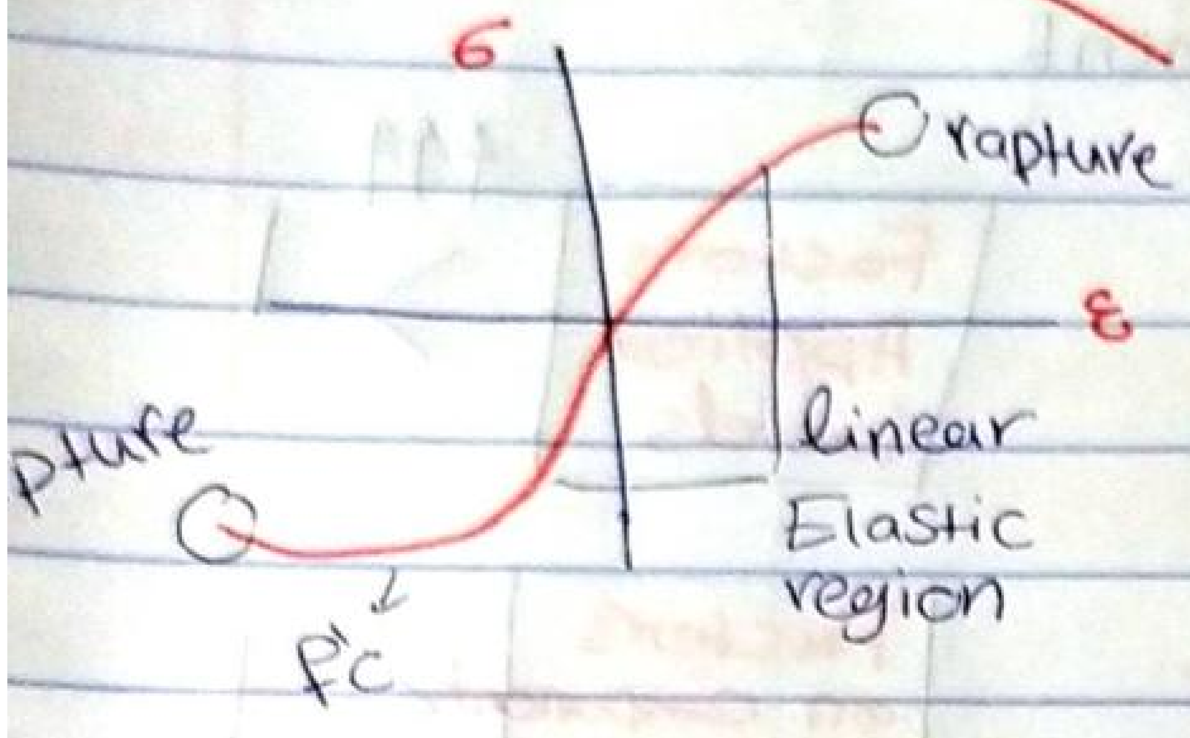
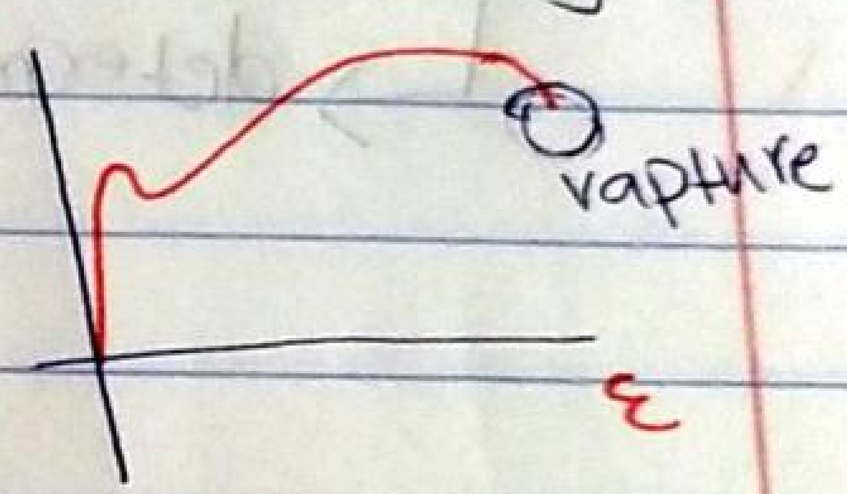
※ Concrete — Water, Gravel + Sand, cement, additives ⇒

- high Compression strength
- Normal strength 10-40 MPa
- High strength 40-150 MPa
- Brittle material
- durable



※ Steel ⟶ High strength In tension, ductility



- location of needed steel reinforcment?
  - main Steel (Tension).

