ARCH 324 STRUCTURE II

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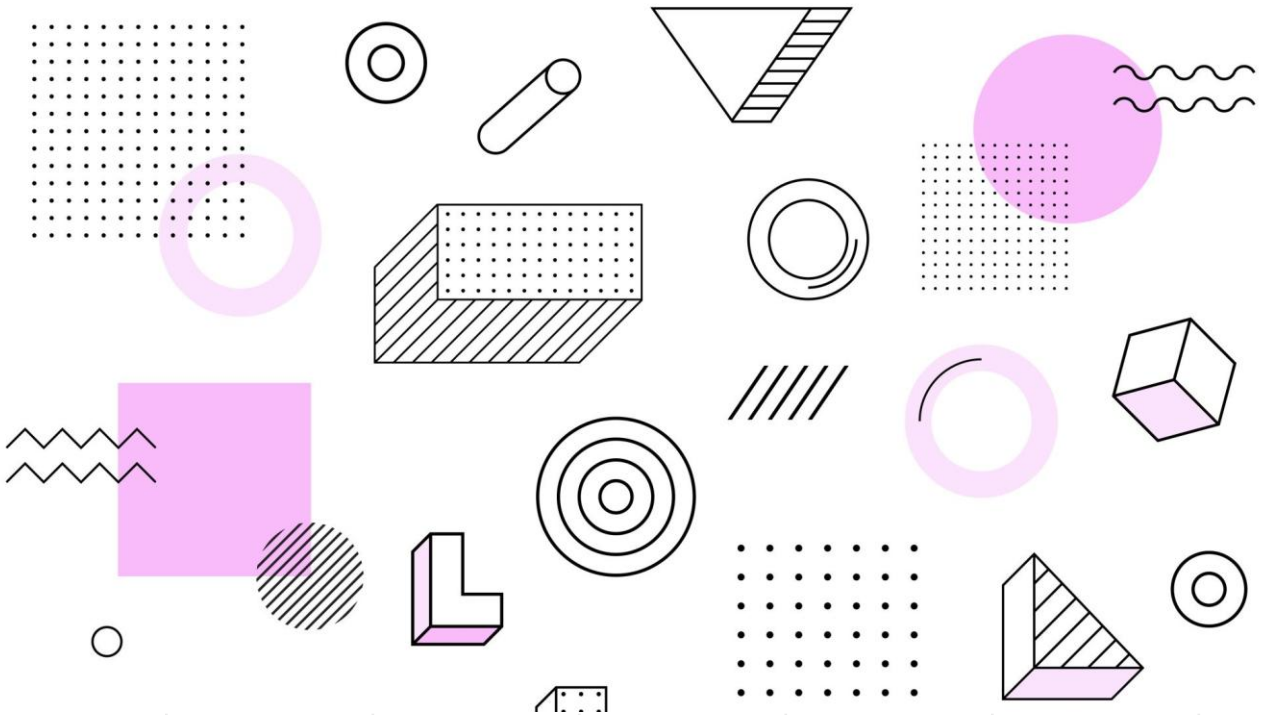
Winter 2025

