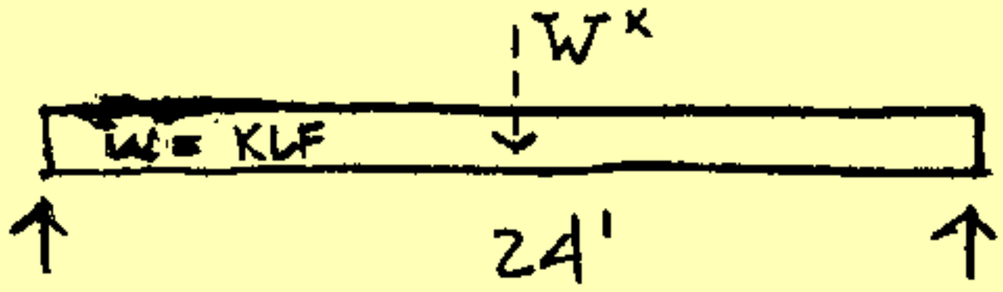
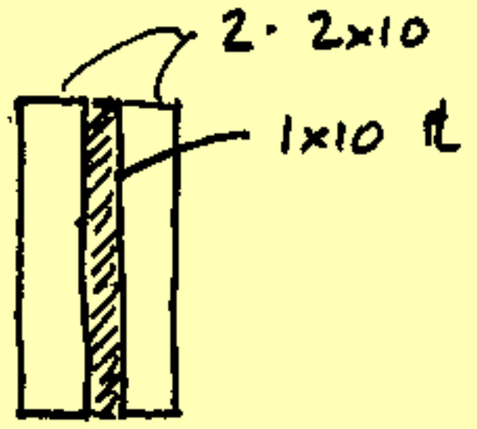
open.michigan



FOR THE FLITCHED BEAM SHOW FIND THE MAXIMUM ALLOWABLE W LOAD.



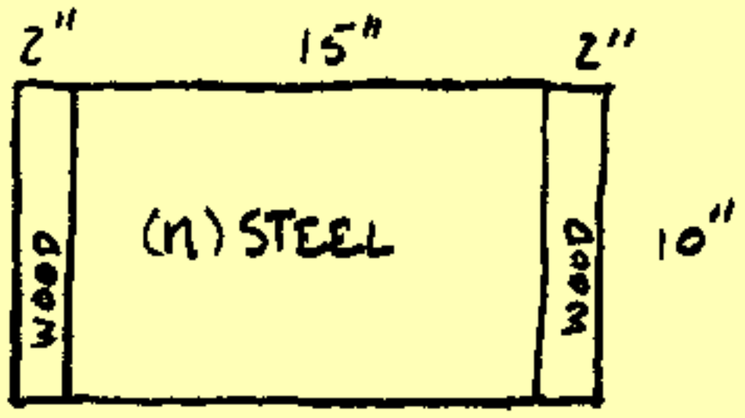
$E_{WOOD} = 2\,000\,000$ PSI

$E_{STEEL} = 30\,000\,000$ PSI

F_b WOOD $= 1.5$ KSI

F_b STEEL $= 20$ KSI

TRANSFORMED SECTION:



$$I_{TR} = \frac{bh^3}{12} = \frac{19(10)^3}{12} = 1583.33 \text{ in}^4$$

$$n = \frac{E_{STEEL}}{E_{WOOD}} = \frac{30}{2} = 15$$

ASSUME WOOD CONTROLS; (FROM $f = \frac{Mc}{I}$)

$$M_{max} = \frac{wl^2}{8} \quad \text{ALSO} \quad M_{max} = \frac{f I_{TR}}{c}$$

$$\frac{wl^2}{8} = \frac{f I_{TR}}{c} \; ; \quad w = \frac{f I_{TR} 8}{c l^2} = \frac{1.5(1583.33)8}{(5)(24\times12)^2}$$