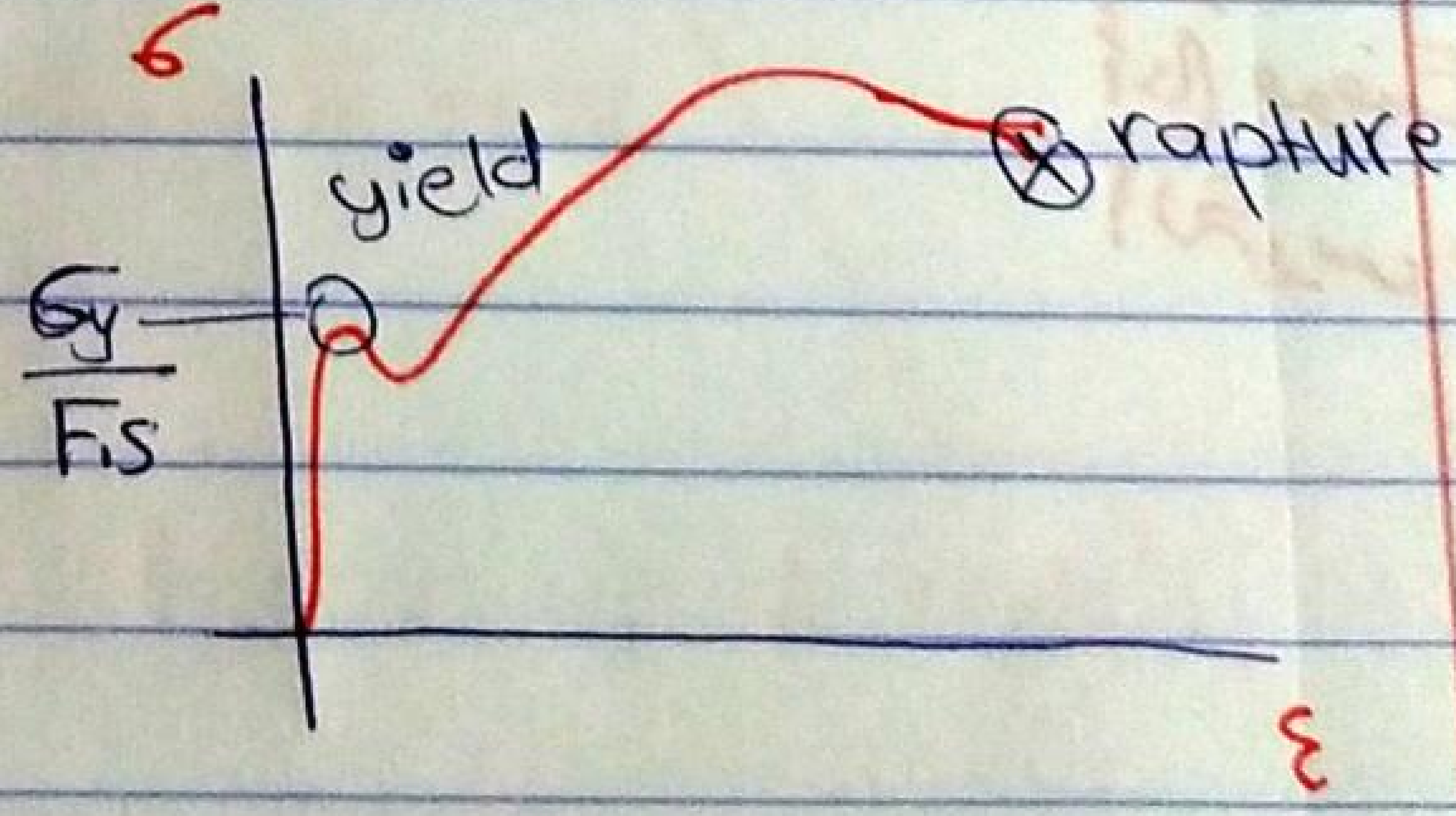
- Design:- is the process of devising a system and/or a Component to meet desired demand.