Recitation

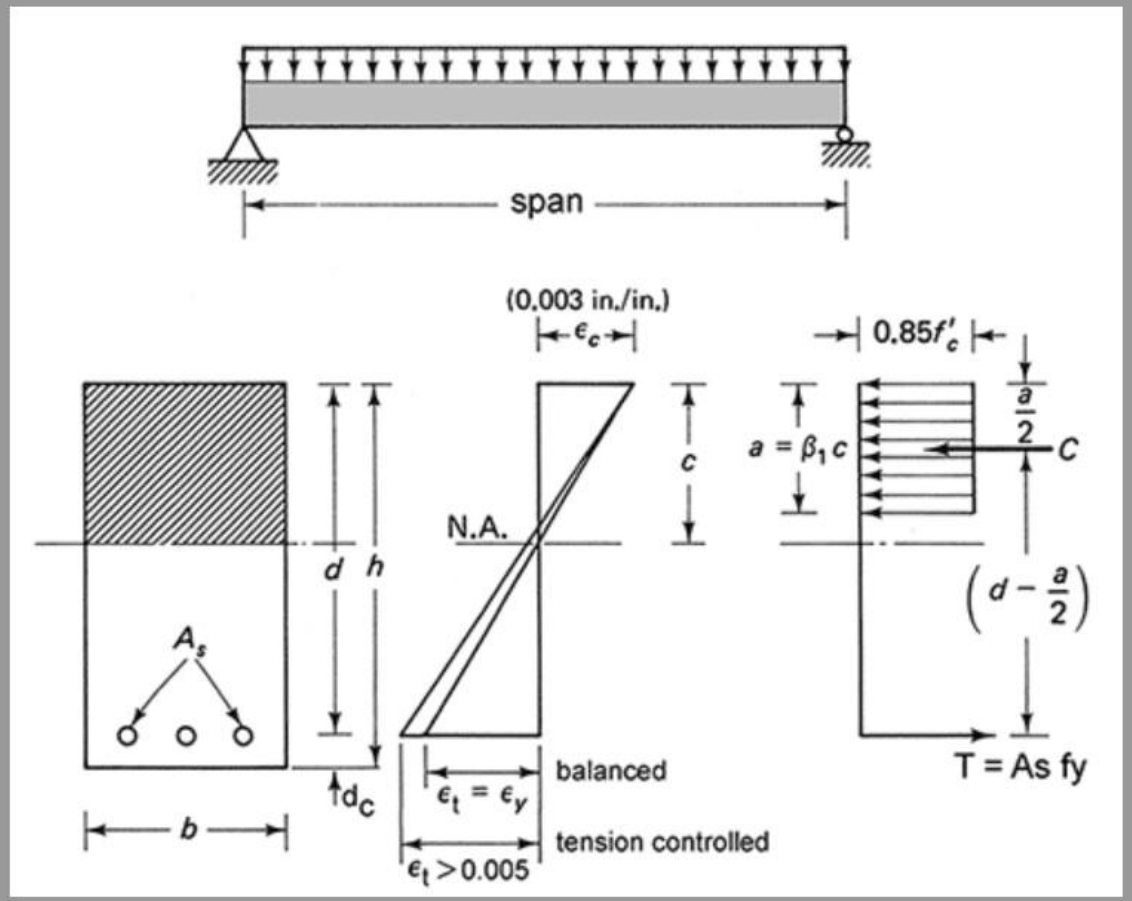


8. Concrete Beam Analysis

Analyze the given composite floor system. Using a transformed section, determine peak stress values in both concrete and steel.

DATASET: 1 -2- -3-

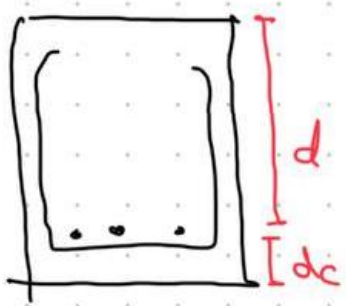
simple span	17 FT
section width, b	14 IN
section height, h	25 IN
max. aggrigate size	0.75 IN
bar size number	5
the number of bars	6
stirrup bar size number	3
concrete cover	1.5 IN
concrete ultimate strength, f'c	6500 PSI
steel yield strength, fy	60000 PSI



#	Question	Your Response		Correct Answer	Score
1	flexural steel bar diameter, db		IN	SUBMIT	
2	stirrup bar diameter		IN	SUBMIT	
3	distance from lower beam edge to center of flexural steel, dc		IN	SUBMIT	
4	distance from top beam edge to center of flexural steel, d		IN	SUBMIT	
5	minimum required area of steel, As,min (GREATER of the 2 criteria)		IN2	SUBMIT	
6	actual area of flexural steel, As		IN2	SUBMIT	
7	depth of concrete stress block, a		IN	SUBMIT	
8	factor beta_1			SUBMIT	
9	distance to Neutral Axis from top of beam, c		IN	SUBMIT	
10	strain in flexural steel, epsilon_t			SUBMIT	
11	strength reduction factor, phi			SUBMIT	
12	tensile force in the flexural steel, T		K	SUBMIT	
13	the nominal bending moment, Mn		K-IN	SUBMIT	
14	the factored bending resistance, phi Mn		K-IN	SUBMIT	
15	the factored design moment, Mu		K-FT	SUBMIT	

