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Subject Structual Analysis I

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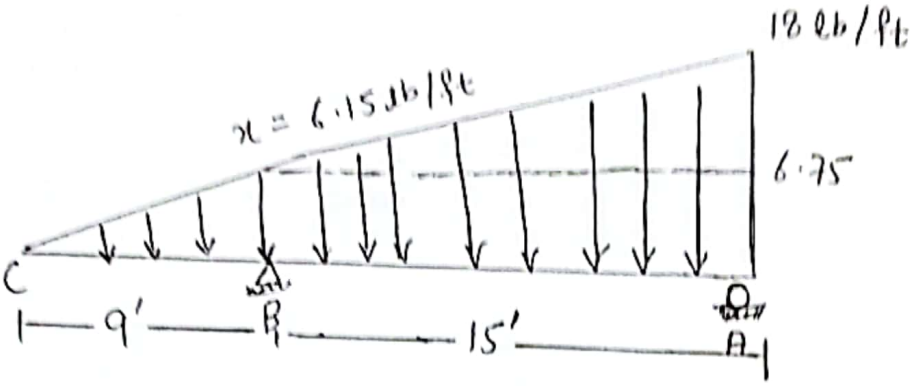
Question no. 1

Draw the shear and bending moment equation and diagrams for the beam shows in fig 1. the value of the uniformity varying load is the last two digits of your registration number

Answer no. 1

Solution :-



By using Similar triangle Method

$$\frac{18}{(15+9)} = \frac{x}{9}$$

$$(18 \times 9) = 24x$$

$$162 = 24x$$

$$x = \frac{162}{24} = 6.75 \text{ lb/ft}$$

$$\sum RA = 0 (RB \times 15) - \left(18 \times \frac{24}{2}\right)\left(\frac{24}{3}\right) = 0$$

$$15RB = 1728$$

$$RB = \frac{1728}{15} = \boxed{115.2 \text{ lb}}$$

$$\sum RB = -(RB \times 15) + (6.75 \times 15)\left(\frac{15}{2}\right) + \left(11.25 \times \frac{15}{2}\right)\left(\frac{2 \times 15}{3}\right) - \left(6.75 \times \frac{9}{2}\right)\left(\frac{9}{3}\right) = 0$$

$$= -15RB + 1512 =$$

$$RA = \frac{1512}{15} = \boxed{100.8 \text{ lb}}$$

(Shear force calculator)

S.F@ C = $\boxed{0}$

S.F@ B = $-(6.75 \times 9)\frac{11}{2}$ = $\boxed{-30.375 \text{ lb}}$

again S.F@ B = $-30.325 + 115.2$

$\boxed{= 84.825 \text{ lb}}$

S.F@ A = $-(18 \times 24)\frac{1}{2} + 115.2$

$= -216 + 115.2$

$\boxed{= -100.8 \text{ lb}}$

again S.F@ B = $-100.8 + 100.8$

$= \boxed{0}$

(Bending Moment Calculation)

