SHEAR FORCE AND BENDING MOMENT DIAGRAMS IN STATICALLY DETERMINATE BEAMS :— ①

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BEAM :— A Beam is a structural member, subjected to a system of external forces at right angles to it's longitudinal axis.

STATICALLY DETERMINATE BEAM :

A Beam is said to be statically determinate, if it's reaction components can be determined by using equations of static equillibrium conditions only ($\Sigma F_x = 0$, $\Sigma F_y = 0$ and $\Sigma M = 0$)

ie No of unknown reactions = No of equm conditions.

STATICALLY INDETERMINATE BEAM :

A Beam is said to be statically indeterminate, if it's reaction components cannot be determined by using equillibrium equation.

ie No of unknowns reactions > Available equm equations

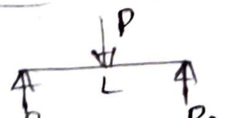
- Simply supported beams
- overhanging beam
- Cantilever beam

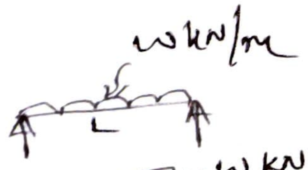
} statically determinate beam

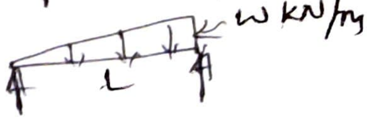
- Fixed beam
- Continuous beam
- Propped cantilever beam

} Statically indeterminate beam.

Typeos of loads acting on the beam :

- Concentrated load — 

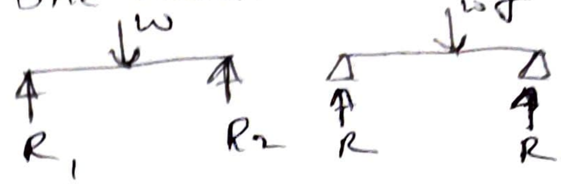
- Uniformly distributed load (UDL) — 

- — " — Varying load (UVL) — 

- Externally applied moment.

Types of supports:

→ Simple support --- One reaction along vertical direction

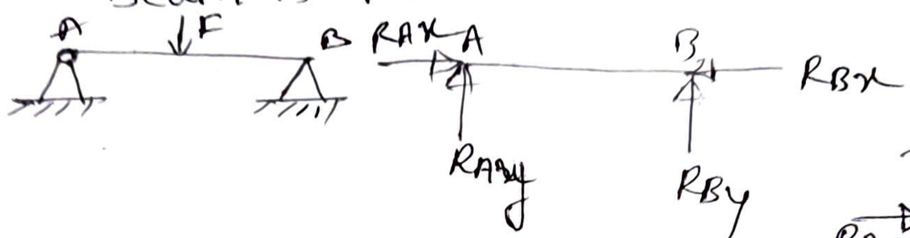


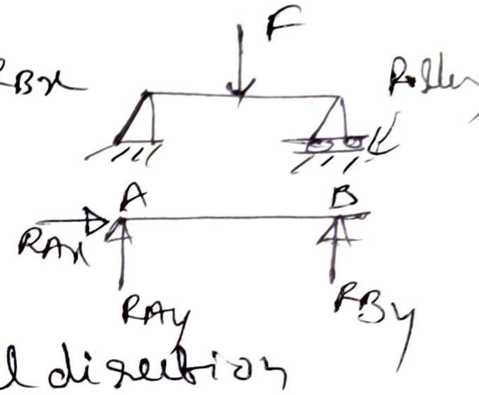
→ beam is free to move along H^le direction + rotate about support

→ Pinned or Hinged support:

Two reactions, one along Horizontal + other along vertical direction.

→ Beam is free to rotate about the support

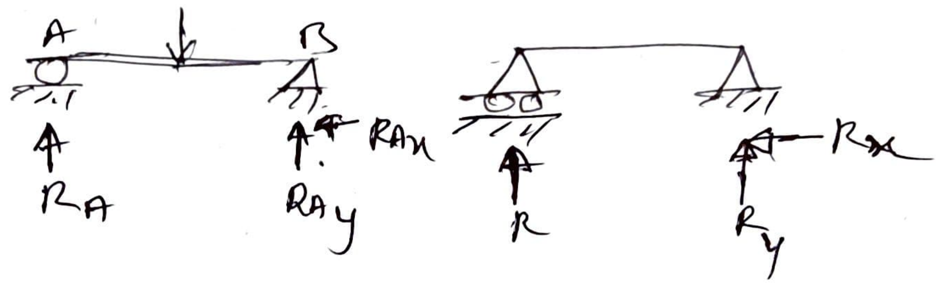




→ Roller support!

→ One reaction along vertical direction

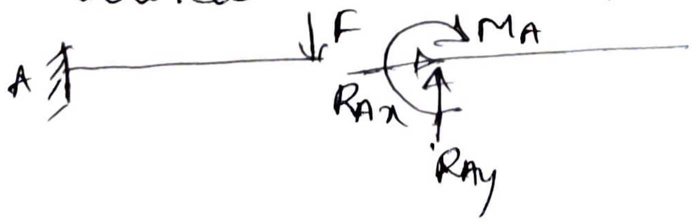
→ beam is free to move along H^le direction + free to rotate about the support.



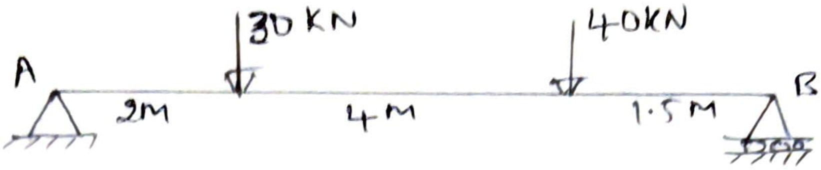
→ Fixed support:

Two reactions, along H^le + V^le directions and a External moment.

beam is prevented from moving along H^le + vertical direction + also rotation



(2)

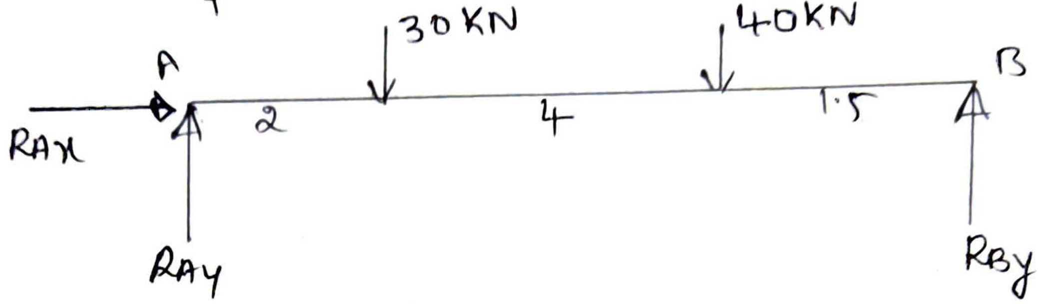


(2)

Find the support reactions @ A & B

Soln: First draw FBD

since the support @ A is hinged – 2 reactions
& – " – @ B is roller – One – " –



$\Sigma M_A = 0$, to get RBy

ie $R_{Ax} \times 0 + R_{Ay} \times 0 + 30 \times 2 + 40 \times 6 - R_{By} \times 7.5 = 0$

$\Rightarrow 300 - 7.5 R_{By} = 0 \Rightarrow 7.5 R_{By} = 300$

$\Rightarrow R_{By} = 40 KN$

$\Sigma F_y = 0$ or $\Sigma M_B = 0$, to get RAy

$R_{Ay} - 30 - 40 + R_{By} = 0$

$R_{Ay} = 30 + \cancel{40} - \cancel{40} = 30KN$. $R_{Ay} = 30 KN$

$\Sigma F_x = 0$, to get RAx.

$\boxed{R_{Ax} = 0}$ ($\because$ there is no any H-le force otherthan reaction RAx)

For cross check.

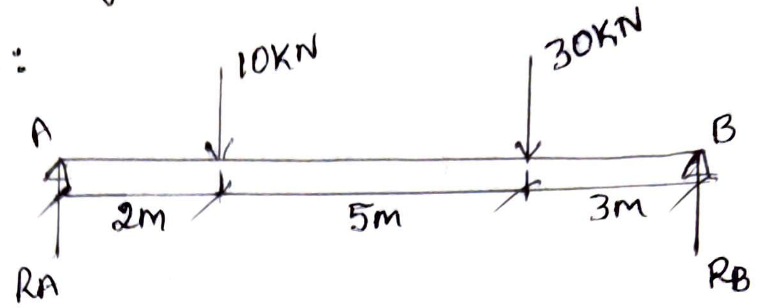
$30 + 40 = \underset{R_{By}}{40} + \underset{R_{Ay}}{30}$

$70 = 70$ Then the beam is under equillibrium condition.

Calculation of support reactions for statically determinat beams

Example:

(1)



Find $RA = ?$ & $RB = ?$

Procedure:

(1) RA & RB can be calculated by using 3 static equillibrium conditions.
ie $\Sigma Fx = 0$, $\Sigma Fy = 0$ & $\Sigma M = 0$

(2) First consider moment about A is equal to zero ie $\Sigma M_A = 0$ or $\Sigma M_B = 0$, whichever is easy for calculation

(3) Sign convensions ↑(+), ↓(−), ↻(+) & ↺(−)

(4) Consider $\Sigma M_A = 0$

$$\text{ie } \cancel{R_A \times 0}^{\,0} + 10 \times 2 + 30 \times 7 - R_B \times 10 = 0$$
LHS = RHS

$$230 - 10R_B = 0$$

$$\Rightarrow 10R_B = 230 \Rightarrow R_B = 23\ KN$$

$\Sigma Fy = 0$ or $\Sigma M_B = 0$ to get RA

$$R_A - 10 - 30 + R_B = 0$$
$$R_A = 10 + 30 - 23 = 17\ KN$$

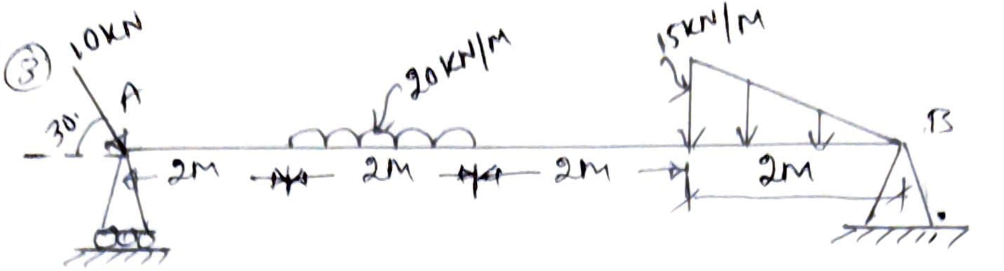
For cross check;

summation of applied force = summation of RA & RB

$$\Rightarrow 10 + 30 = 23 + 17$$
$$40 = 40$$

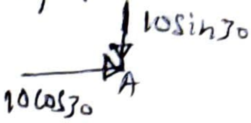
$\therefore R_A = 17\ KN$
$R_B = 23\ KN$