  - The system: Beams, Slabs, Columns
  - The demand: loads

- Reinforced concrete design?? — Geometry of concrete member; Amount and location of Steel reinforcment

※ Design method:-

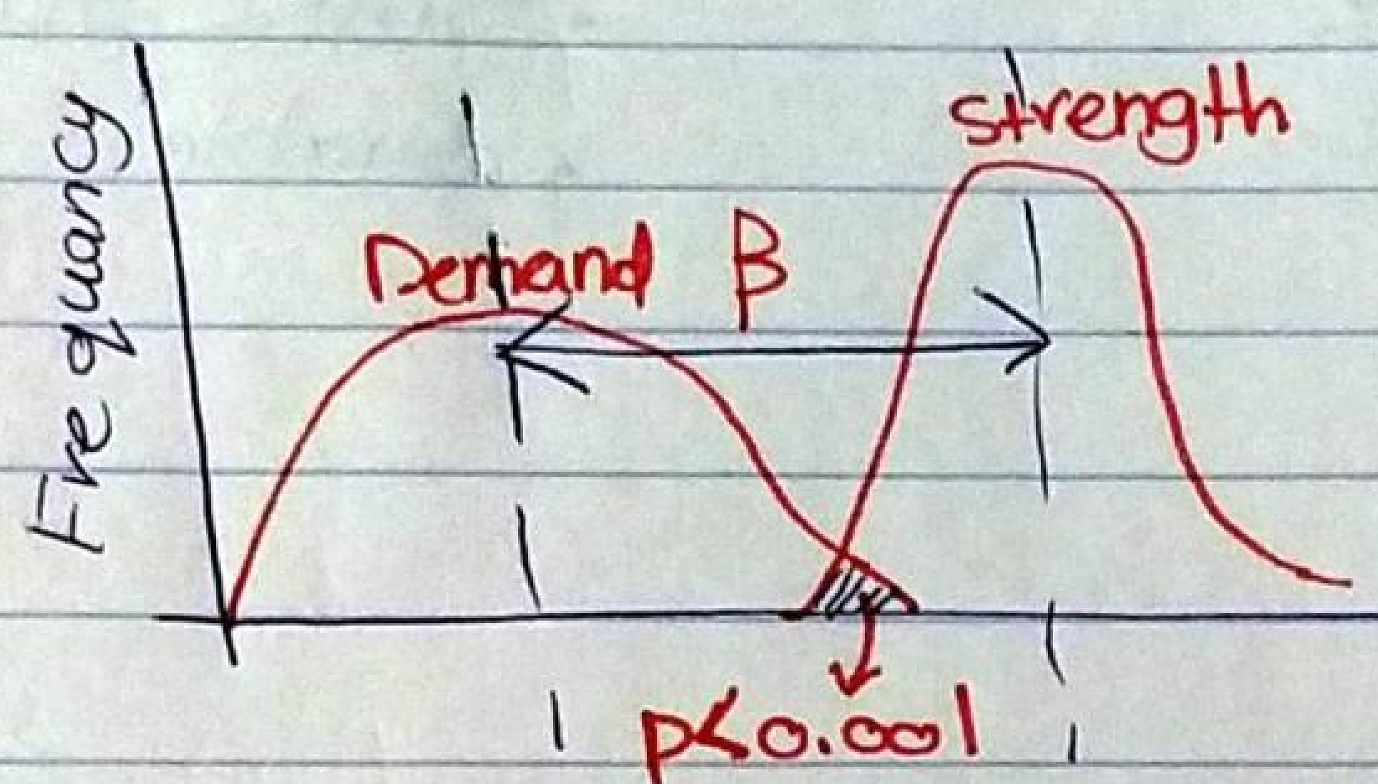
[1] Allowable Stress design (ASD)



2 load and resistance factored design (LRFD).

↳ Considers the Variability In the applied loads (Internal) and Component.

