ATME College of Engineering

DESIGN OF RC STRUCTURES

Course code: BCV601

By: Dr. Pujitha Ganapathi C.
Assistant Professor
Department of Civil Engineering

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INTRODUCTION

What are the objectives of RC design?

1. Structure should perform satisfactorily during its life span
2. Structure should take up the forces which are likely and deform within the limit
3. The structure should resist misuse or fire.

Design of RC member involves:

1. Deciding the size or dimension of the structural element and amount of reinforcement required.
2. To check whether the adopted size perform satisfactorily during its life span.

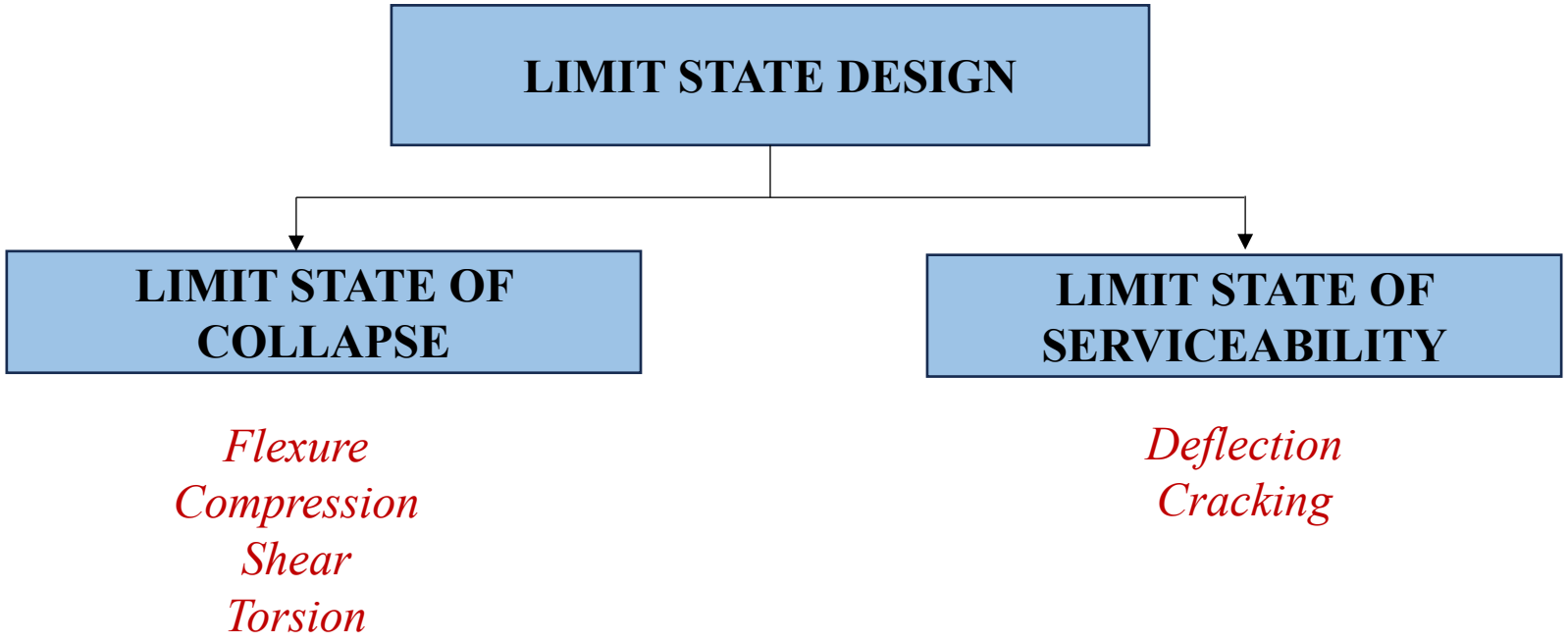
INTRODUCTION

Why Limit State Method ?

- Working Stress Method → Deals only with the elastic behaviour of the material
- Ultimate Load Method or Load Factor Method → Load factor is the ratio between the ultimate load a section can carry to the working load it has to carry
- Limit State Method

INTRODUCTION

LIMIT STATE - a state of impending failure, beyond which a structure ceases to perform its intended function satisfactorily, in terms of either safety or serviceability (i.e., it either collapses or becomes unserviceable).