ASTM STANDARD REINFORCING BARS

Bar size, no.	Nominal diameter, in.	Nominal area, $in.^2$	Nominal weight, lb/ft
3	0.375	0.11	0.376
4	0.500	0.20	0.668
5	0.625	0.31	1.043
6	0.750	0.44	1.502
7	0.875	0.60	2.044
8	1.000	0.79	2.670
9	1.128	1.00	3.400
10	1.270	1.27	4.303
11	1.410	1.56	5.313
14	1.693	2.25	7.65
18	2.257	4.00	13.60



distance from lower beam edge to center of flexural steel, dc

$$= \text{Cover} + \text{Stirrup diameter} + \frac{\text{flexural bar diameter}}{2}$$

$$= 1.5 + 0.375 + \frac{0.625}{2} = 2.1875$$

distance from top beam edge to center of flexural steel, d

$$d = h - dc = 25 - 2.1875 = 22.8125$$

$$A_{s\min} = \begin{cases} 1. \dfrac{3\sqrt{f'_c}}{f_y} b_w d = \dfrac{3\sqrt{6500}}{60000}(147)(22.8125) = 1.2874 \\ 2. \dfrac{200 b_w d}{f_y} = \dfrac{200(147)(22.8125)}{60000} = 1.064 \end{cases}$$

we should choose Max of 1 and 2 :

This is min requirement for the As

As : Actual area of flexure steel

As = No. bars x bar cross-sectional Area based on table

As : 6 x 0.31 = 1.86 < 1.2874 : Asmin

Calculate a: depth of Concrete Stress block

$$a = \frac{A_s f_y}{0.85 f'_c b} = \frac{(1.86)(60000)}{0.85(6500)(14)} = \frac{111600}{77350} = 1.442$$

$$\beta_1 = 0.85 - 0.05\left(\frac{f'_c - 4000}{1000}\right)$$

$$= 0.85 - 0.05\left(\frac{6500 - 4000}{1000}\right) = 0.725$$

C: Distance to N.Axis from top of beam

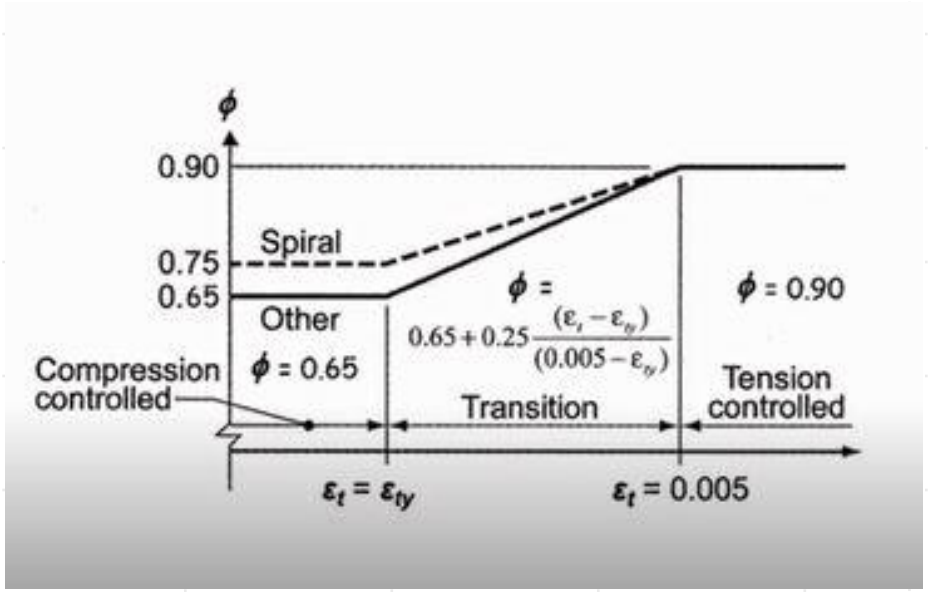
$$C = \frac{a}{\beta_1} = \frac{1.442}{0.725} = 1.988$$

$$\varepsilon_t = \frac{d-c}{c}(0.003) \geq 0.005$$

$$\frac{22.8125 - 1.988}{1.988}(0.003) = 0.031 \geq 0.005$$

Tension Controled

$\phi = 0.9$



Calculate tensile force T

$$T = A_s f_y = (1.86)(60000) = 111600$$

Calculate Nominal Bending Moment M_n

$$M_n = A_s f_y \left(d - \frac{a}{2}\right)$$

$$\overline{=}$$

T

$$M_n = (1.86)(60000)\left(22.8125 - \frac{1.442}{2}\right)$$

$$= 2465477.4 \xrightarrow{\div 1000} 2465.41 \text{ k-IN}$$

$$\emptyset M_n = 0.9 M_n = 2218.87$$

$$M_u = \emptyset M_n = 2218.87 \div 12 = 184.90 \text{ k-FT}$$

$\downarrow$

max

- Thanks for your attention ☺