more than one load applied In Variable



↳ propability of faulier

Factors Applied loads	>
Factors on Component Strength	<

↳ determine frome the Table 5.3.1
- AscE
- AcF

β → تزيد 3 أقصاها
9:27 min

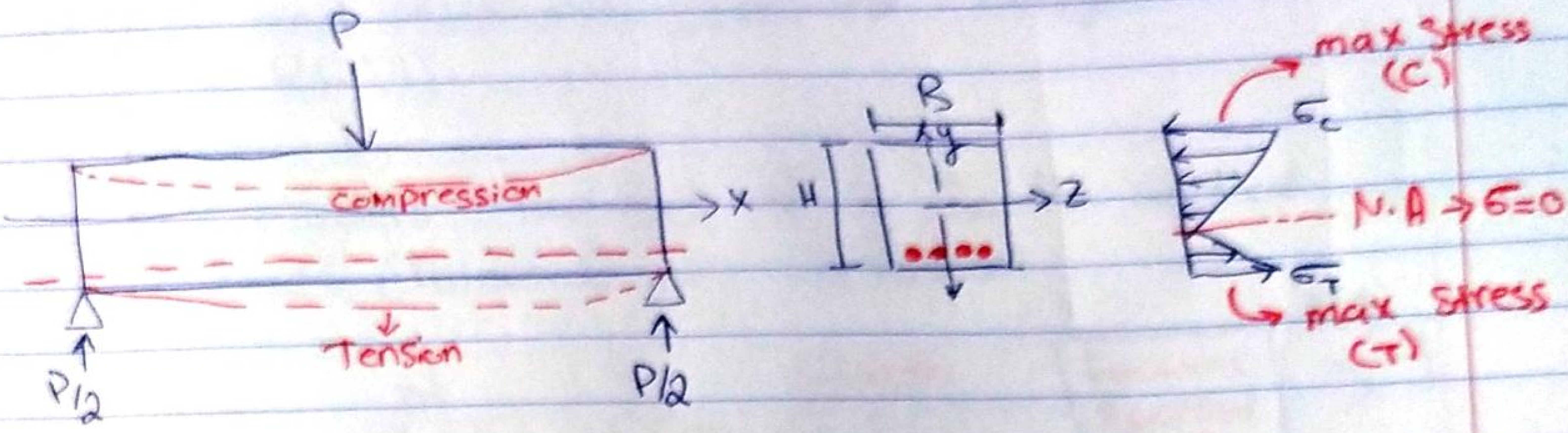
- main load that we use $U = 1.2D + 1.6L$ (D → Dead load, L → Lifeload)

- After Structural analysis we get ultimate Internal factors 21.2.1

- **Nominal strength** : Statics and Mechanices of mat.