3

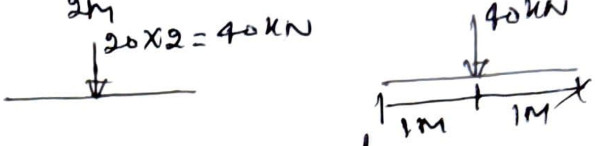


Solⁿ: Support A is roller – One reaction – RAy

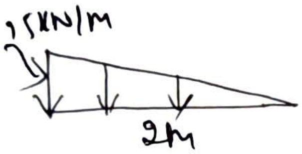
Support B is hinged – Two reaction – RBy & RBx



- Resolve 10 KN force along x & y direction
- Convert UDL (20kN/m, 2m) into point load

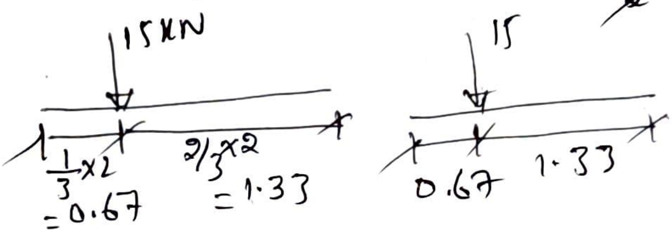


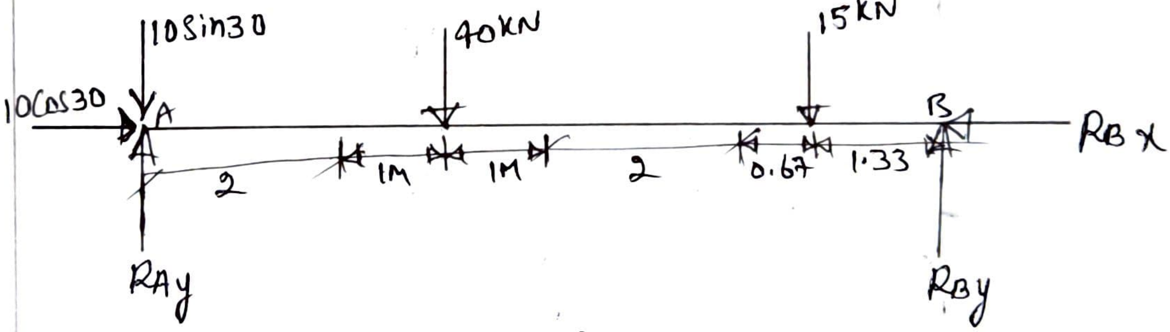
- Convert UVL into pt load



pt load = Area of Δle

$= \frac{1}{2} \times 2 \times 15 = \underline{15\text{ KN}}$





$\Sigma M_A = 0$, to get RBy

$40 \times 3 + 15 \times (\underbrace{2+2+2+0.67}_{6.67}) - R_{By} \times 8 + R_{Bx} \times 0 = 0$

$220.05 - 8 R_{By} = 0 \quad \Rightarrow R_{By} = 27.50\text{ KN}$

$\Sigma F_y = 0 \quad \Rightarrow R_{Ay} - 10\sin 30 - 40 - 15 + R_{By} = 0$

$\Rightarrow R_{Ay} = +10\sin 30 + 40 + 15 - 27.5$

$\Rightarrow R_{Ay} = 32.5$

$\Sigma F_x = 0 \quad \Rightarrow 10\cos 30 - R_{Bx} = 0$

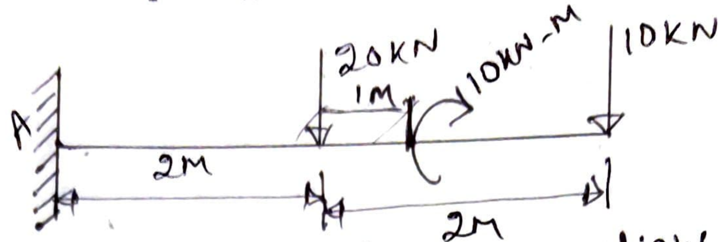
$\Rightarrow \underline{R_{Bx} = 8.66\text{ KN}}$

For cross check. Vertically ↓ force = v^lly upward reaction

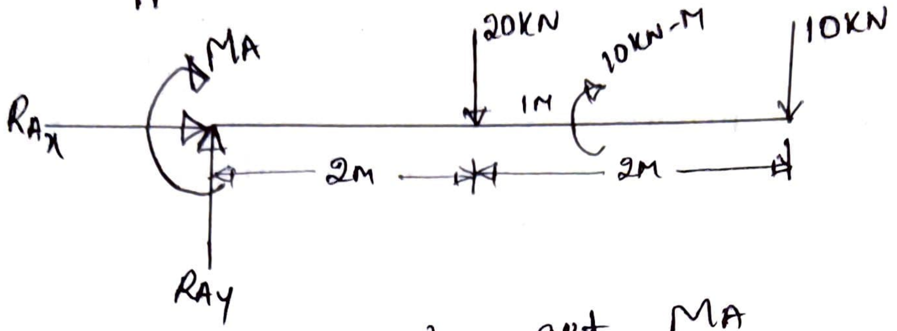
$\Rightarrow 10\sin 30 + 40 + 15 = 27.5 + 32.5$

$\Rightarrow 60 = 60$ //

(4)



Support A is fixed - 2 reactions & Moment



$\Sigma MA = 0$, to get MA

$\Rightarrow MA + 20 \times 2 + 10 + 10 \times 4 = 0$

$MA = -90\ KN\text{-}M = 90\ KN\text{-}M$ (↻)

$\Sigma Fx = 0 \Rightarrow RAx = 0$

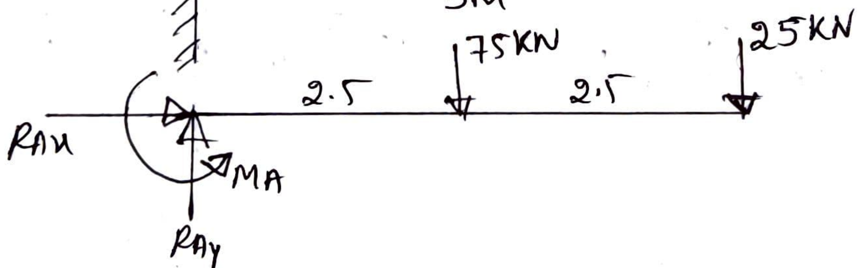
$\Sigma Fy = 0 \Rightarrow RAy - 20 - 10 = 0$

$\Rightarrow RAy = 30\ KN$

Fro cross check, $20 + 10 = RAy$

$30 = 30$

(5)



$\Sigma MA = 0 \Rightarrow -MA + 75 \times 2.5 + 25 \times 5 = 0$

$\Rightarrow -MA = -312.5\ KN\text{-}M$

$\Rightarrow MA = 312.5\ KN\text{-}M$

$\Sigma Fy = 0$

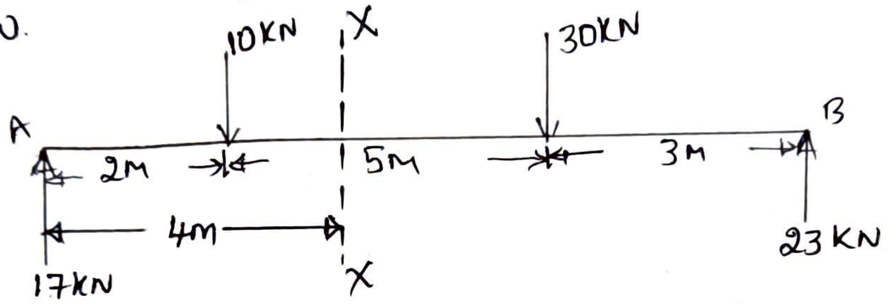
$RAy - 75 - 25 = 0 \Rightarrow RAy = 100\ KN$

$\Sigma Fx = 0 \Rightarrow RAx = 0$

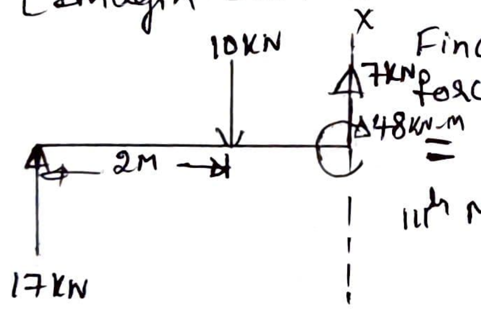
Understanding the meaning of shear force (SF) and Bending moment in beam (BM) :-

The beam transfer the applied loads to the support. In the process of transfering the applied loads to the supports, the beam develop resistance to moment and transverse shear forces at all it's cross sections. The moment & SF developed at all sections of beam are determined and will be shown diagrammetrically.

To understand the meaning of SF & BM, consider a section X-X at a distance 4m from left hand support A in the beam shown in fig below.



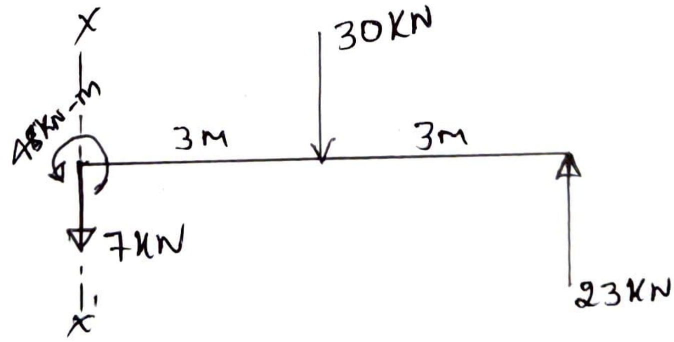
Consider the left hand portion of section X-X [Imagin beam is cut into two pieces]



Find the algebraic sum of all the forces normal to axis within X-X

$= 17 - 10 = 7 KN \uparrow$ (acting upwards)

IIIly $M_{x-x} = 17 \times 4 - 10 \times 2 = 48$ KN-m (C)



IIIly, If we consider right portion

Algebraic sum of forces $= 23 - 30 = -7 KN = 7 KN (\downarrow)$

& $\Sigma M_{x-x} = -23 \times 6 + 30 \times 3 = -48$ KN-m $= 48$ KN-m (C)

∴ The force 7 KN is called as SF & moment 48 KN-m is called as BM

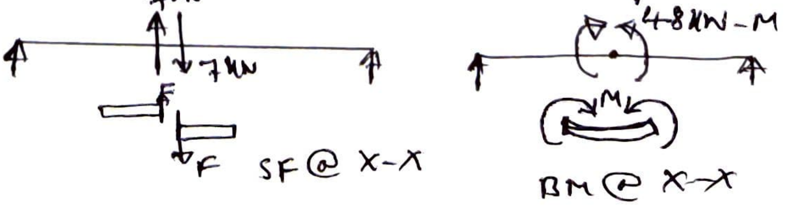
Considering left portion,
vertical forces acting are reaction 17 KN acting upwards and the external load 10 KN acting vertically downwards. ∴ the resultant force acting on the left portion is upward (7 KN), to maintain the equilibrium of the left portion there must be a induced force of 7 KN acting vertically downwards at the cut section. This 7 KN force is known as shear force.