STRESS-STRAIN DIAGRAM

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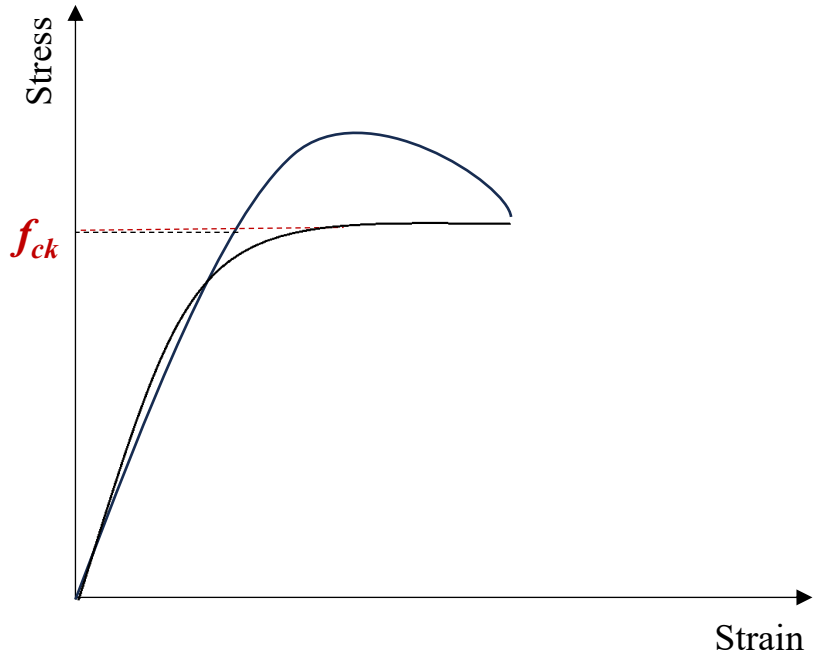
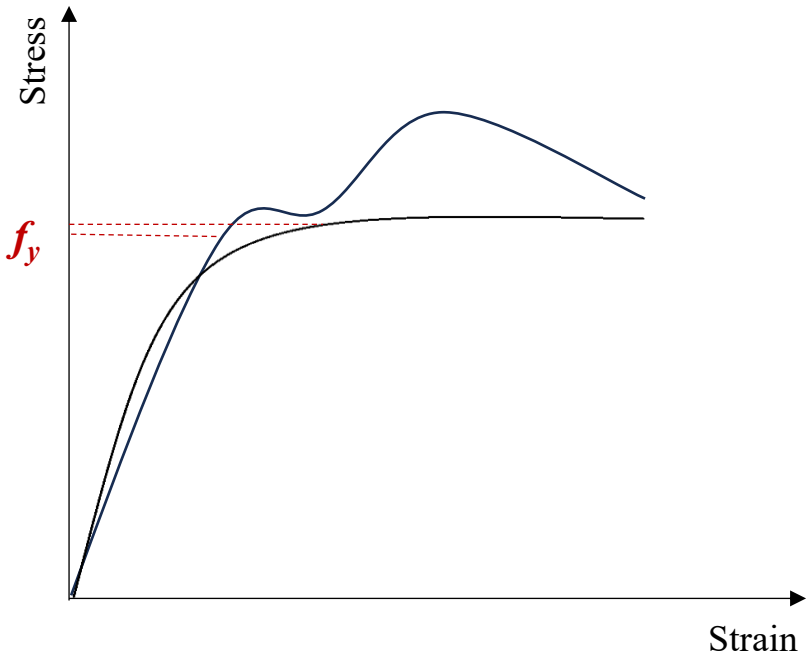
Proof stress of steel is the stress required to produce a specific amount of permanent (plastic) deformation, commonly defined as 0.2% strain. It acts as a substitute for yield strength in materials that lack a clear, well-defined yield point, such as high-strength steel or alloys.



