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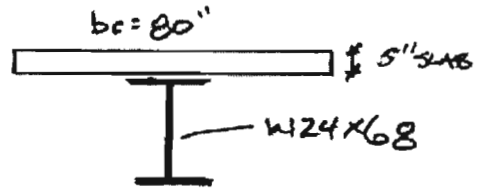
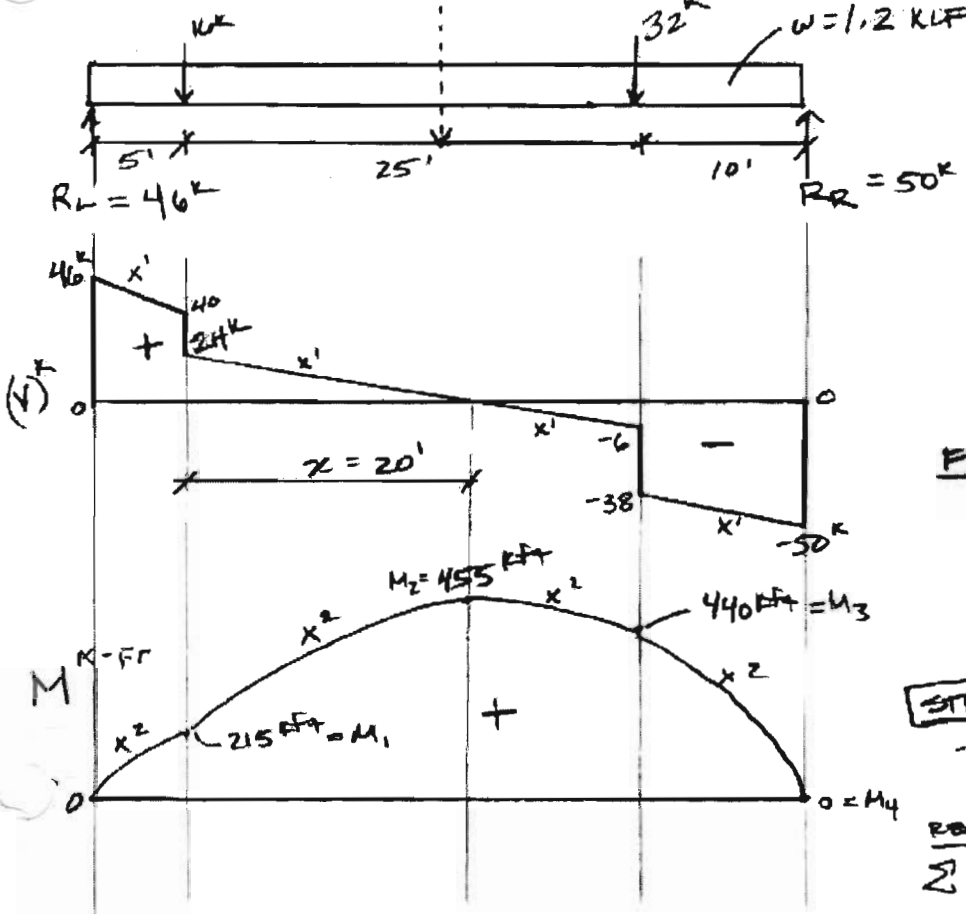
14-2(II)

2.16.05

1 of 3

$N = 48^k$

GIVEN:



$$\left. \begin{aligned} F'_s &= 24 \text{ ksi} \\ F'_c &= 1800 \text{ psi} \end{aligned} \right\} \text{ALLOWABLE}$$

$$n = 1/8$$

FIND:

① CHECK THE SAFETY

$$F'_b \geq f_b$$

ALLOW. ACTUAL.

STEP 1: FIND M_{MAX}

- SINCE UNSYMMETRICAL LOADING,
MUST USE DIAGS.

REACTIONS:

$$\sum M_{BL} = 0 = 16^k(5') + 48^k(20) + 32^k(30) - R_R(40')$$

$$R_R = 50^k$$

$$\sum F_y = 0 = R_L - 16^k - 48^k - 32^k + 50^k$$

$$R_L = 46^k$$

SHEAR: FIND x - WHERE $V = 0$

$\Delta V = \text{AREA LOADING}$

$$24^k - 0 = 1.2 \text{ KLF}(x)$$

$$x = 20 \text{ ft}$$

MOMENT:

$$M_1 = \frac{1}{2}(46^k - 40^k)(5') + (40^k)(5') = 215 \text{ k-ft}$$

$$M_2 = M_1 + \text{AREA OF } V_{DIAL} = 215^k + \frac{1}{2}(24^k)(20) = 455 \text{ k-ft}$$