Therefore the resultant force acting on any one of the portions normal to the axis of the beam is called shear force at the section.

=) Thus the section X–X is subjected to forces 7 KN and Moment 48 KN–M as shown above. The force is trying to shear off the section is called shear force. The moment bends the section is called bending moment.

=) SHEAR FORCE : "Shear force at a section in a beam is the force that is trying to shear off the section and is obtained as the algebraic sum of all the forces including the reactions acting normal to the axis of the beam either to the left or to the right of the section."

=) BENDING MOMENT : Bending moment at a section in a beam is the moment that is trying to ~~bend~~ bend it and is obtained as the algebraic sum of all the ~~forces including the~~ moments about the section of all the forces, either to the left or to the right portion).

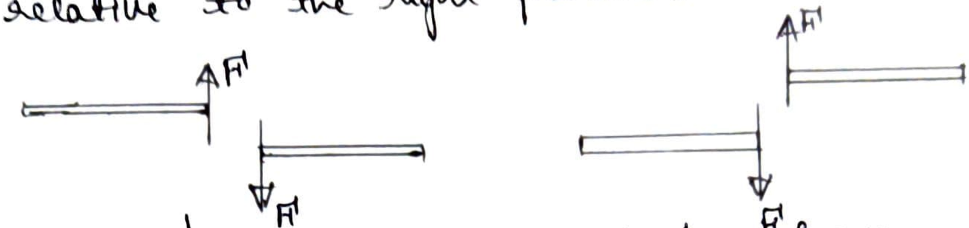


-: SIGN CONVENTIONS FOR SF & BM :-

SF: → Shear force at a section is considered to be Positive when the resultant force to the left of the section is upwards or to the right of the section downwards.

OR

→ The SF is +ve if it tends to move left portion upward relative to the right portion.

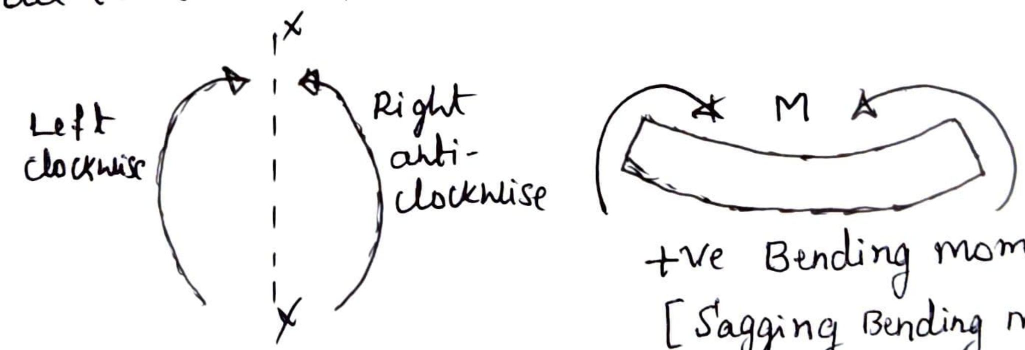


+ve shear force   -ve shear force

BM: → If the algebraic sum of the moments to the left of the section is clockwise or to the right of the section anticlockwise, then the moment is taken as Positive. It's effects is to create sagging of the beam as shown below

OR

→ The BM is +ve if it tries to sag the beam. If left portion of the beam is considered +ve moment works out to be clockwise

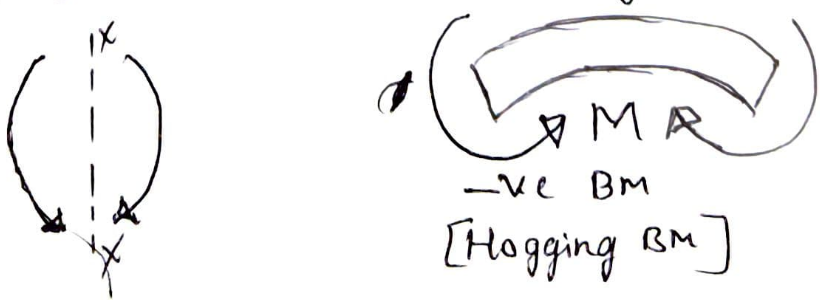


+ve Bending moment
[Sagging Bending moment]

→ If the ΣM to the left of the section is anticlockwise or to the right of the section clockwise, the BM is taken as negative. It's effects is to cause hogging of the beam.

OR

→ The BM is -ve if it tries to hog the beam.



-ve BM
[Hogging BM]

SHEAR FORCE & BENDING MOMENT DIAGRAMS:

shear force and bending moment values very from section to section. A designer needs not only the value's of shear force and bending moment at salient Points, but also needs information about the nature of variation. Hence, the diagrams showing these at all the sections of the beam is necessary.

SFD[Shear Force Diagram]:

A diagram in which ordinate represent shear force and abscissa represents the position of the section is called shear force diagram.

BMD [Bending Moment Diagram]:

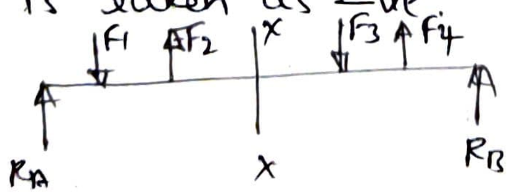
A diagram in which ordinate represents bending moment and abscissa represents the position of the section is called BMD.

⇒ The following sign conventions are used for drawing B.M & SF diagram.

Important points for drawing shear force and bending moment diagram. :

(1) Consider the left or right portion of the section

(2) Add the forces (including the reactions) normal to the beam on one side of the portion. If the left portion of the section is considered, a force on the left portion acting upwards is +ve (↑+ve), while a force on the left portion acting down -wards is taken as -ve



In left portion RA & F2 +ve & F1 is -ve

In right portion F3 is +ve & RB & F4 are -ve

(3) ⇒ Left portion

→ upward forces are +ve

→ Downward are -ve

Right portion

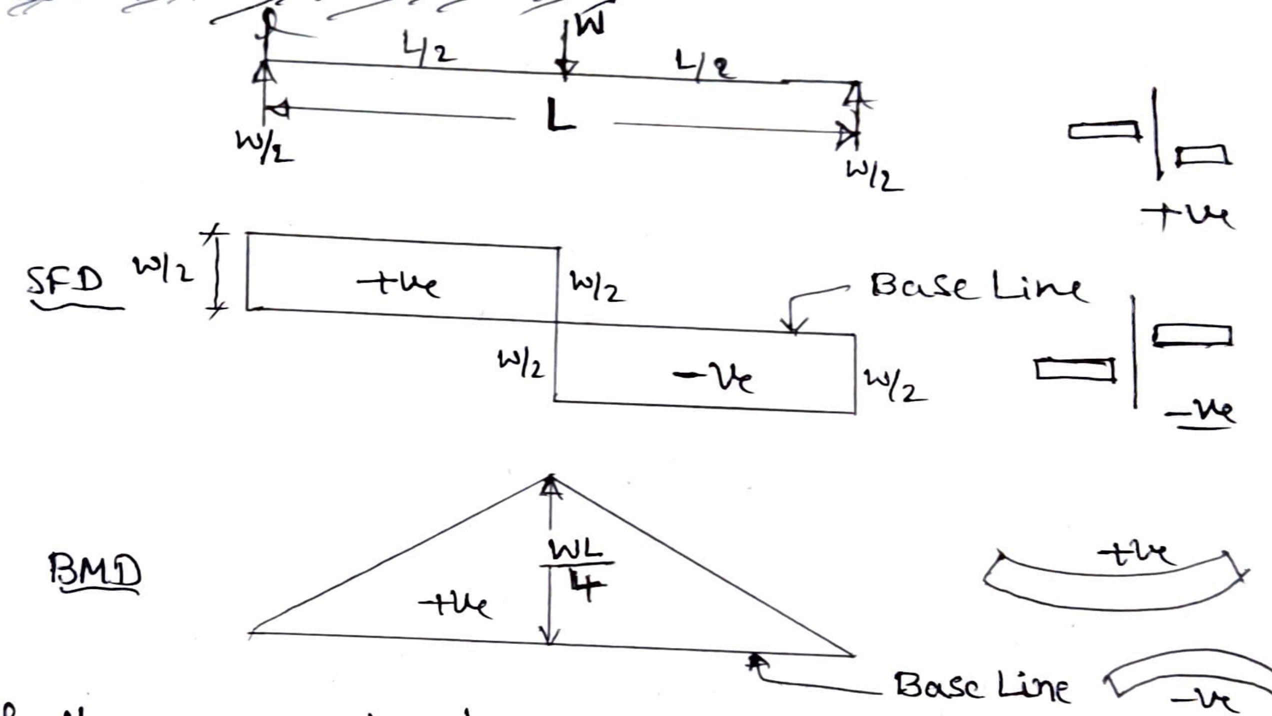
→ Downward are +ve

→ upward are -ve

(3) The +ve value's of SF and BM are plotted above the base line.
The -ve value's of SF and BM are plotted below the base line.

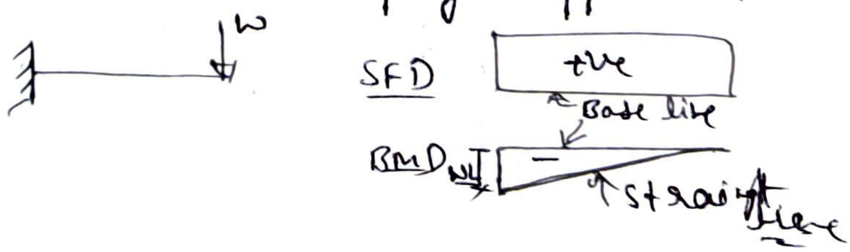
(4) The shear force will increase or decrease suddenly by a vertical straight line at a section where there is a vertical point load.