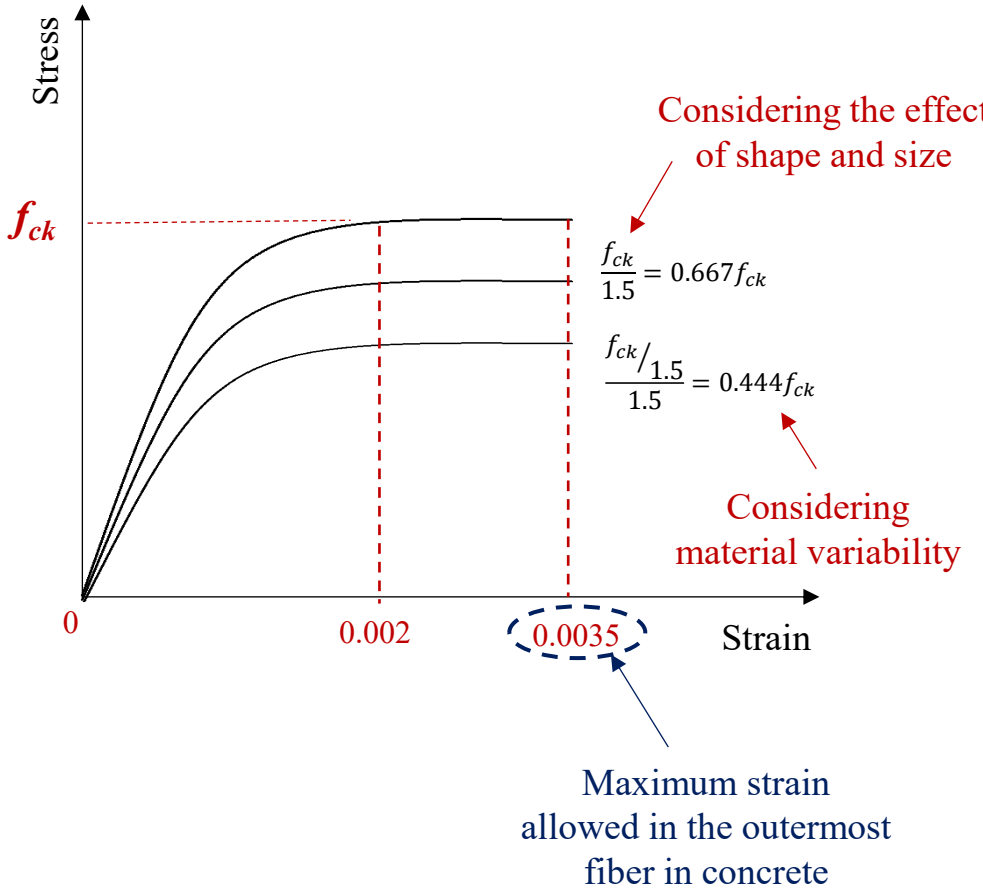
Stress-Strain curve of concrete



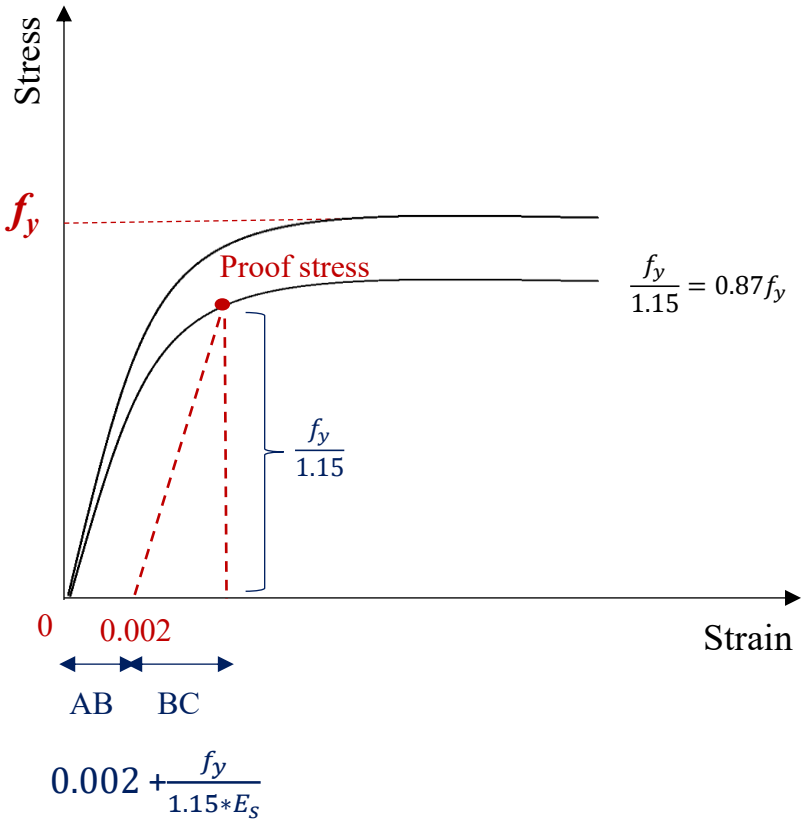
Stress-Strain curve of steel

STRESS-STRAIN DIAGRAM

Stress-Strain curve of concrete



Stress-Strain curve of steel