- $\phi M_n \geq M_u$ → M_u: ultimate moment

M_n ↳ أعلى مومنت يتحمله العرس بسحبش



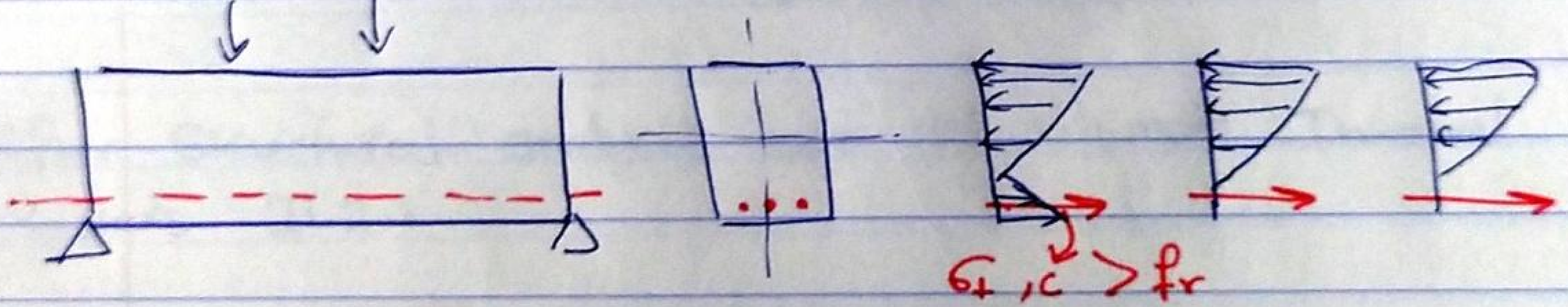
$M_{max} = PL/4$, $V_{max} = P/2$

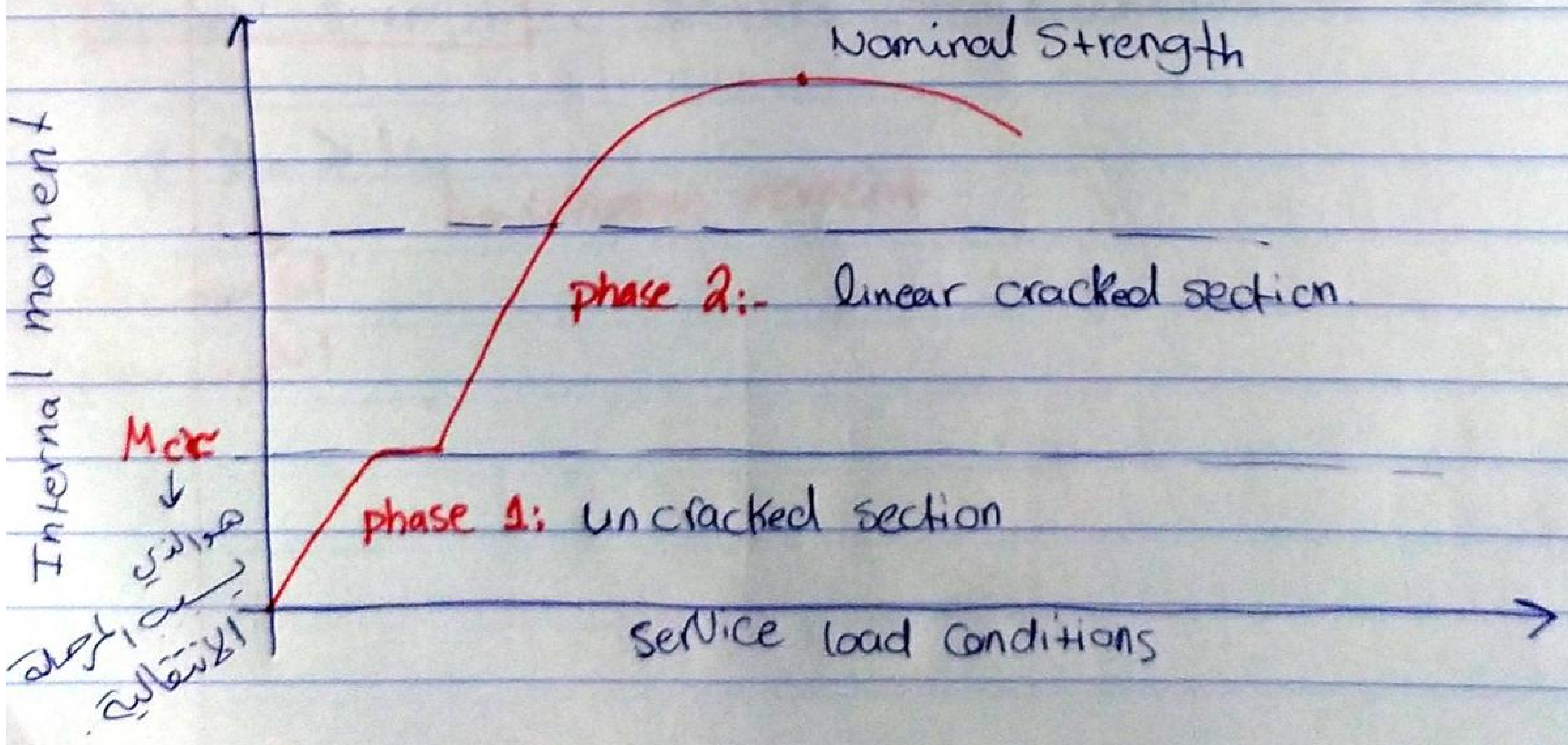
M → normal stress

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

>>> . M: moment
. y: The far of point from the N.A
. I: second moment of Inertia

* max stress at $y = H/2$

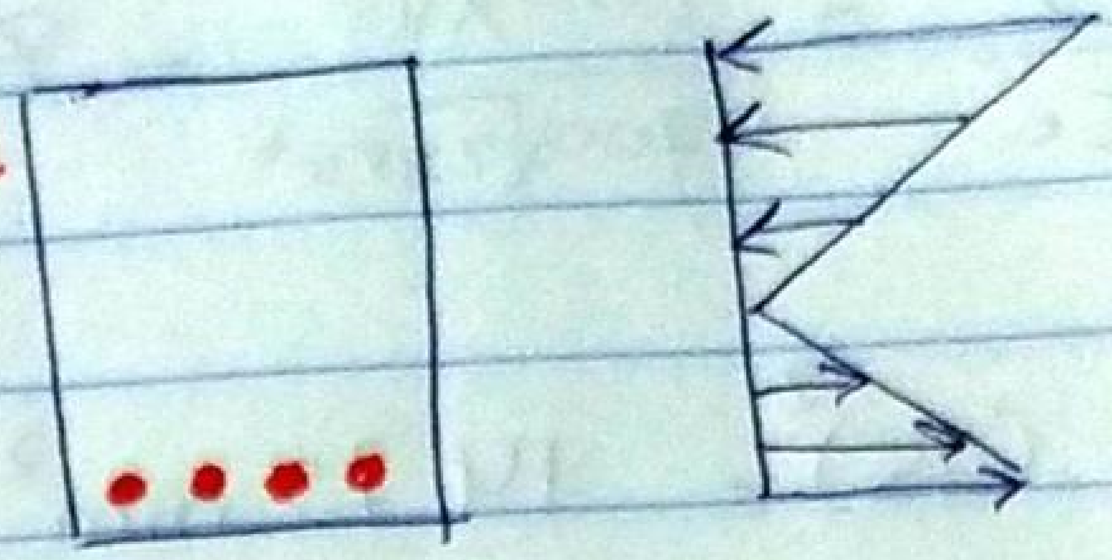




* Phase 1:

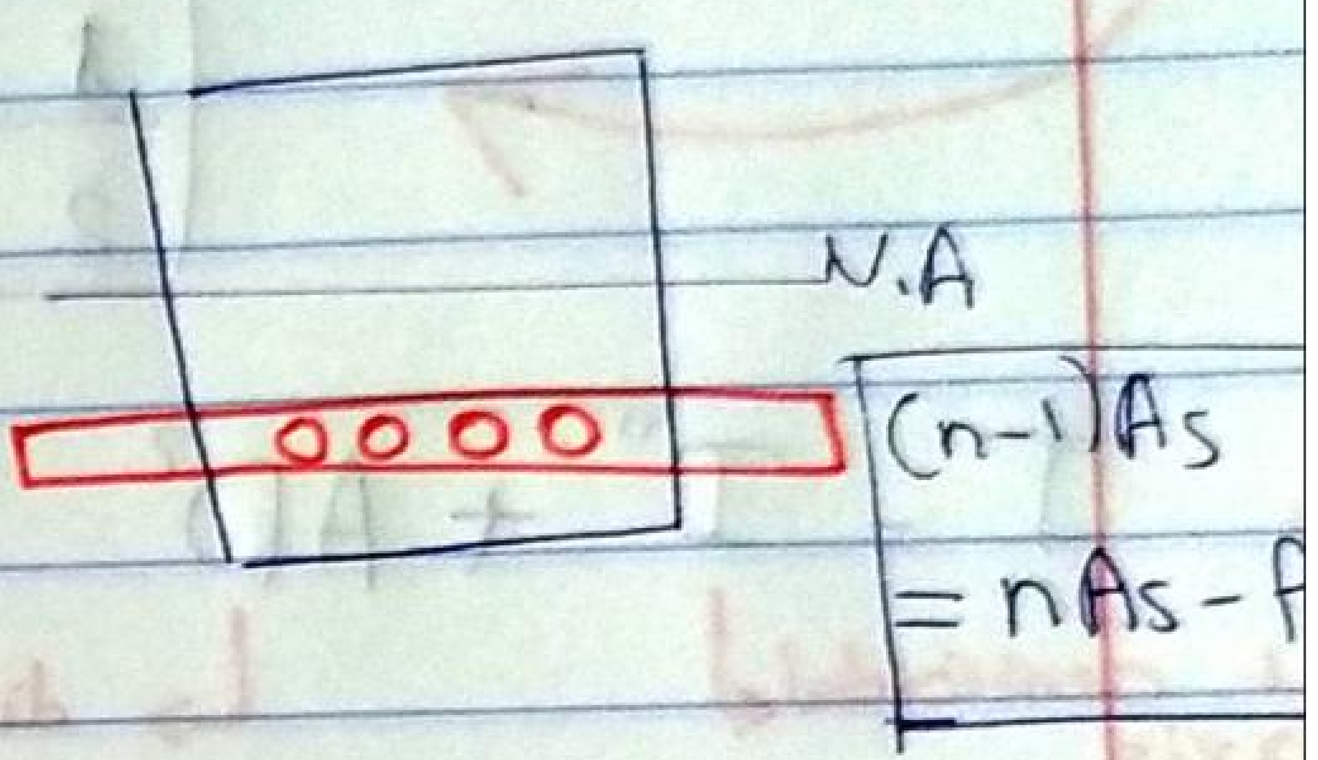
→ Normal weight = 1

* Tension < $f_r = 0.62\lambda\sqrt{f_c'}$
ACT



* Transformed using modular ratio (n)

$n = \frac{E_s}{E_c}$ → E_s → modulus of elasticity of steel = 200 GPa
→ E_c → modulus of elasticity of concrete $E_c = 4700\sqrt{f_c'}$ MPa