(5) SF is maximum at support, SF is Zero at a section where BM is maximum. ~~And BM is Zero at a point or section where shear force is maximum~~



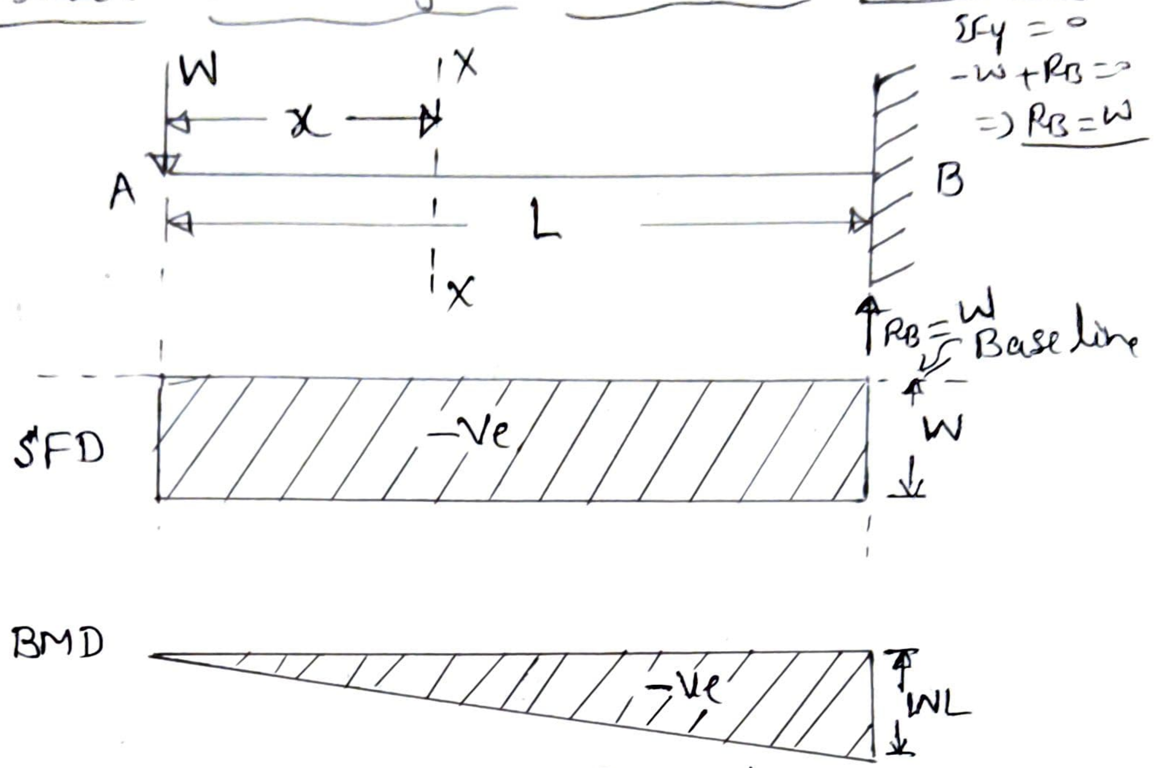
(6) If there is no loading at a section, the shear force will not change at the section or in other words, the SF between any two vertical load will remain unchanged i.e. SFD will be horizontal.

(7) The BM at the free end of a cantilever and the two supports of a simply supported beam will be zero.



SFD AND BMD FOR STANDARD CASES :

(1) Cantilever beam subjected to load at free end



Consider the beam shown in fig above,
Take a section X−X @ a distance 'x' from end A
Considering left hand portion of section X−X
for calculating SF and BM.

SF − Adding all the forces within X−X
BM − Taking moment about X−X due to all the forces which are in left portion.

∴ shear force i.e. SF at section X−X is,
i.e. F = $-W$ [∵ Force W is acting downward]

$|||^{ly}$ SF @ before B = $-W$ (∵ there is no other force than W)

& SF @ B = $-W + W = 0$

There fore SFD ~~and BMD are~~ shown in fig above.

BM @ X−X ⇒ $M = -Wx$

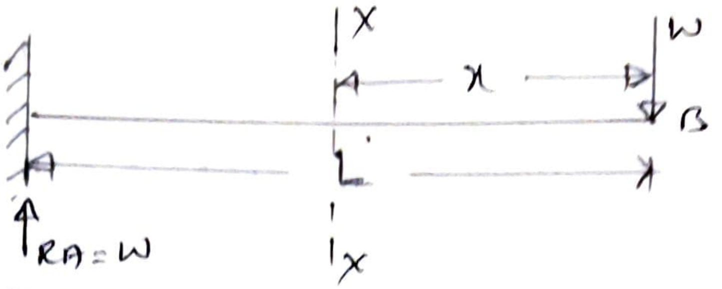
At $x = 0 \Rightarrow M = 0$
At $x = L \Rightarrow M = -WL$

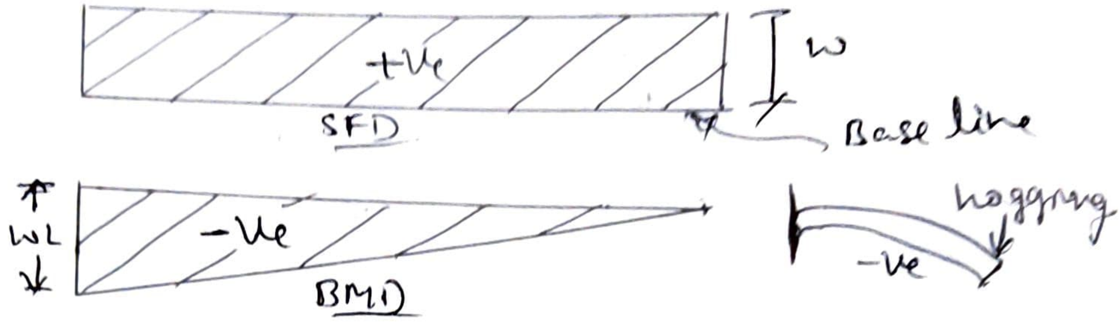
HW;

$\Sigma F_y = 0$

$-W + R_A = 0$

$\Rightarrow R_A = W$





considering right portion of x-x section

SF @ X-X $\Rightarrow F = W$

IIIly SF @ beforce A $= W$ [section @ A]

& SF @ A $= W - W = 0$

BM @ xx $= -Wx$

[In left portion ↻ +ve & ↺ -ve
& in right " ↻ -ve & ↺ +ve]

@ $x = 0$ $M = 0$

@ $x = L$ $M = -WL$

OR considering calculation of SF from left hand side

SF @ A $= R_A = W$ (↑ +ve)

SF @ X-X $= W$

SF @ before B $= W$

SF @ B $= R_A - W = W - W = 0$ [$\uparrow_{R_A}$ +ve, ↓ -ve] on left side

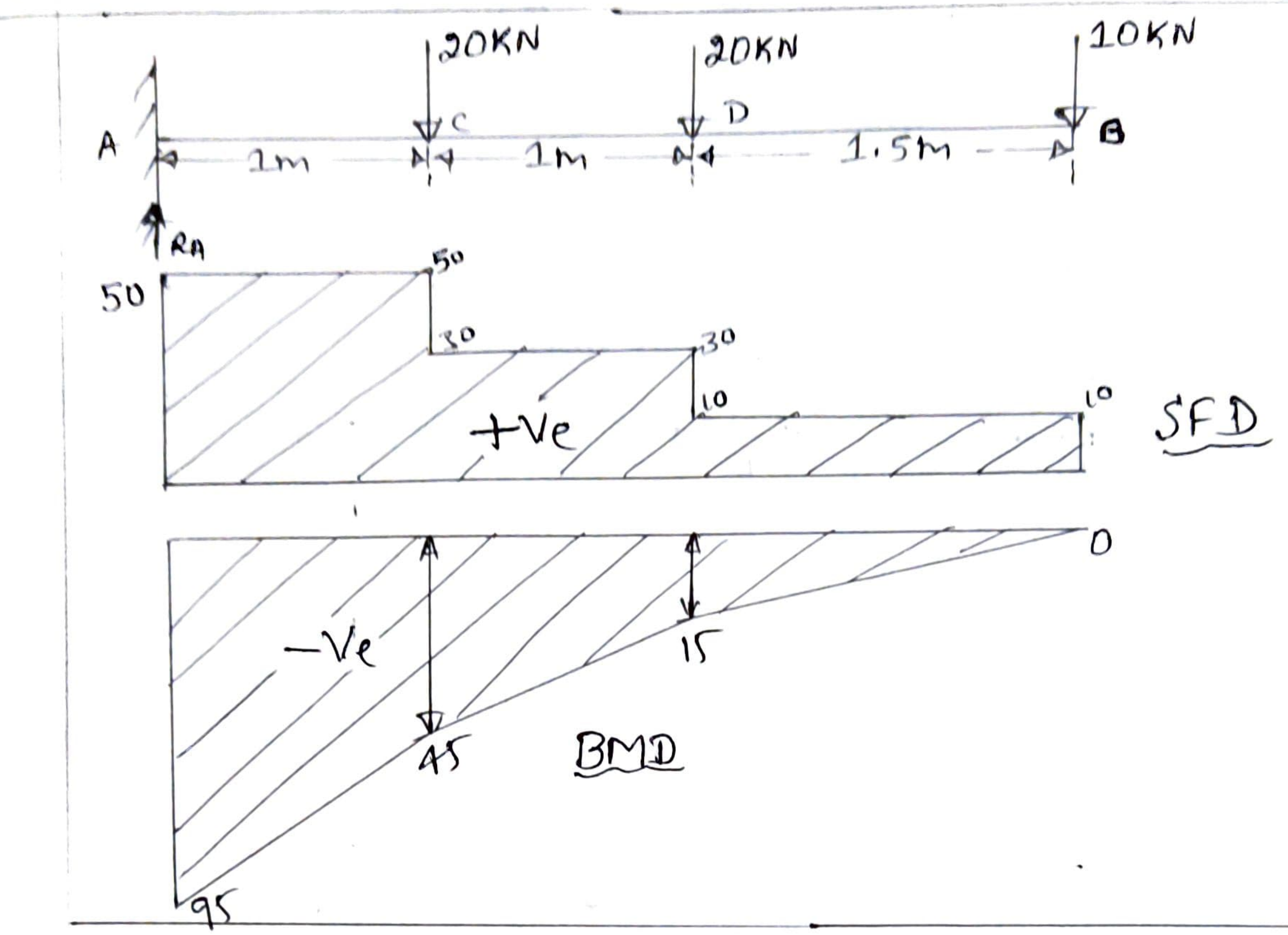
& BM @ B $= 0$

BM @ A $= W \times L = WL$

since the load W is trying to hog the beam, so that moment about A is taken as -ve.