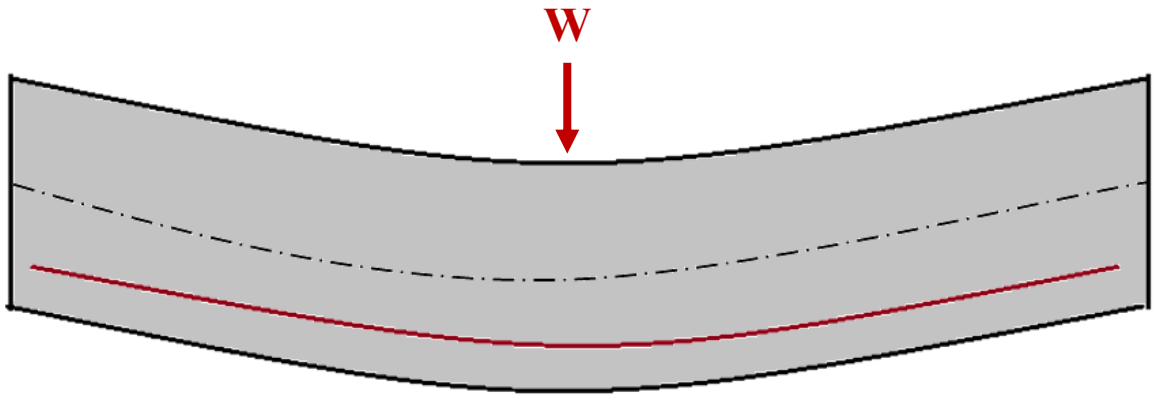
$$AB = 0.002$$

$$\frac{f_y/1.15}{BC} = E_s$$

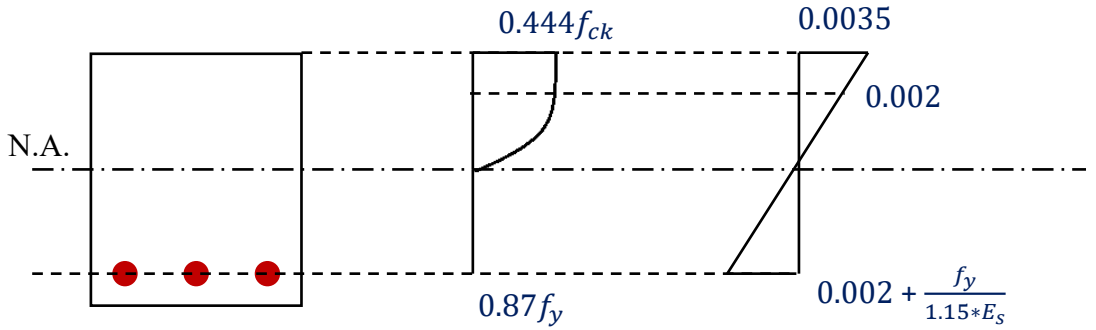
$$BC = \frac{f_y/1.15}{E_s}$$

$$BC = \frac{f_y}{1.15 * E_s}$$

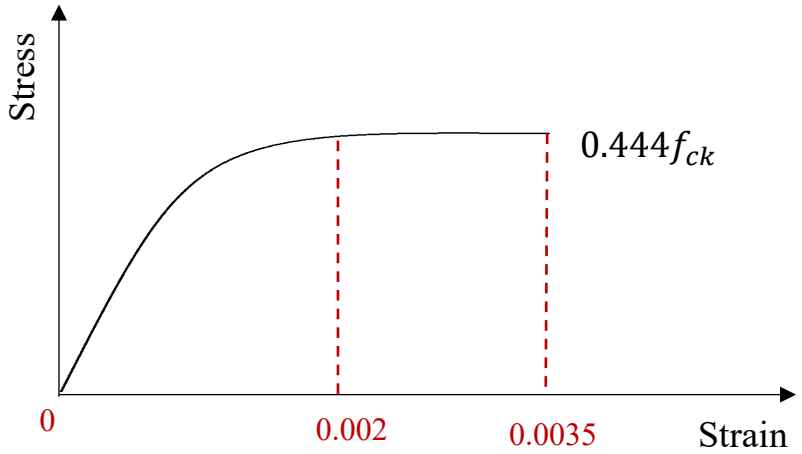