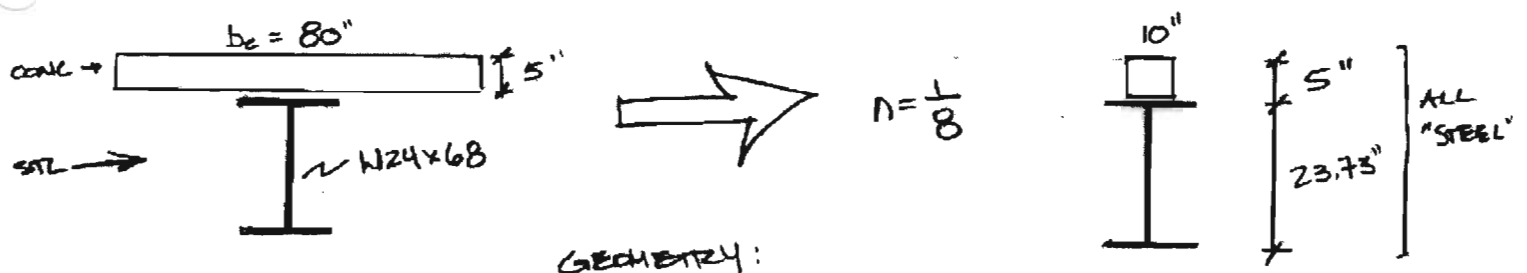
$$M_3 = M_2 + \text{AREA } V_{DIAL} = 455^k + \frac{1}{2}(25' - 20')(-6^k) = 440 \text{ k-ft}$$

$$M_4 = M_3 + \text{AREA } V_{DIAL} = 440^k + \frac{1}{2}(-50^k - -38^k)(10') + (-38^k)(10') = 0 \text{ k-ft}$$

FROM DIAG:

$$M_{MAX} = 455 \text{ k-ft}$$

STEP 2: TRANSFORM TO "HOMOGENEOUS" SECTION.



GEOMETRY:

STEEL - LOOK UP IN TABLES. (P. 347)
 FOR W24x68 $b = 8.965"$
 $d = 23.73"$
 $A = 20.1 \text{ IN}^2$
 $I = 1830 \text{ IN}^4$
 $S = 154 \text{ IN}^3$

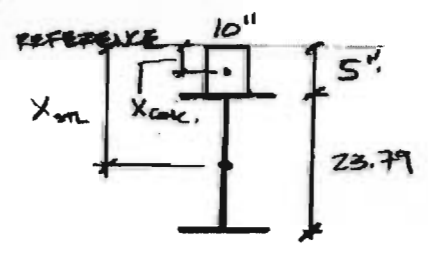
CONCRETE - TRANSFORM TO STEEL

TRANSFORMED $b_c = b_c \times n$
 $= 80" (\frac{1}{8}) = 10"$

STEP 3: FIND N.A.

$\sum A x = A \bar{x}$ (p. 40) $\Rightarrow \bar{x} = \frac{\sum A x}{A} = \frac{464 \text{ IN}^3}{70.1 \text{ IN}^2} = 6.62 \text{ IN. FROM THE TOP}$

	A (IN ²)	X (IN)	Ax (IN ³)
CONC.	10" x 5" = 50	$\frac{5}{2} = 2.5$	125
STEEL	20.1	$\frac{23.73}{2} + 5 = 16.9$	339
	70.1		464

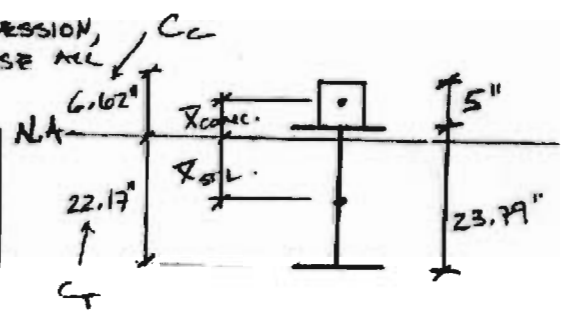


STEP 4: FIND I_{TR}.

$I_{tr} = I + A \bar{x}^2$, $I = \frac{bd^3}{12}$ FOR RECT.

- USE ONLY THE PORTION OF CONCRETE IN COMPRESSION, IGNORE CONC. BELOW N.A. (THIS CASE USE ALL THE CONC.)

	I (IN ⁴)	A (IN ²)	\bar{x} (IN)	$A \bar{x}^2$	$I + A \bar{x}^2$
CONC.	$10(5)^3/12 = 104.2$	10 x 5 = 50	$6.62 - \frac{5}{2} = 4.12$	848.7	952.9
STEEL	1830	20.1	$\frac{22.17 - 23.73}{2} = 10.28$	2122.1	3952.1
					$I_{tr} = 4905$



$\Rightarrow I_{TR} = 4905 \text{ IN}^4$

STEP 5: FIND F_b

$$F_b = \frac{M C}{I} \leftarrow \text{GENERAL EQUATION}$$

SINCE WORKING IN "STL" - MUST CONVERT CONC STRESS.

$$f_{\text{conc}} = \frac{M C_{\text{CN}}}{I_{\text{TR}}} = \frac{455 \text{ kft} (6.62") (\frac{1}{8}) \times 12"}{4905 \text{ IN}^4} = \underline{921 \text{ PSI}}$$

$$f_{\text{STL}} = \frac{M C_F}{I_{\text{TR}}} = \frac{455 \text{ kft} (22.17") \times 12"}{4905 \text{ IN}^4} = \underline{24.7 \text{ KSI}}$$

STEP 6: CHECK SAFETY

$$f'_{\text{STL}} \geq f_{\text{STL}} \Rightarrow 24 \text{ KSI} \neq 24.7 \text{ KSI}$$

ALLOWABLE w/ F.S. ACTUAL

N.G. - STEEL FAILS!!

$$f'_{\text{CONC}} \geq f_{\text{CONC}} \Rightarrow 1800 \text{ PSI} \geq 921 \text{ PSI} \checkmark \text{ o.k.}$$

IN CONCLUSION, THE BEAM IS NOT ADEQUATELY DESIGNED SINCE STEEL FAILS.