$\therefore M_A = \underline{-WL}$

② Cantilever beam subjected to several pt loads: (8)



Calculation of Reaction @ A

$\Sigma F_y = 0 \Rightarrow R_A - 20 - 20 - 10 = 0 \Rightarrow R_A = 50\,KN$

Calculation of SF @ A, C, D & B:

SF @ A $= R_A = 50\,KN$ (↑ +ve)

SF @ before C $= R_A = 50\,KN$

SF @ C $= R_A - 20(\downarrow) = 50 - 20 = 30\,KN$

SF @ before D $= 30\,KN$

SF @ D $= 30 - 20(\downarrow) = 10\,KN$

SF @ before B $= 10\,KN$

SF @ B $= 10 - 10 = 0$

Calculation of BM @ A, C, D & B:

BM @ A i.e. $M_A = -10 \times 3.5 - 20 \times 2 - 20 \times 1$

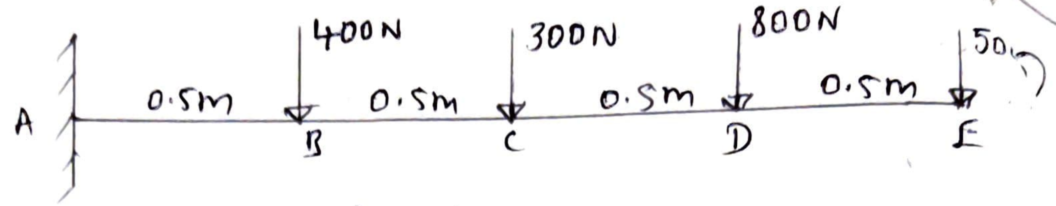
$M_A = -95\,KN-M$

BM @ C i.e. $M_C = -10 \times 2.5 - 20 \times 1 = -45\,KN-M$

IIly $M_D = -10 \times 1.5 = -15\,KN-M$

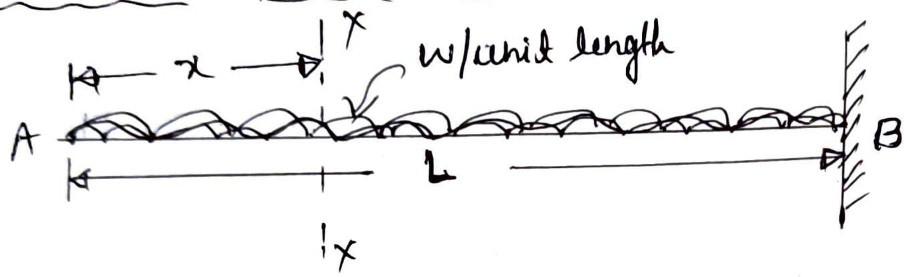
& $M_B = 0$

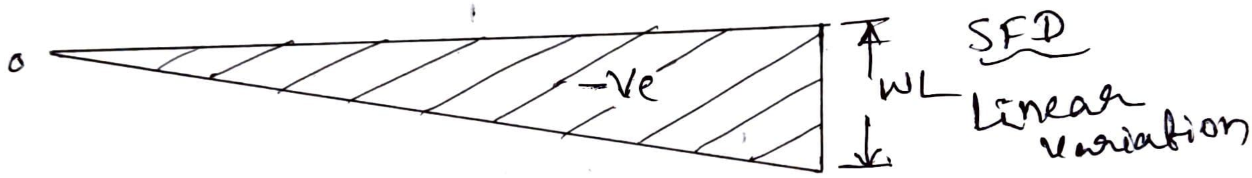
H.W:

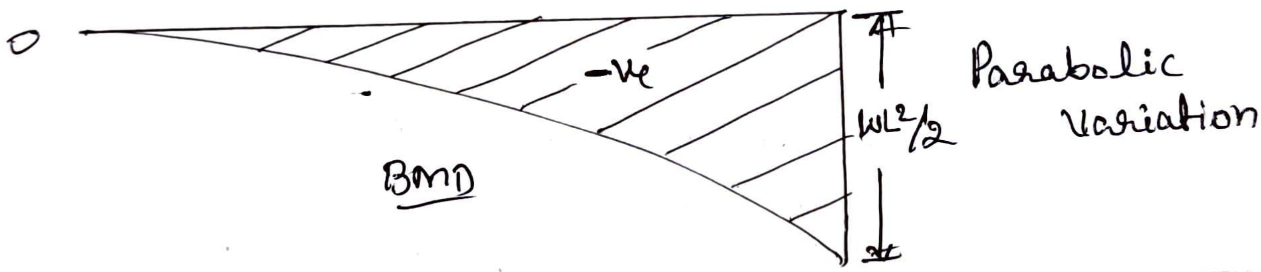


Draw SFD & BMD

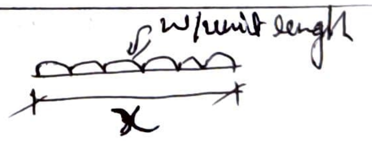
③ Cantilever beam subjected to UDL over entire span:



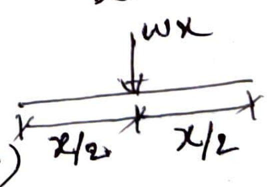




Consider left hand portion



SF @ X-X $= -wx$



at $x = 0$ (ie at A) SF $= 0$

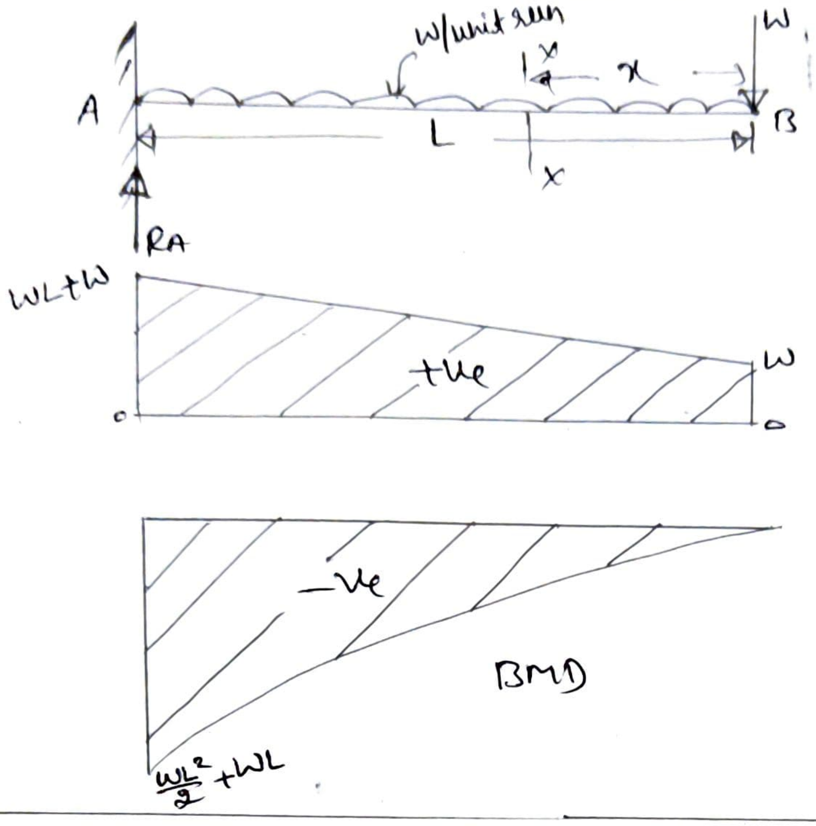
@ $x = L$, SF $= -WL$ (Linear Variation)

BM @ x-x $= -wx \times \frac{x}{2} = -w\frac{x^2}{2}$

@ $x = 0$, BM $= 0$

@ $x = L$, BM $= \frac{-WL^2}{2}$ (Parabolic variation)

Cantilever beam subjected to UDL over entire span & point load @ free end (9)



Calculation of RA, $\Sigma F_y = 0$, $R_A - wL - W = 0$
$\Rightarrow R_A = wL + W$

SF @ A $= R_A(\uparrow) = wL + W$

~~SF @ B~~ $= \cancel{(wL + W) - w(\downarrow) - wL\ wL + W\ W}$

$= \cancel{R_A(\uparrow) - wL(\downarrow) - W(\downarrow)}$

$= \cancel{(wL + W) - wL - W}$

$= \cancel{wL + W - wL - W}$

SF @ before (B) $= R_A - wL = \cancel{wL} + W - \cancel{wL} = W$

SF @ B $= W - W = 0$

OR considering Right portion

SF @ x - x $= W + wx$

@ $x = 0$, SF $= W$ (SF @ B)

@ $x = L$ SF $=$ $W + wL$

BM @ x-x $= -Wx - wx \times \frac{x}{2} = -Wx - \frac{wx^2}{2}$

@ $x = 0$, BM $= 0$

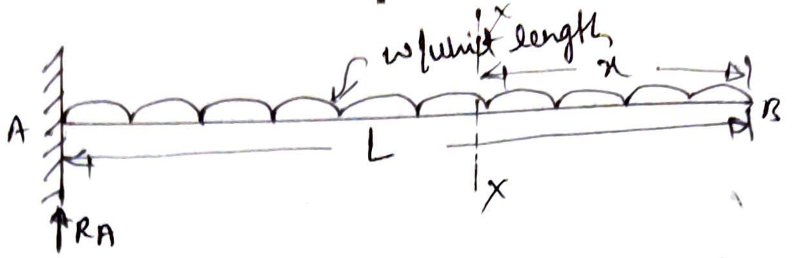
@ $x = L$, BM $= -\left(WL + \frac{wL^2}{2}\right) = -WL\left[1 + \frac{wL}{2}\right] = -WL\left[\frac{2 + wL}{2}\right]$

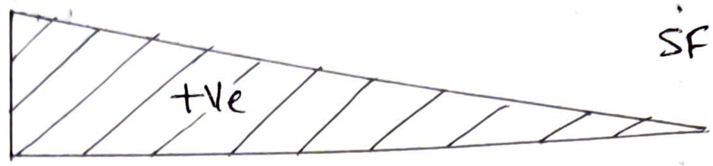
OR

BM @ A $= -\left[WL + wL \times \frac{L}{2}\right] = -\left[WL + \frac{wL^2}{2}\right]$

BM @ B $= 0$

HW)

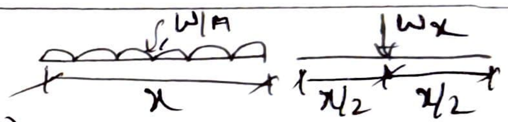




SFD, Linear variation

BMD, Parabolic variation

Consider right portion



SF @ x - x = Wx (+ve ↓)

@ x = 0 , SF = 0

@ x = L , SF = WL

OR

Calculate RA, $\Sigma F_y = 0 \Rightarrow RA - WL = 0 \Rightarrow RA = WL$

SF @ A = RA(↑) = WL, SF @ before B = RA = WL

SF @ B = RA(↑) - WL(↓) = WL - WL = 0

BM @ x - x (From right side)