MOMENT OF RESISTANCE DERIVATION

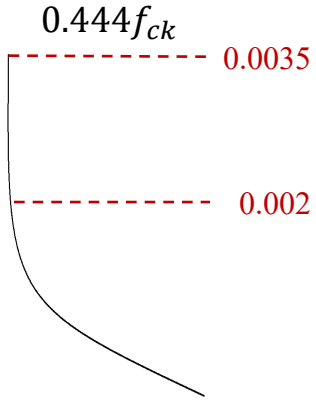


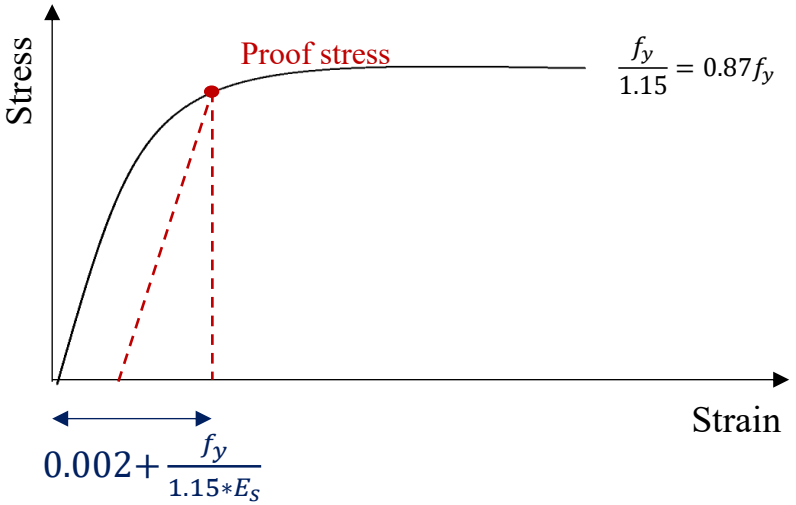
Longitudinal section of a beam



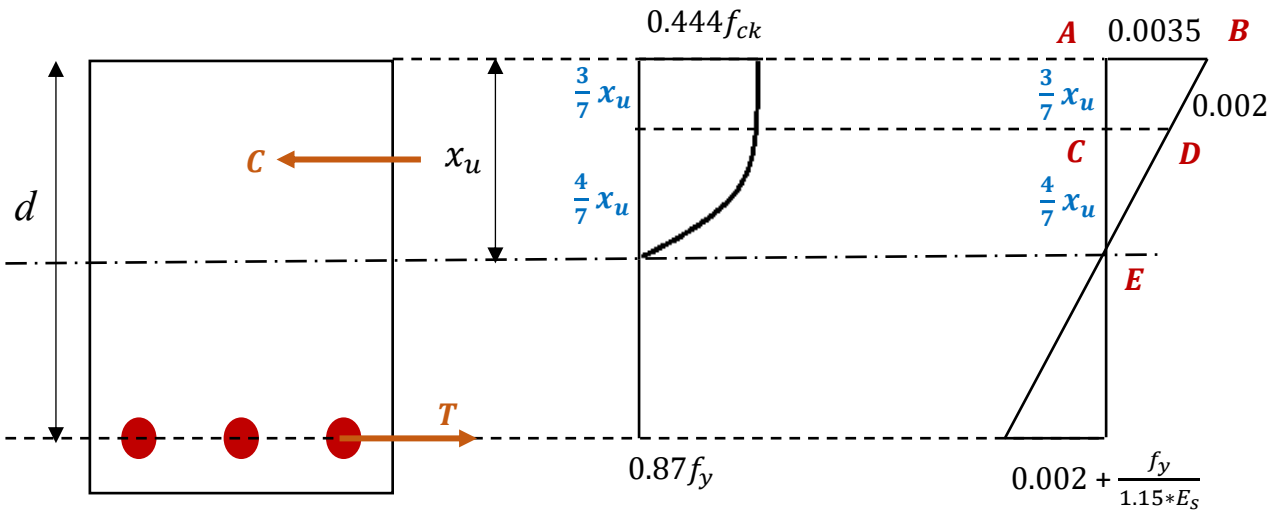
Cross-section of a beam | Stress Diagram | Strain Diagram