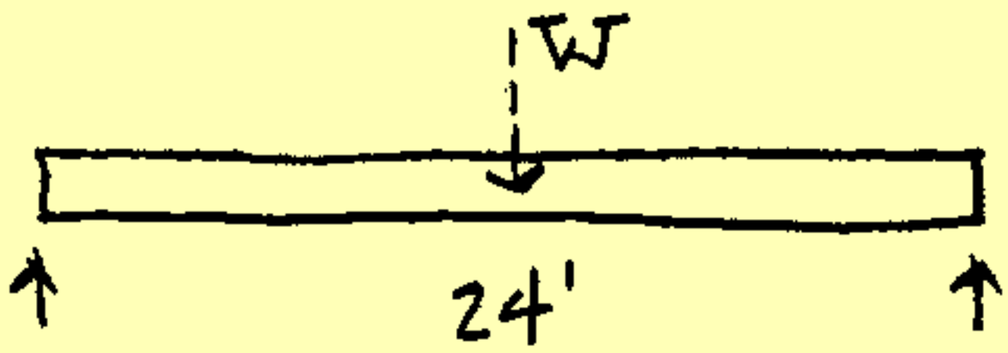
$$w = .04581 \text{ K/in} = 0.549 \text{ K/F}$$

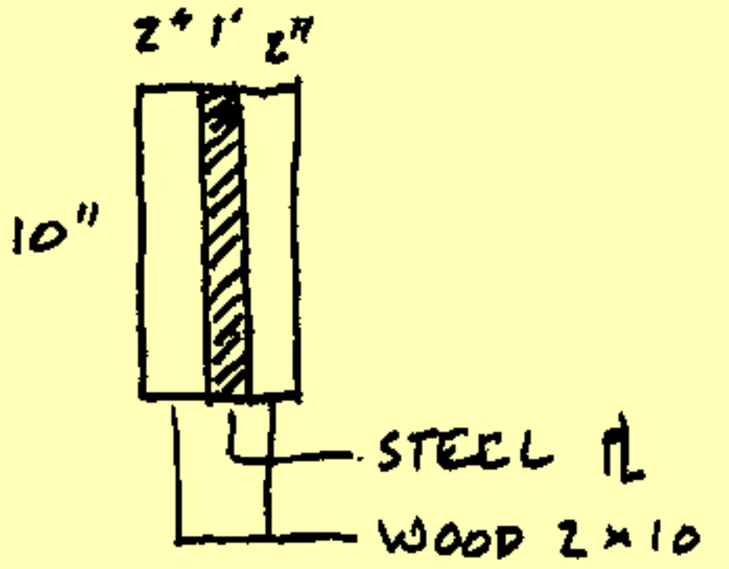
ASSUME STEEL CONTROLS

$$w = \frac{f_s I_{TR} 8}{c l^2 (n)} = \frac{20(1583.33)8}{5(24\times12)^2(15)} = .0407 \text{ K/in} = .488 \text{ K/FT}$$

∴ STEEL CONTROLS

$w = 0.488$ K/FT AND $\underline{W = 11.7 \text{ K}}$





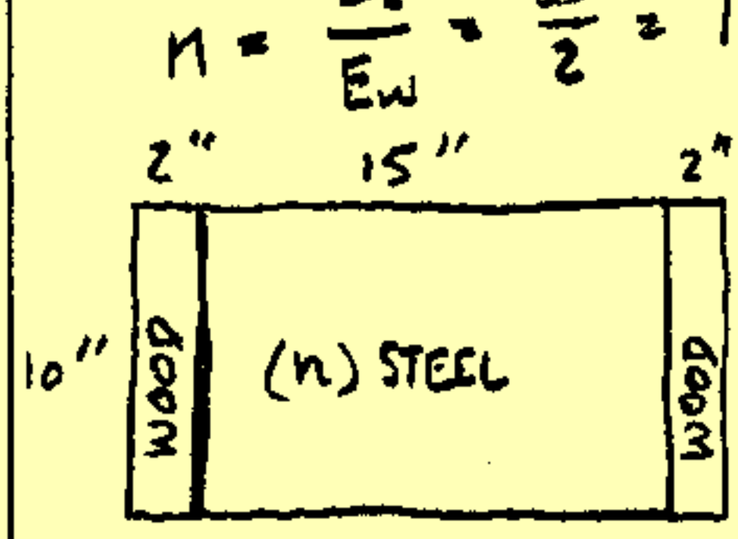
$E_{WOOD} = 2\,000\,000$ PSI
$E_{STEEL} = 30\,000\,000$ PSI