$BM = -Wx \times \frac{x}{2} = -\frac{Wx^2}{2}$

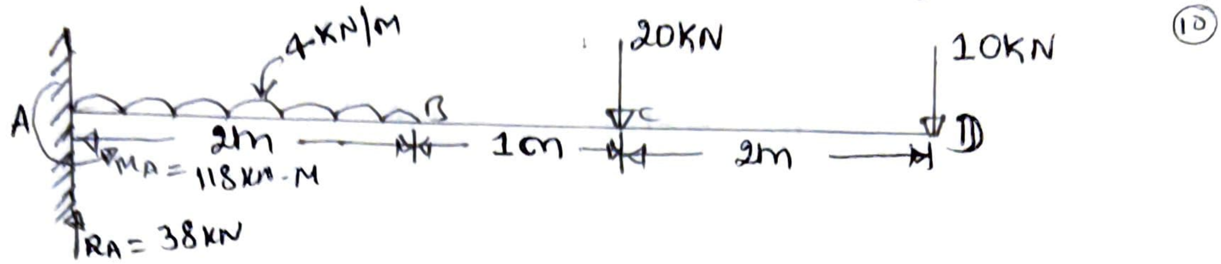
@ x = 0, BM = 0, @ x = L, BM = $-\frac{WL^2}{2}$

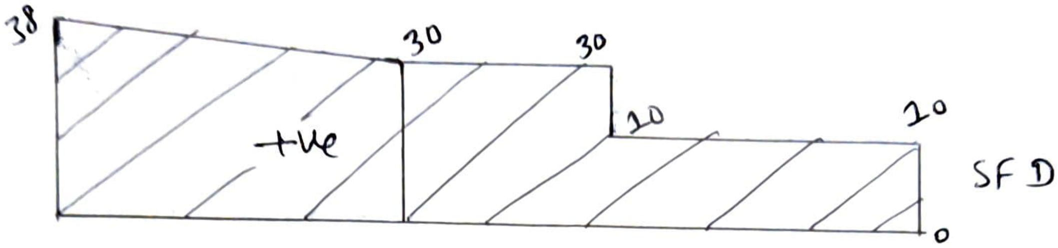
OR

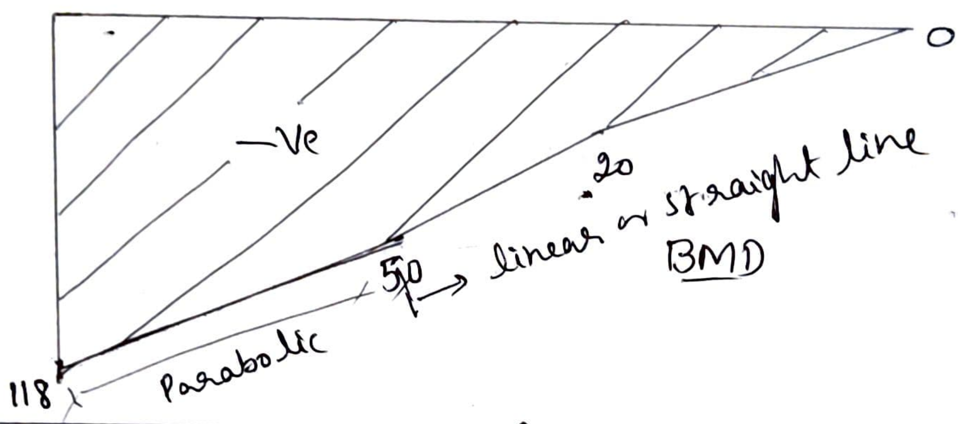
BM @ A $= -WL \times \frac{L}{2} = \frac{WL^2}{2}$

BM @ B = 0

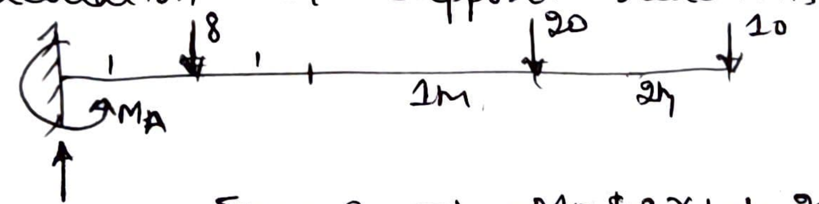
Cantilever beam subjected to UDL & Point load (10)







Calculation of support reactions



$R_A = 38$ KN

$M_A = 118$ KN-M

$R_A = 38$ KN $\quad \Sigma M_A = 0 \Rightarrow -M_A + 8\times1 + 20\times3 + 10\times5 = 0$

$\Rightarrow M_A = 118$ KN-M (↺)

$\Sigma F_y = 0 \Rightarrow \uparrow R_A - 8 - 20 - 10 = 0 \Rightarrow$ $R_A = 38$ KN

Calculation of S.F

Consider section @ A, B, C & D, left hand sides

∴ SF @ A $= R_A \uparrow = 38$ KN

SF @ before $= R_A - 8\,[4\times2]\downarrow = 38 - 8 = 30$ KN

SF @ B $= 30$ KN

SF @ before C $= 30$ KN

SF @ C $= 30 - 20 = 10$ KN

SF @ before D $= 10$

SF @ D $= 10 - 10 = 0$

Means SF @ D = 10KN

Calculation of BM at A, B, C, D

Consider sections @ A, B, C & D, Left hand posn

$\therefore$ BM @ A $= -M_A = -118$ KN-m

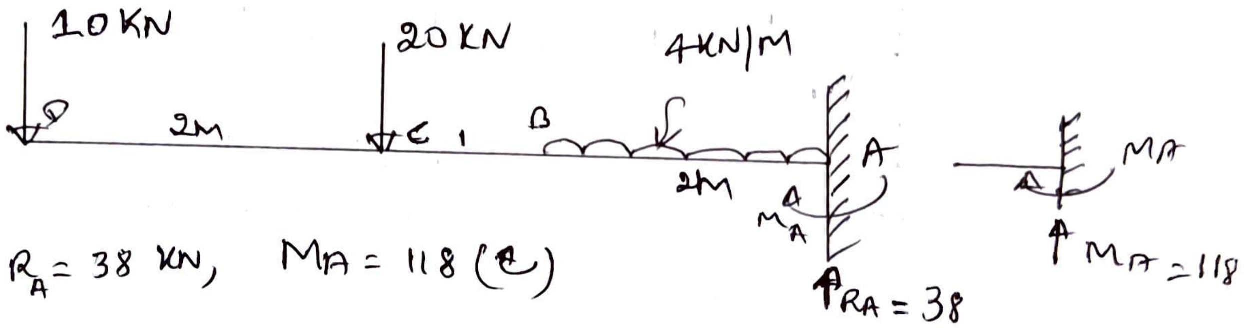
BM @ B $= -M_A - 8\times 1 \; +38\times 2 = -118 - 8 + 38\times 2 = -50$

MB @ C $= -M_A + 38\times 3 - 8\times 2 = -20$ KN-m

BM @ D $= -M_A + 38\times 5 - 8\times 4 - 20\times 2 = 0$

Nature of Force & BM [SF & BM] variation

Load	SF	BM
No Load	Constant	Linear
UDL	Linear	Parabolic
UVL	Parabolic	Cubic



$R_A = 38$ KN, $M_A = 118$ (↺)

SF @ D $= -10$

SF @ before C $= -10$

SF @ C $= -10 - 20 = -30$

SF @ before B $= -30$

SF @ B $= -30$

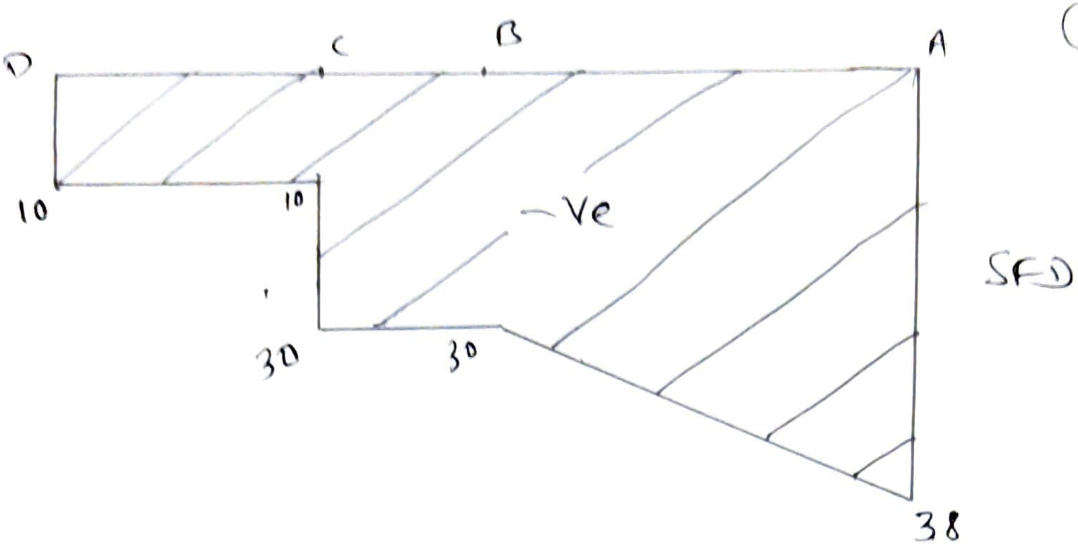
SF @ before A $= -30 - 8 = -38$

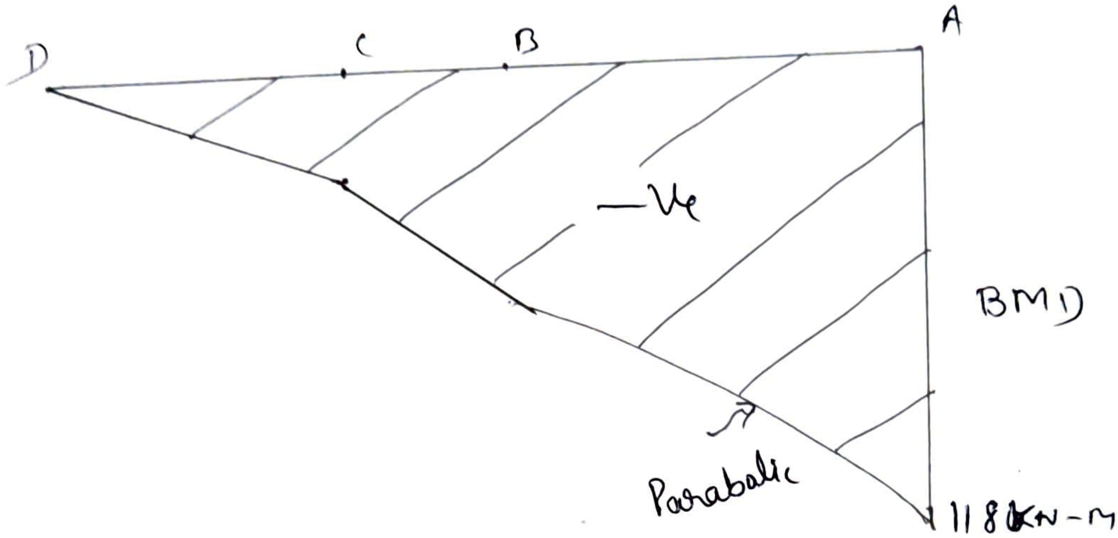
SF @ A $= -38 + 38 = 0$

BM @ D = 0, BM @ C = -20, BM @ B = -50

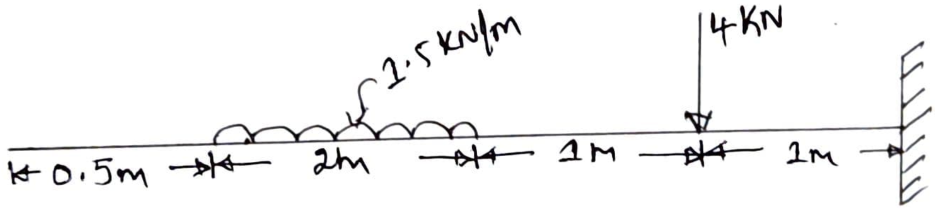
BM @ before A $= -10\times 5 - 20\times 3 - 8\times 1 = -118$ KN-M