MOMENT OF RESISTANCE DERIVATION

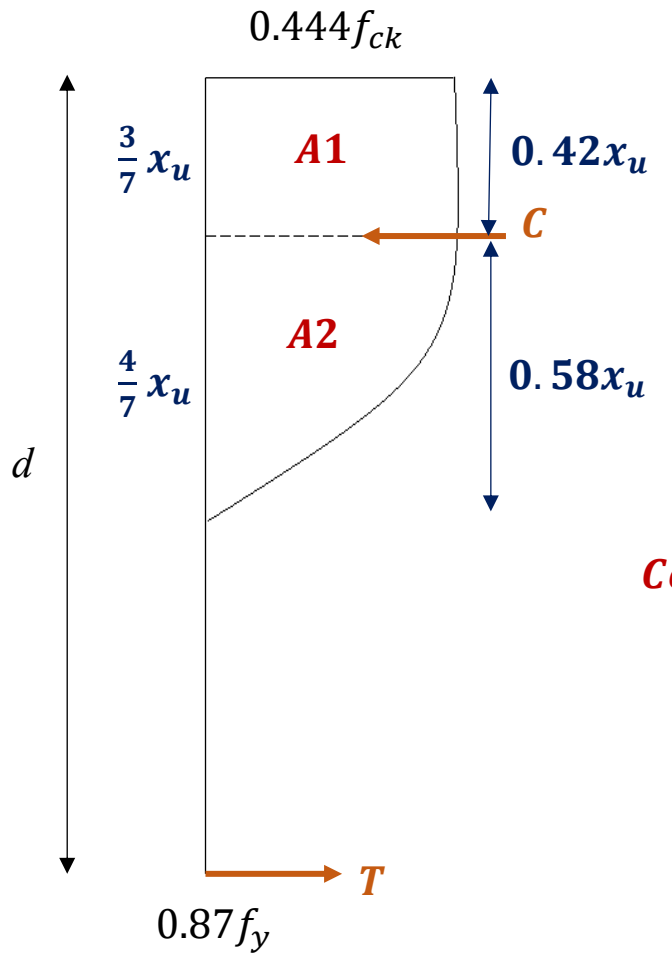


$$\frac{AE}{0.0035} = \frac{CE}{0.002}$$

$$\frac{x_u}{0.0035} = \frac{CE}{0.002}$$

$$CE = \frac{4}{7}x_u$$

MOMENT OF RESISTANCE DERIVATION



$$A1 = 0.444f_{ck} \times \frac{3}{7}x_u = \frac{4}{21}f_{ck}x_u$$

$$A2 = \frac{2}{3} \times 0.444f_{ck} \times \frac{4}{7}x_u = \frac{32}{189}f_{ck}x_u$$