F_b WOOD $= 1.5$ KSI
F_b STEEL $= 20$ KSI

$$M_{MAX} = \frac{W_{TOTAL}\, l}{8} \quad ; \quad W_{TOTAL} = \frac{M_{MAX}\, 8}{l}$$

TRANSFORMED SECTION :

$$n = \frac{E_s}{E_w} = \frac{30}{2} = 15$$

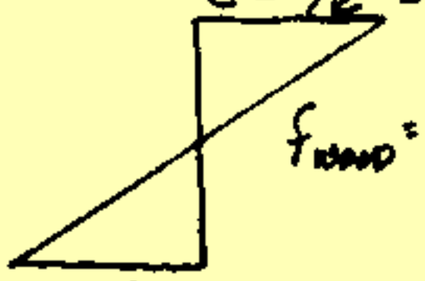


$$I_{TR} = \frac{b h^3}{12} = \frac{19\,(10)^3}{12} = 1583.33\ in^4$$

STRAIN COMPATABILITY : (ALTERNATE METHOD)

ASSUME WOOD CONTROLS STRAIN

$\epsilon = f/E = 1.5/2000 = 0.00075$

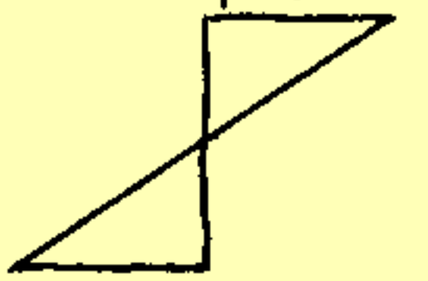


STRAIN - WOOD

CHECK →

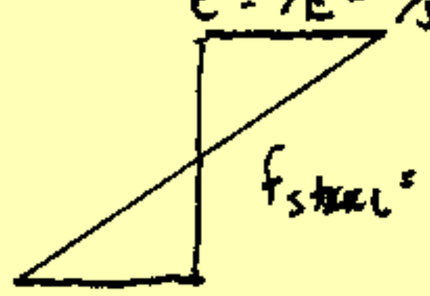
$f = E\epsilon = 30000(.00075) = 22.5 > 20$

∴ STEEL CONTROLS STRAIN !



STRESS - STEEL

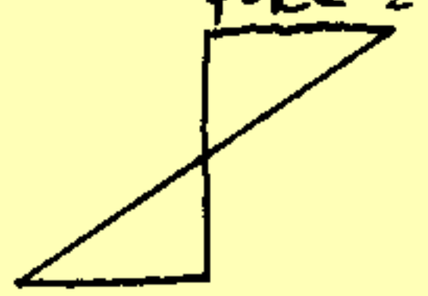
$\epsilon = f/E = 20/30000 = 0.000667$



STRAIN - STEEL

FIND →

$f = E\epsilon = 2000(.000667) = 1.33$ KSI



STRESS - WOOD

FIND MAX ALLOWABLE MOMENT :

$$f = \frac{Mc}{I} \; ; \quad M = f\frac{I}{c} = \frac{1.33\,(1583.33)}{5} = 422.22 \text{ in-K}$$

FOR WOOD :

$$= 35.185 \text{ FT-K}$$

FOR STEEL :

$$M = f\frac{I}{c(n)} = \frac{20\,(1583.33)}{5\,(15)} = 422.22 \text{ in-K}$$

$$= 35.185 \text{ FT-K}$$

MOMENTS AGREE !, OK ✓

FIND LOAD W :

$$W = \frac{M\ 8}{l} = \frac{35.185\,(8)}{24} = \underline{11.73}^{\,K} \text{ TOTAL}$$