BM @ A $= -118 + 118 = 0$


D
C
B
A
10
10
-Ve
30
30
38
SFD

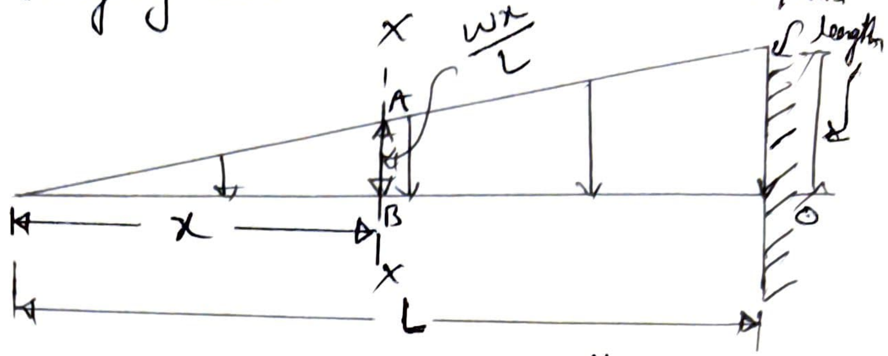

D
C
B
A
-Ve
BMD
Parabolic
118 KN-m

HW:


1.5 KN/m
4 KN
0.5m
2m
1m
1m

2) Cantilever beam subjected to UVL over entire length (12)

UVL - Uniformly Varying Load



Magnitude of the UVL @ O = w/unit length.

∴ Magnitude @ x-x is calculated as follows

ie $\frac{w}{L} = \frac{AB}{x} \Rightarrow AB = \frac{wx}{L}$

$SF @ x-x = -\frac{1}{2} \times x \times \frac{wx}{L} = -\frac{wx^2}{2L}$

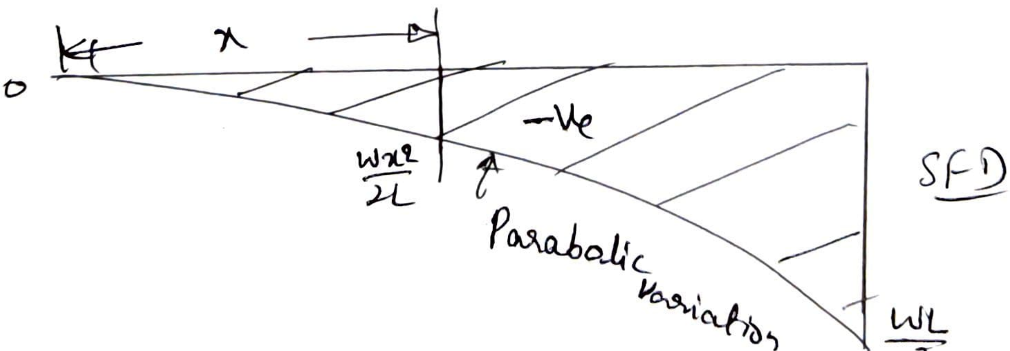
@ $x = 0$, $SF = 0$

@ $x = L$, $SF = \frac{-wL^2}{2L} = \frac{-wL}{2}$

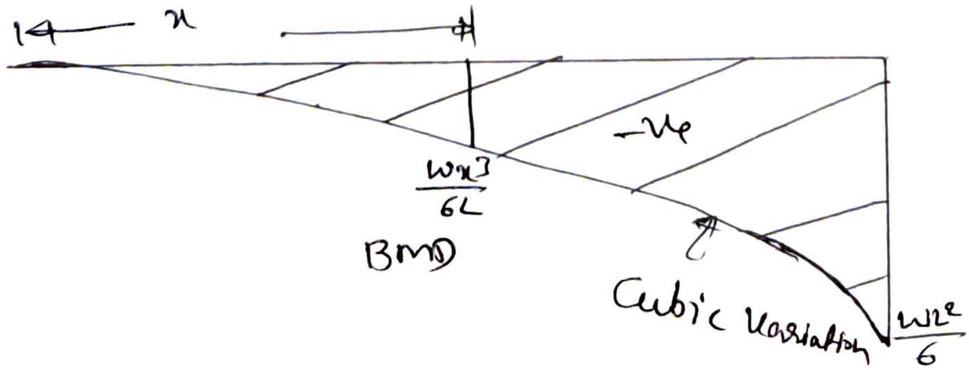
$BM @ x-x = -\frac{wx^2}{2L} \times \frac{x}{3} = -\frac{wx^3}{6L}$ (Cubic Variation)

At $x = 0$, $BM = 0$

At $x = L$, $BM = \frac{-wL^3}{6L} = \frac{-wL^2}{6}$

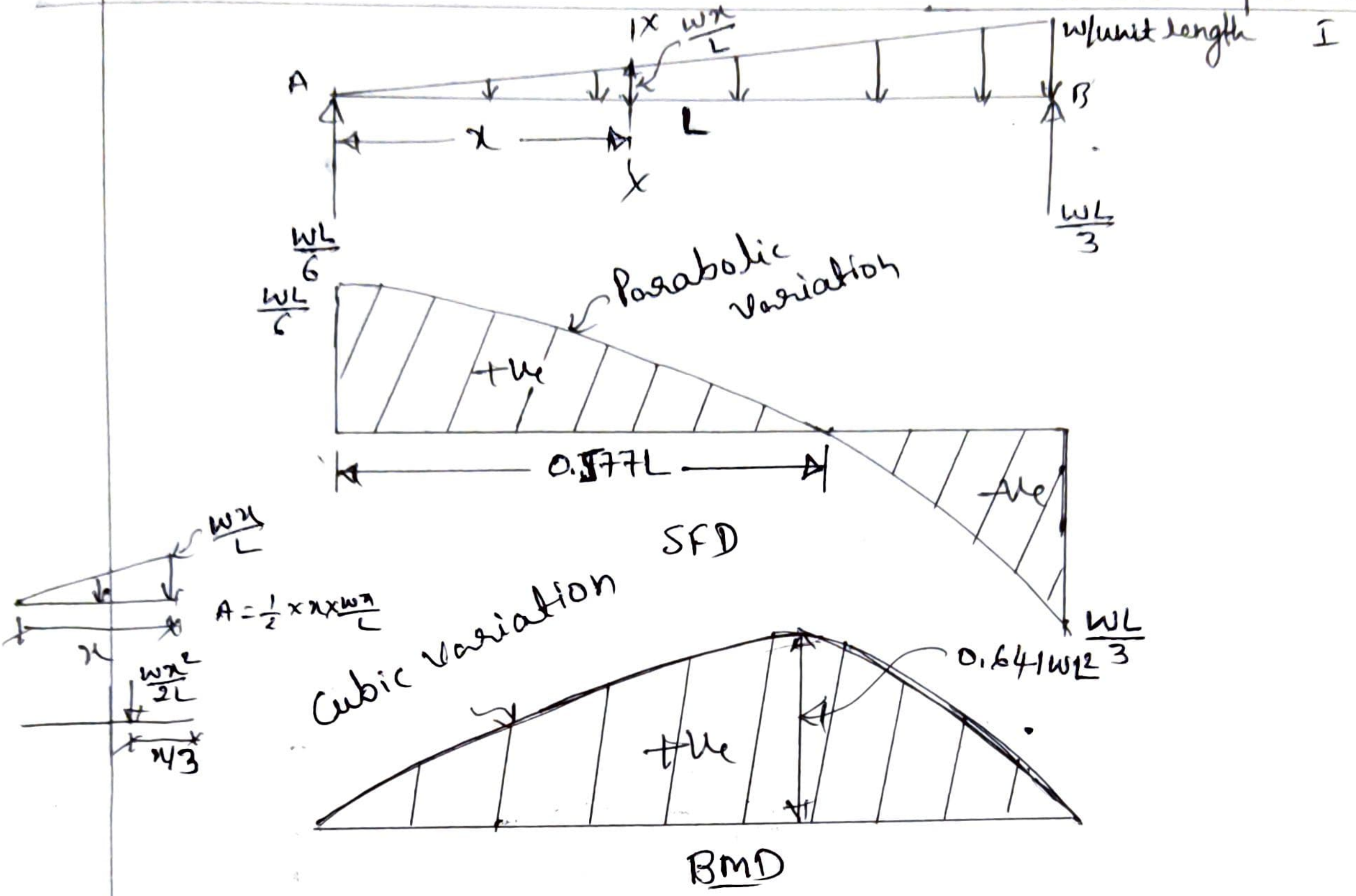


SFD



BMD

Simply Supported beam subjected to UVL over entire span :



SFD: SF @ X-X $= \frac{WL}{6} - \frac{wx^2}{2L}$

$x = 0$, SF@ A $= \frac{WL}{6}$, $x = L$, SF @ B $= \frac{WL}{6} - \frac{WL^2}{2L}$

$= \frac{WL}{6} - \frac{WL}{2} = \frac{WL - 3WL}{6}$

$= \frac{-2WL}{6} = -\frac{WL}{3}$

$\therefore$ SF @ B $= -\frac{WL}{3}$

Since in case of UDL, SF is zero @ $x = \frac{L}{2}$

But in UVL SF is zero at a distance x from end A.

if SF @ X-X $= 0$

$\Rightarrow \frac{WL}{6} - \frac{wx^2}{2L} = 0$

$\Rightarrow \frac{wx^2}{2L} = \frac{WL}{6} \Rightarrow x^2 = \frac{WL}{6} \times \frac{2L}{W} = \frac{2L^2}{6}$

