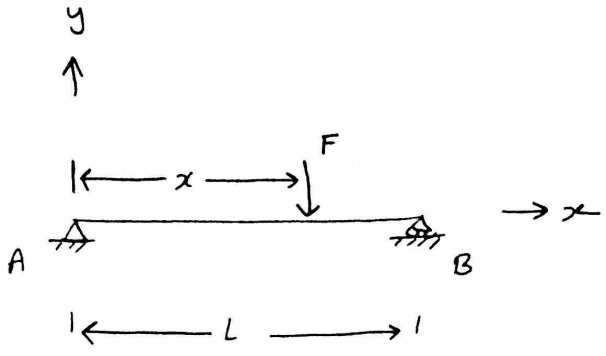
* Deflection of Beams

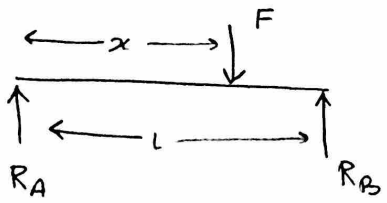
① Simply Supported Beam



F: Force
L: Beam Length

- Reactions at A and B
- Deflection $y(x)$

Free-body diagram



To find reactions

$\circlearrowleft \Sigma M_A = 0$ and $\circlearrowleft \Sigma M_B = 0$

$\Rightarrow$

$$R_A = F\left(1 - \frac{x}{L}\right) \quad \text{Eq(a)}$$

$$R_B = F\frac{x}{L}$$

Deflection

$$\frac{d^2y}{dx^2} = \frac{M}{EI} \Rightarrow y(x) = \frac{1}{EI}\left[\int_0^x \left(\int_0^x M(x)\,dx\right)dx + C_1 x + C_2\right]$$

C_1 and C_2 $\Rightarrow$ Constants $\Rightarrow$ from Boundary Conditions

$$y(x) = \frac{FL^3}{48EI}\left(3\frac{x}{L} - 4\frac{x^3}{L^3}\right) \qquad 0 \le x \le L/2$$

At center $x = L/2$

$$y(L/2) = \frac{FL^3}{48EI} \quad \text{Eq(b)}$$

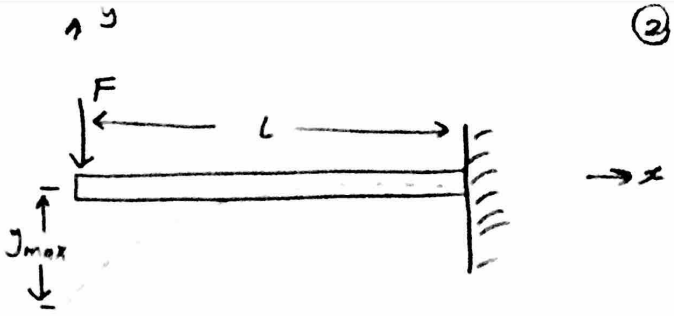
E: Elastic modulus
I: moment of Inertia

$$I = \frac{1}{12}bh^3$$

(2) Cantilever Beam

$x = 0$

$$y_{max} = \frac{FL^3}{3EI} \quad - Eq(c)$$



$$y(x) = \frac{F}{6EI}\left(-x^3 + 3L^2x - 2L^3\right)$$

*What will we do in the Lab ?

1- Simply Supported beam

- Apply Force (F)
- Change distance x

→ measure reactions at A and B and compare to theory Eq(a) ⇒ Table 1

→ measure deflections and compare to theory Eq(b) ⇒ Table 2

2- Cantilever Beam

- Apply Force (F)
- Change Beam Length (L)

→ measure Deflection and compare to theory Eq(c) ⇒ Table 3

Distance x from support A (mm)	Experimental		Theoretical		Percentage Error (%)	
	Reaction force A (N)	Reaction force B (N)	Reaction force A (N)	Reaction force B (N)	Reaction force A	Reaction force B
100						
200						
300						
400						
500 (Center)						

Table 1: Part 1, *Reaction forces.*

Distance x from support A (mm)	Deflection W (Experimental) (mm)	Deflection W (Theoretical) (mm)	Percentage Error (%)
100			
200			
300			
400			
500 (Center)			

Table 2: Part 2, simply supported beam deflection.

Length L from clamp (mm)	Deflection W (Experimental) (mm)	Deflection W (Theoretical) (mm)	Percentage Error (%)
200			
300			
400			

Table 3: Part 3, cantilever beam deflection.