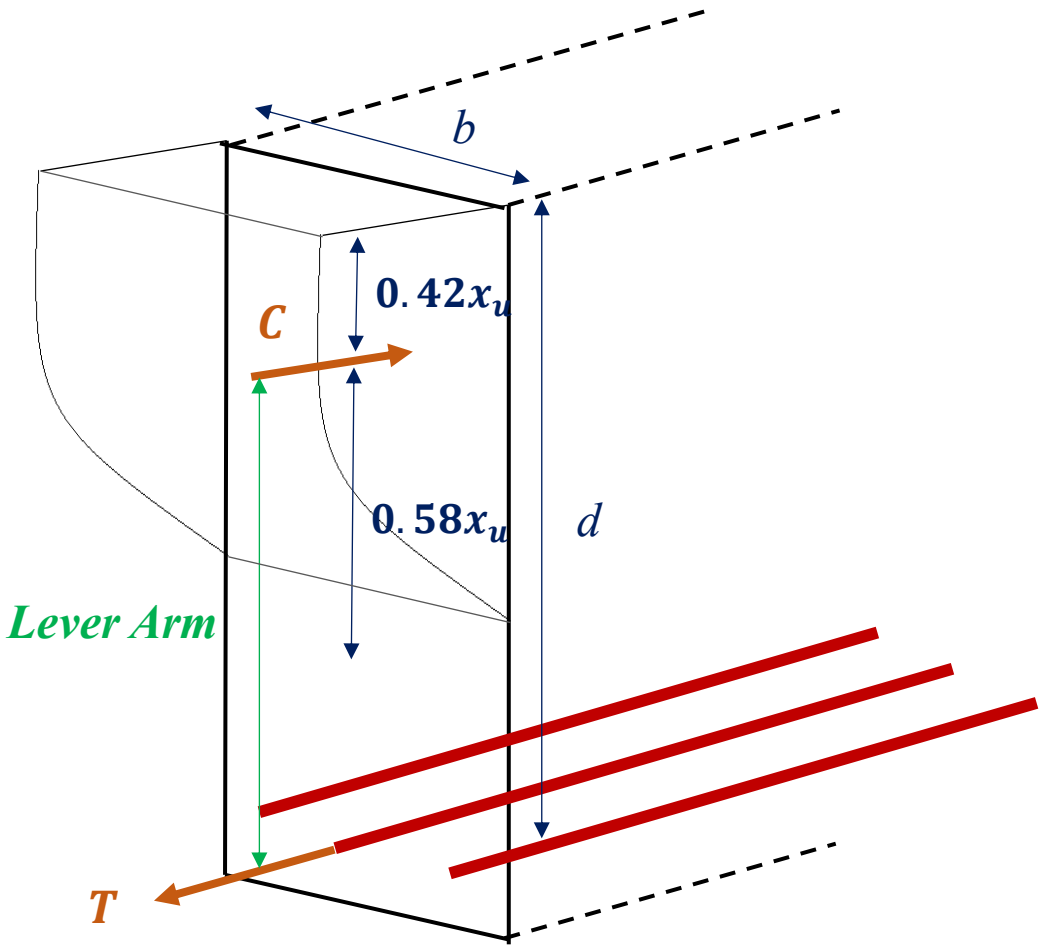
$$A = A1 + A2 = \frac{68}{189}f_{ck}x_u = 0.36f_{ck}x_u$$

$$Centroid = \frac{A1 \times x_1 + A2 \times x_2}{A} = \frac{\left(\frac{4}{21}f_{ck}x_u\right) \times \left(\frac{4}{7}x_u + \frac{\frac{3}{7}x_u}{2}\right) + \left(\frac{32}{189}f_{ck}x_u\right) \times \left(\frac{5}{8} \times \frac{4}{7}x_u\right)}{\frac{68}{189}f_{ck}x_u}$$

$Centroid = 0.58x_u$ ..... *From Bottom of the Beam*

$Centroid = 0.42x_u$ ..... *From Top of the Beam*

MOMENT OF RESISTANCE DERIVATION



$$C = 0.36 f_{ck} x_u b \qquad T = 0.87 f_y A_{st}$$

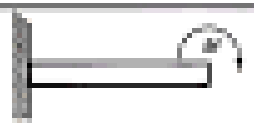
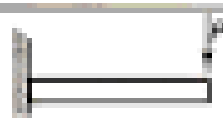
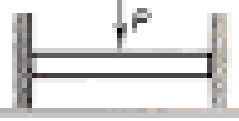
Moment of Resistance (M.R) = C × Lever Arm (OR) T × Lever Arm

$$M.R = C \times (d - 0.42x_u)$$

OR

$$M.R = T \times (d - 0.42x_u)$$

DEFLECTION FORMULA

Images	Max Slope	Max Deflection
	$\theta = -\frac{ML}{EI}$	$y = -\frac{ML^2}{2EI}$
	$\theta = -\frac{PL^2}{2EI}$	$y = -\frac{PL^3}{3EI}$
	$\theta = -\frac{pL^3}{6EI}$	$y = -\frac{pL^4}{8EI}$
	$\theta = -\frac{WL^3}{24EI}$	$y = -\frac{WL^4}{30EI}$
	$\theta = -\frac{WL^3}{8EI}$	$y = -\frac{11WL^4}{120EI}$
	$\theta = -\frac{PL^2}{64EI}$	$y = -\frac{PL^3}{192EI}$
	$\theta = -\frac{PL^2}{16EI}$	$y = -\frac{PL^3}{48EI}$
	$\theta = -\frac{pL^3}{24EI}$	$y = -\frac{5pL^4}{384EI}$
	$\theta = \pm\frac{ML}{24EI}$	$y = \pm\frac{ML^2}{72\sqrt{3}EI}$