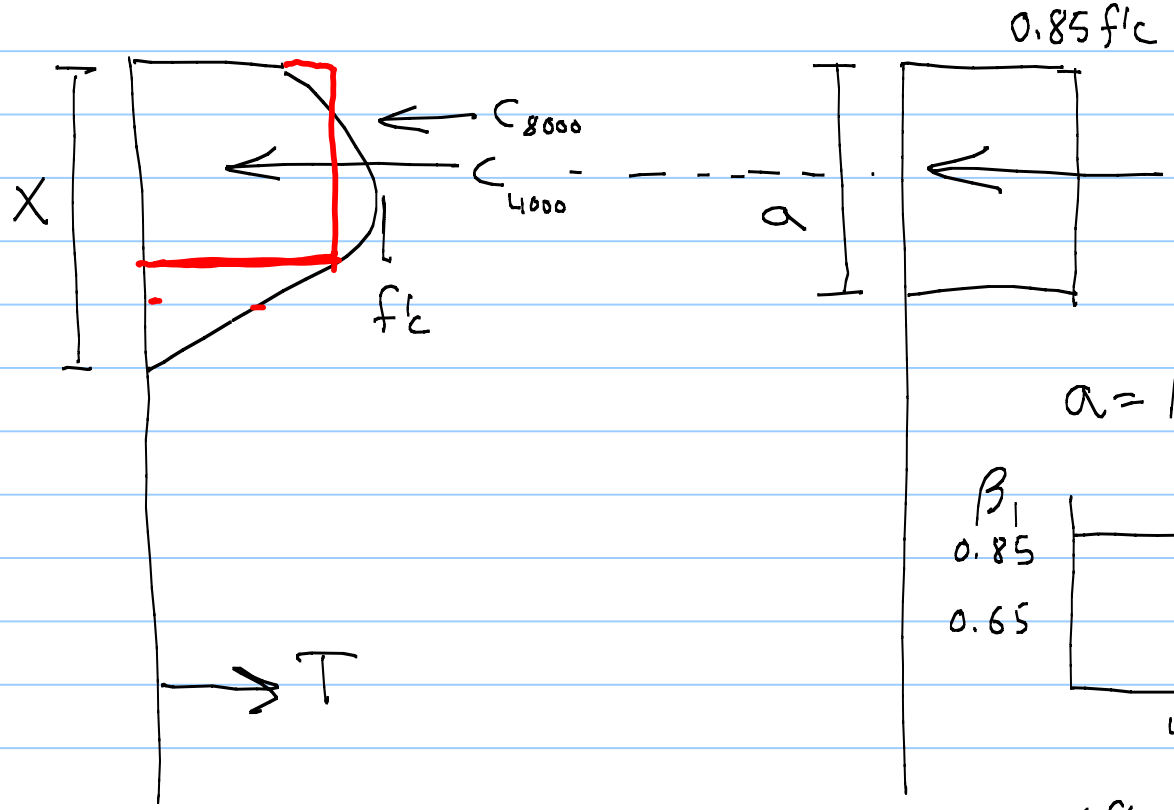
$M_n = (C \text{ or } T)\ arm$ couple



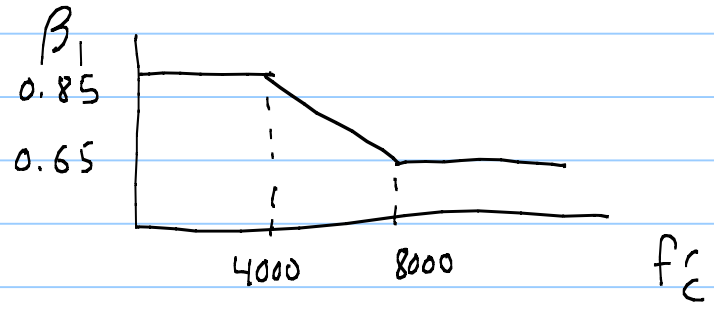
Whitney (1942)

Whitney Stress Block

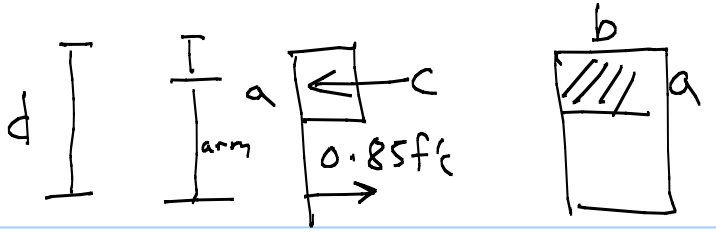
$a \downarrow \quad f'_c \uparrow$



$$a = \beta_1 X$$



$$\beta_1 = 0.85 - \left(\frac{f'_c - 4000}{1000}\right)(.05) \geq 0.65$$



Steps to get M_n

(1) assume $f_s = f_y$ (steel yields at failure)

(2) Get $T = A_s f_y$

(3) Set $C = T$ solve for a

$C = 0.85 f'_c (b)(a) = A_s f_y$

$$a = \frac{A_s f_y}{0.85 f'_c b}$$

(4) Get $M_n = T(\text{arm})$

$$M_n = A_s f_y \left(d - a/2\right)$$

(5) check $\varepsilon_s > \varepsilon_y$

$$\frac{\varepsilon_s}{d-x} = \frac{0.003}{x}$$

$X = a/\beta_1$

$\varepsilon_s > \varepsilon_y$