B.Mal C = 0

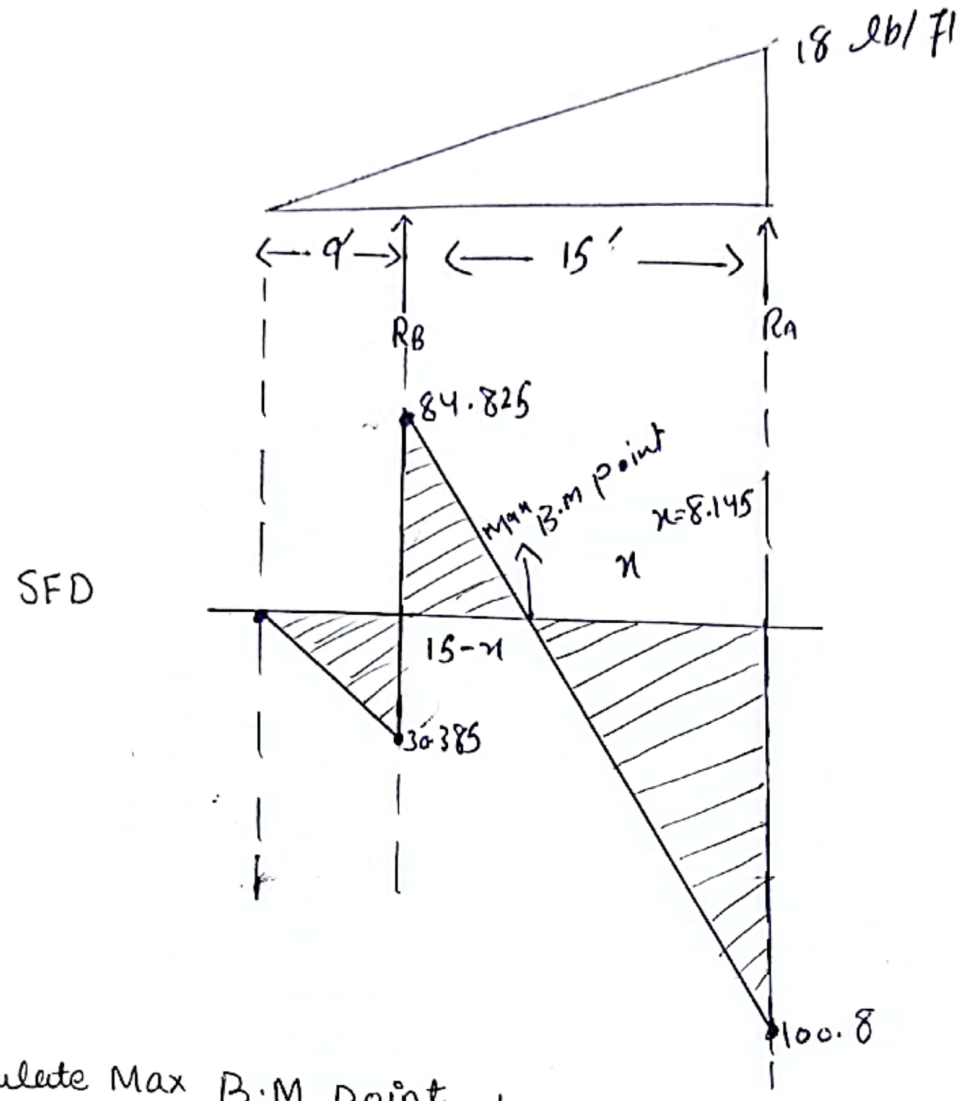
B.Mal B = $(-6.75 \times 9)\frac{9}{3}$ = $\boxed{-182.25 \text{ lb ft}}$

B.Mal A = $(18 \times \frac{24}{2})(\frac{24}{3}) + 115.2 \times 15$

$= -1728 + 1728$

$= \boxed{0 \text{ lb-ft}}$

(3)