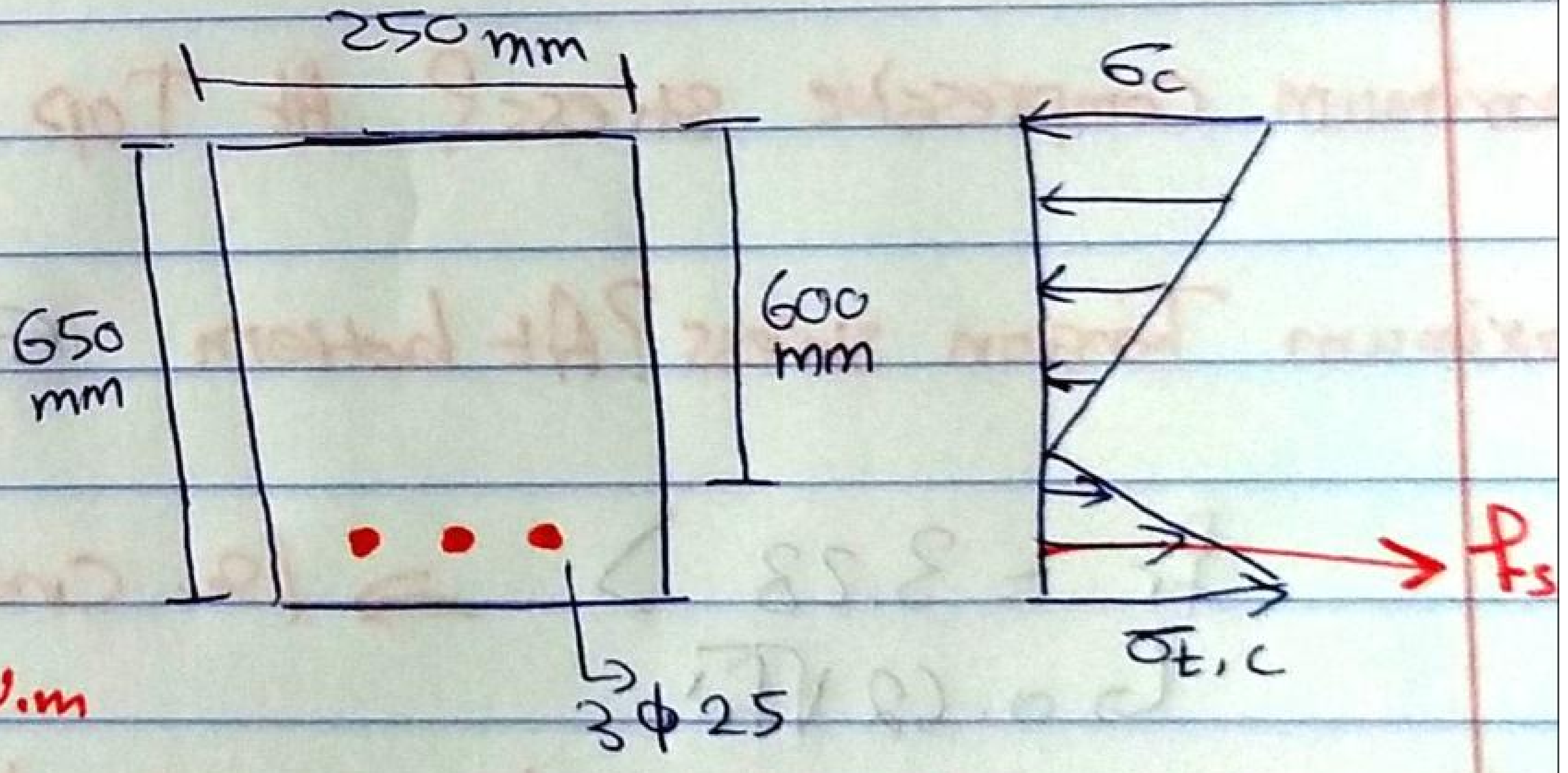
* Stress In Concrete ⟹ $\sigma = \frac{My}{I}$