$\Rightarrow x^2 = \frac{2L^2}{6}$

Taking square root on both side

$\sqrt{x^2} = \sqrt{\frac{2L^2}{6}} \Rightarrow x = \frac{L}{\sqrt{3}} = 0.577L$

$\therefore$ SF is zero at a distance 0.577L from end A

BM @ x-x $= \frac{WL}{6}x - \frac{wx^2}{2L} \times \frac{x}{3} = \frac{WLx}{6} - \frac{wx^3}{6L}$

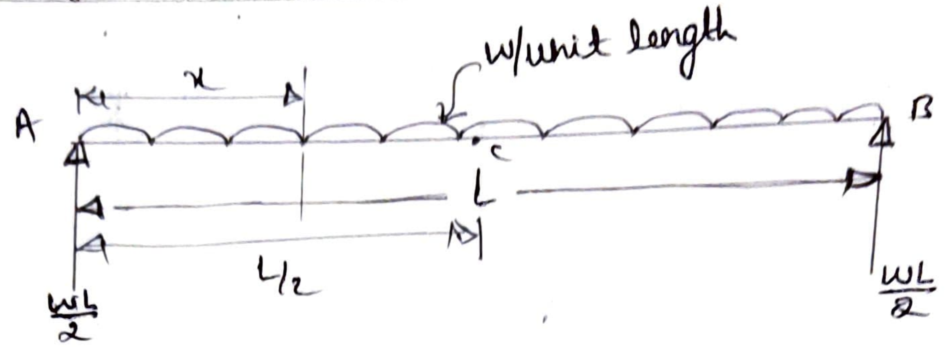
BM @ $x = 0.577L = \frac{WL \times 0.577L}{6} - \frac{W(0.577L)^3}{6L}$

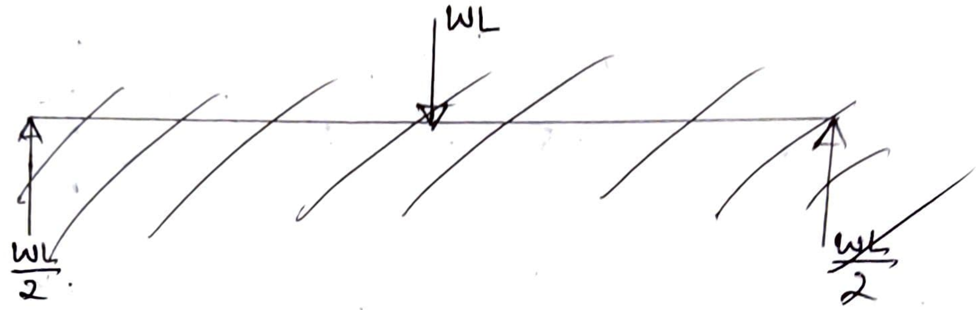
BMD: BM @ A & B = 0

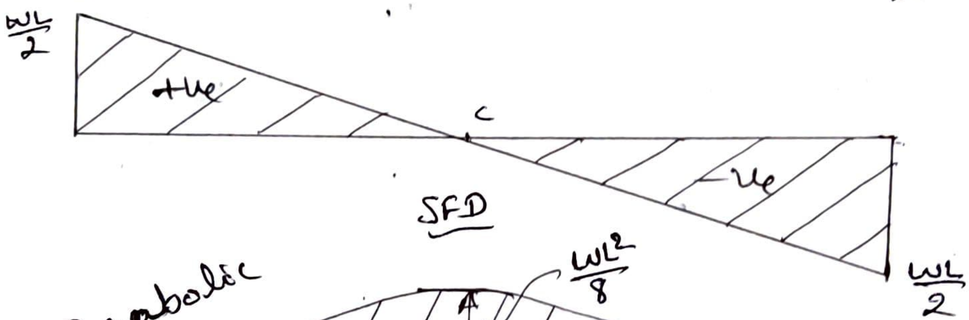
$\Rightarrow$ BM @ $x = \ldots = 0.0961WL^2 - 0.032WL^2 = 0.064WL^2$

$= 0.064WL^2$

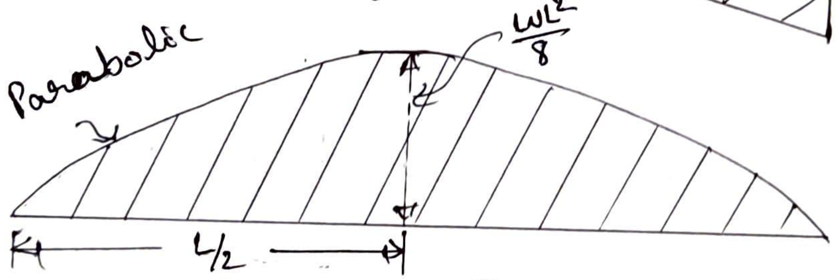
* Simply supported Beam subjected to UDL entire







SFD



BMD

** BM is max at a pt where SF is zero

SFD: SF @ x - x $= \frac{WL}{2} - Wx$

@ $x = 0$, SF @ A $= \frac{WL}{2} - 0 = \frac{WL}{2}$

@ $x = L$, SF @ B $= \frac{WL}{2} - WL = -\frac{WL}{2}$

@ $x = \frac{L}{2}$, SF @ C $= \frac{WL}{2} - \frac{WL}{2} = 0$

BMD: BM @ x - x $= \frac{WL}{2}x - \frac{Wx^2}{2}$

@ $x = 0$, BM @ A $= 0$

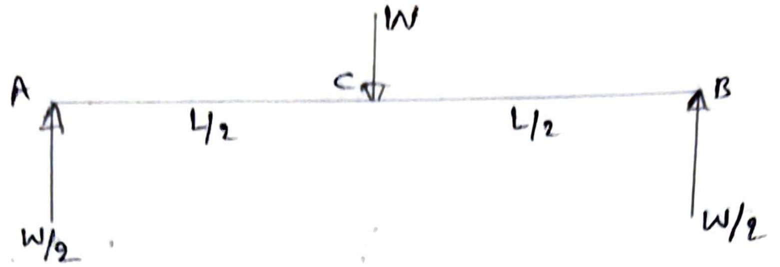
@ $x = L$, BM @ B $= \frac{WL^2}{2} - \frac{WL^2}{2} = 0$

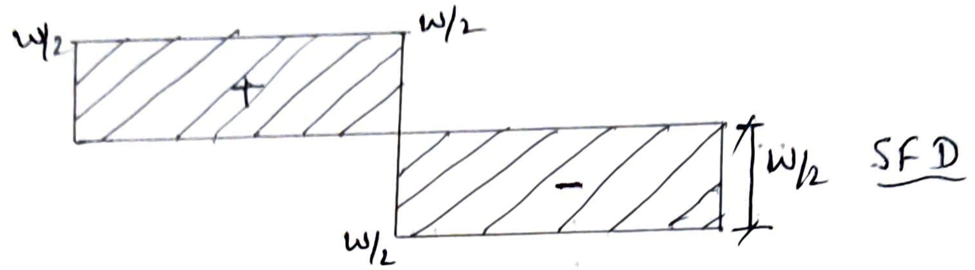
@ $x = \frac{L}{2}$, BM @ C $= \frac{WL \times L}{2 \times 2} - \frac{W}{2} \times \frac{L^2}{4}$

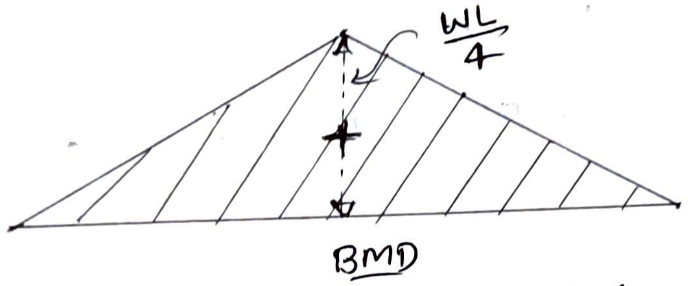
$= \frac{WL^2}{4} - \frac{WL^2}{8}$

$= \frac{2WL^2 - WL^2}{8} = \frac{WL^2}{8}$

: Simply supported beam with point load @ centre







SFD:

$SF @ A = \frac{W}{2}$, $SF @ \text{before } C = \frac{W}{2}$

$SF @ C = \frac{W}{2} - W = \frac{W - 2W}{2} = -\frac{W}{2}$

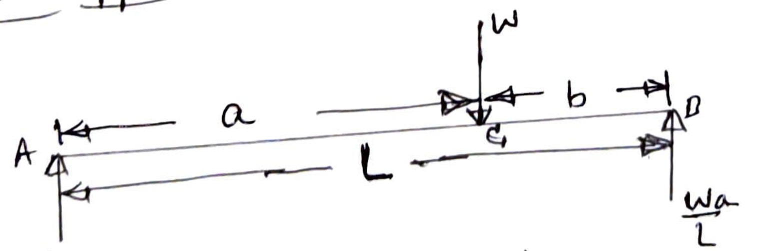
$SF @ \text{before } B = -\frac{W}{2}$, $SF @ B = -\frac{W}{2} + \frac{W}{2} = 0$

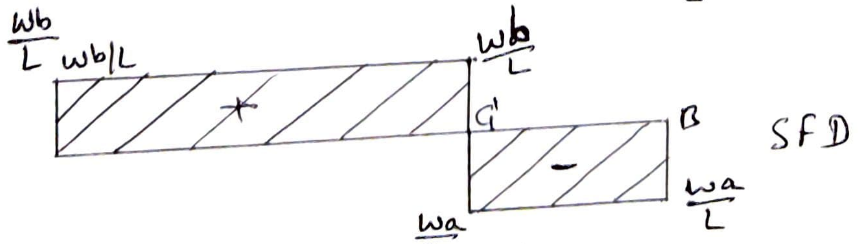
BMD:

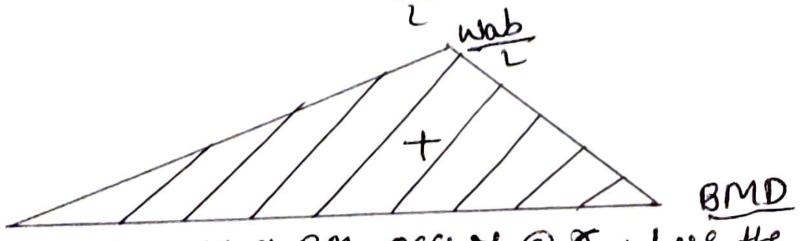
$BM @ A \,\&\, @ B = 0$

$BM @ C = \frac{W}{2} \times \frac{L}{2} = \frac{WL}{4}$

* simply supported beam subjected to eccentric Load







From SFD & BMD Max BM occurs @ C where the SF changes its sign

* Simply supported beam subjected to sev... Point loads