Calculate Max B.M point by Similar triangle m

$$\frac{84.825}{15-x} = \frac{100.8}{x}$$

$$84.825x = 1512 - 100.8x$$

$$185.625x = 1512$$

$$\boxed{x = 8.145}$$

Similar Triangle m

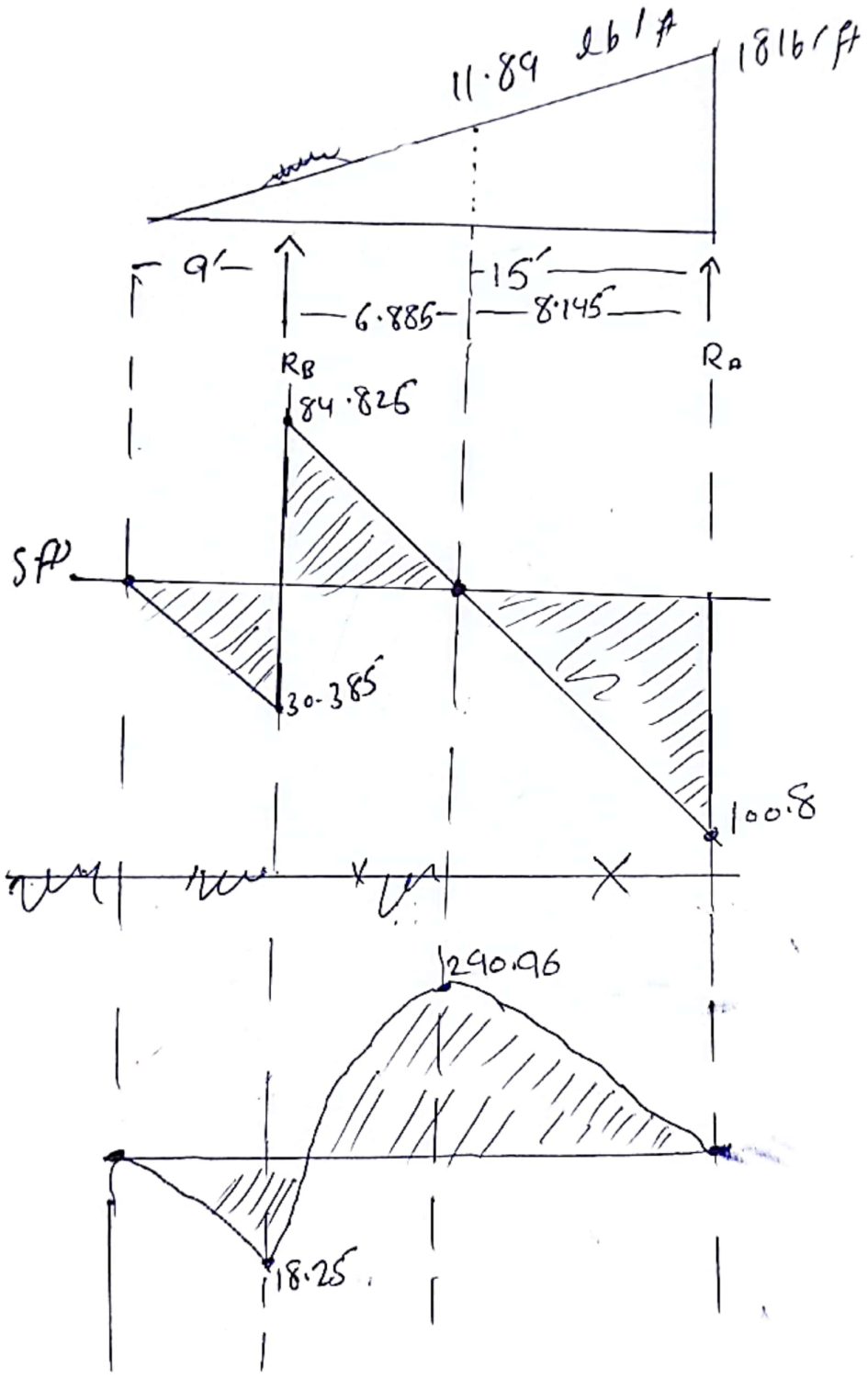
$$\frac{18}{25} = \frac{x}{15.855}$$

$$\boxed{x = 11.89 \text{ lb/ft}}$$

(4)