* Stress In Steel ⟹ $f_s = n\sigma_c$

* The cracking moment M_{cr}

$$M_{cr} = \frac{f_r I}{(H - \bar{y})}$$

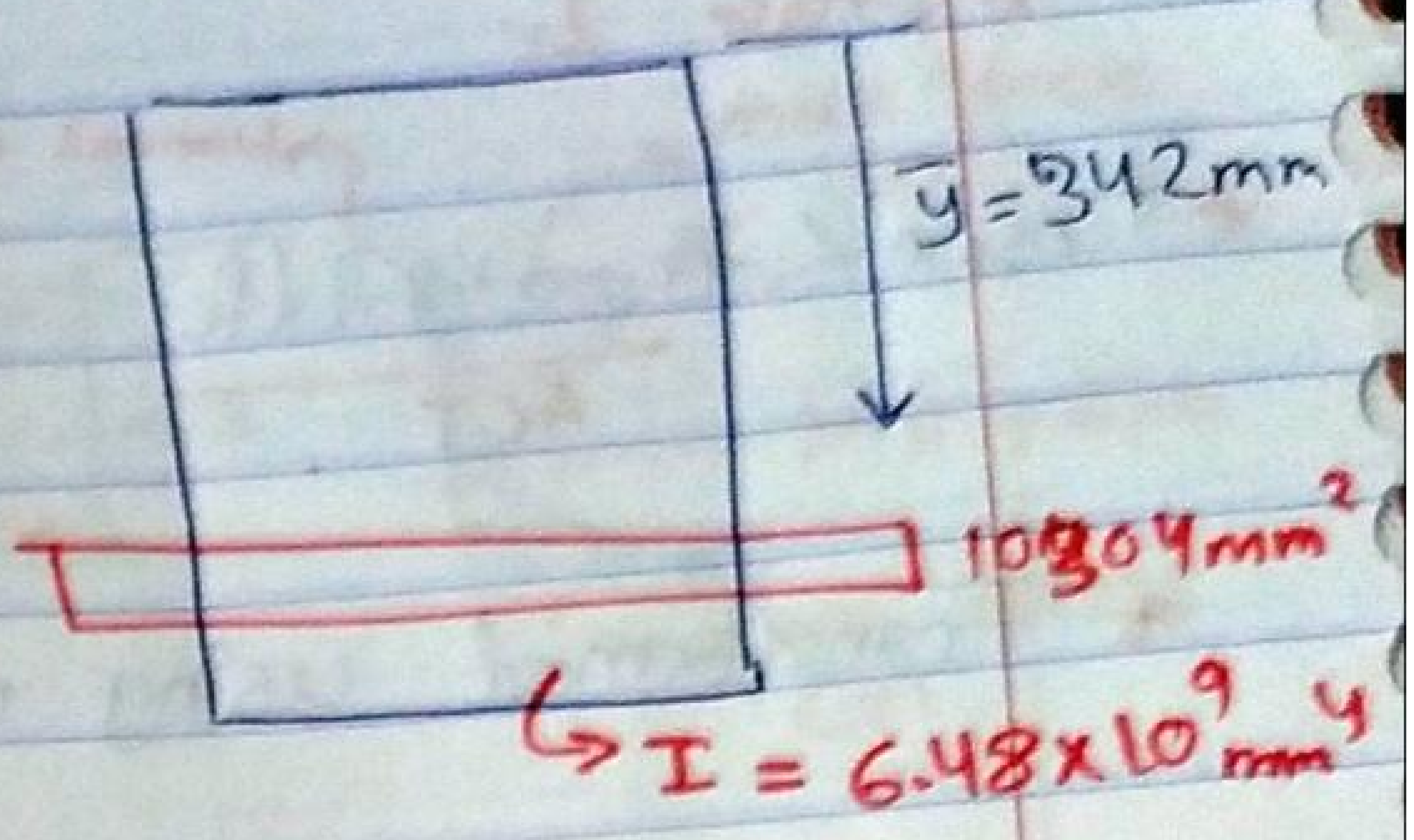
. Example:-



. $f_c' = 28$ MPa
. $F_y = 420$ MPa
. applied positive moment in the Section = 60 KN.m

⟹ Find . $\sigma_{T max}$, $\sigma_{c max}$ In concrete ?
. M_{max} Before cracking ?

$\rightarrow n = \frac{E_s}{E_c} = \frac{200\times10^6}{4700\sqrt{28\times10^6}} = 8$



$\rightarrow A_s = 3\frac{\pi}{4}(25)^2 = 1472\ mm^2$

$\rightarrow (n-1)A_s = 10304\ mm^2$

$\rightarrow \bar{y} = \frac{\Sigma A\bar{y}}{\Sigma A} = 342\ mm$

#	A	$\bar{y}$	$A\bar{y}$
1	250x650	325	--
2	10304	600	--

$\rightarrow I = I'' + AD^2$

I at centroidal axis

↳ distance between the centroid and the axis

#	I''	A	D	AD²	I'' + AD²
1	$\frac{1}{12}(650)^3(250)$		342-325		
2	0		600 - 342		

↳ لأنه ال Thickness صغير جداً

* maximum compressive stress? At Top $\sigma_c = \frac{60\times10^6\times342}{6.48\times10^9} = 3.17\ MPa$

* maximum Tension stress? At bottom $\sigma_T = \frac{60\times10^6\times(650-342)}{6.48\times10^9} = 2.85\ MPa$

$f_r = 3.28 >$ ⟹ No crack

↳ $0.62\sqrt{f_c'}$

* calculat the stress In the steel bars?

$f_s = n\times\sigma_c = 8\times\frac{60\times10^6\times(600-342)}{6.48\times10^9} = 19.11\ MPa$

* $M_{cr} \Rightarrow f_r = \frac{My}{I}$

$M_c = \frac{f_r\ I}{650-342} = 69\ KN.m$

↳ No crack ✓✓