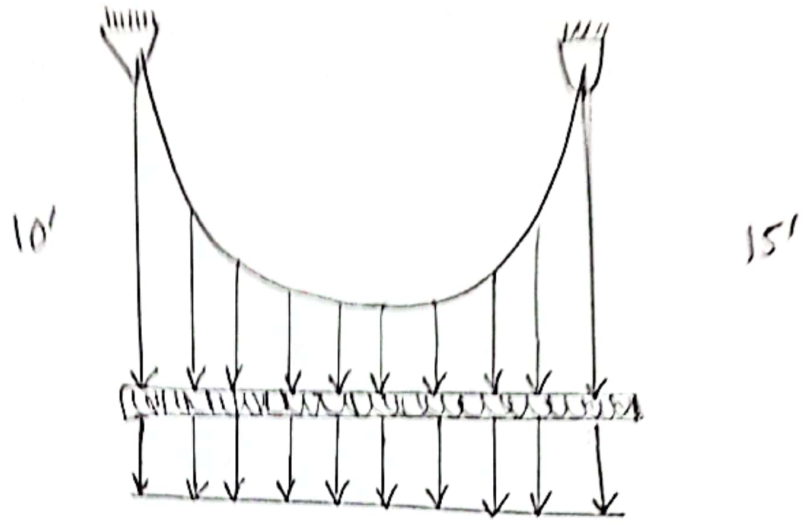
$$B.M @ D = -\left(11.89 \times \frac{15.855}{2}\right)\left(\frac{15.855}{3}\right) + (115.2 \times 6.855)$$

$$B.M @ D = \boxed{290.96 \text{ lb-ft}}$$



Question no: 2

Solution:-



- Cable supports uniform load 918 lb/ft Determine the tension in cable at,

  Support A = ?

  Support B = ?

Solution:-

$$y = \frac{w_o}{2F_H} x^2$$

by putting the value

$$15 = \frac{918}{2F_H} x^2 \quad \text{——(i)}$$

$$10 = \frac{918}{2F_H} (25-x)^2 \quad \text{——(ii)}$$

By Solving both equations

$$F_H = \frac{918}{2(15)} x^2, \quad F_H = \frac{918}{2(10)} (25-x)^2$$

$$F_H = F_H$$

$$\frac{918}{2(15)}x^2 = \frac{918}{2(10)}(25-x)^2$$

$$\frac{918x^2}{30} = \frac{918(125+x^2-2\times 25\times x)}{20}$$

$$\frac{918}{30}x^2 = \frac{918}{20}(125+x^2-50x)$$

$$30.6x^2 = 45.9(125+x^2-50x)$$

$$x^2 = \frac{45.9}{30.6}(125+x^2-50x)$$

$$x^2 = 1.5(125+x^2-50x)$$

$$x^2 = (187.5+1.5x^2-75x)$$

$$15x^2 - x^2 - 75x + 187.5 = 0$$

$$0.5x^2 - 75x + 187.5 = 0 \quad \text{——(i)}$$

Multiply by 2 to get x^2 in regular

$$2(0.5x^2 - 75x + 187.5) = 0$$

$$x^2 - 150x + 375 = 0$$

By Applying quadratic equation, $x_{1/2} = 2.543$

As $F_H = \frac{918}{30}x^2 = \frac{918}{30}(2.543)^2$

$$\boxed{F_H = 197.88 \text{ lb-ft}}$$

$$F_H = \frac{918}{20}(25-x)^2$$

$$= \frac{918}{20}(25-2.543)^2$$

$$\boxed{= 23148.14 \text{ lb-ft}}$$

$$\tan\theta = \frac{918 \times 2.543}{197.88}$$

$$\tan\theta = 197.88$$

$$\theta = \tan^{-1}(197.88)$$

$$\boxed{\theta = 89.71^\circ}$$

Now

$$T_A \sin\theta = w_0 x$$

$$T_A = \frac{w_0 x}{\sin\theta} = \frac{918 \times 2.543}{\sin 89.71}$$

$$\boxed{T_A = 2334.50 \text{ lb}}$$

Now at $x = (25 - 2.543)$

$$x = 22.457$$

$$\tan\theta = \frac{918 \times 22.457}{23148}$$

$$\theta = 41.68^\circ$$

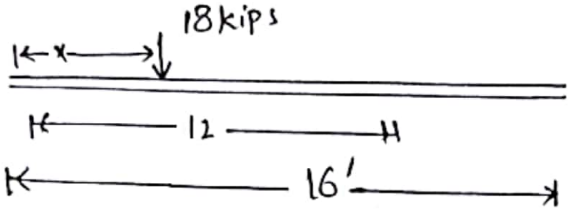
$$T_B = \frac{918 \times 22.457}{\sin 41.68^\circ}$$

$$\boxed{T_B = 31002.20 \text{ lb}}$$

Question no.3

Draw the shear force influence line for beam shown in fig. 3. Also influence line for reaction A.

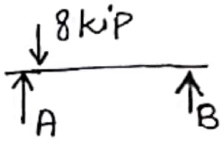
Answer no.3



Solution:-

For $x = 0$

$RA = ?$



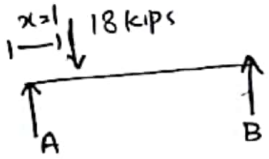
$\circlearrowleft MB_0 = (18 \times 16) - RA(16) = 0$

$= 288 - 16RA = 0$

$RA = \frac{288}{16} = 18$

$RA = 18$ kips

For $x = 1$ ft



$\circlearrowleft MB_0 = (18 \times 15) - RA(16) = 0$

$\Rightarrow 270 - 16RA = 0$

$RA = 16.875$ kips

For $x = 5$

$RA = ?$

$\circlearrowleft MB_0 \quad (18 \times \frac{11}{5}) - RA16 = 6$

$RA = 12.375$ kips

Put $x = 7$ RA = ?

↳ MB = $(18 \times 9) - RA \times 16 = 0$

RA = 10.125 kips

Put $x = 10$ RA = ?

↳ MB = $(18 \times 6) - RA \times 16 = 0$

RA = 6.75 kips

Put $x = 12$ RA = ?

↳ MB = $(18 \times 4) - RA \times 16 = 0$

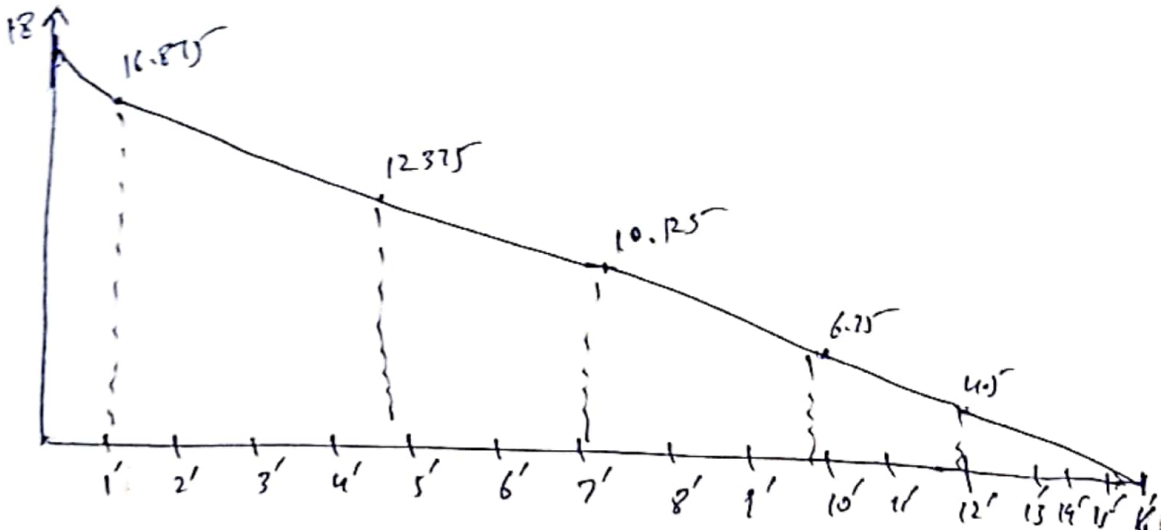
RA = 4.5 kips

Put $x = 16$ RA = ?

↳ MB = $(18 \times 0) - RA \times 16$

$0 - RA$

RA = 0



(Influence line diagram)