PROBLEM 1 DETERMINE THE SHEAR FORCE V AND BENDING MOMENT M AT THE MIDPOINT OF THE SIMPLE BEAM AD SHOWN

GIVEN:

CONSTRAINTS

1) 20 ft BEAM WITH POINT LOAD OF 4 Kips AT 5 ft AND A 2 kip/ft DISTRIBUTED LOAD BETWEEN 10 AND 20 ft
2) A PIN CONSTRAINT IS LOCATED AT A AND A ROLLER CONSTRAINT AT B

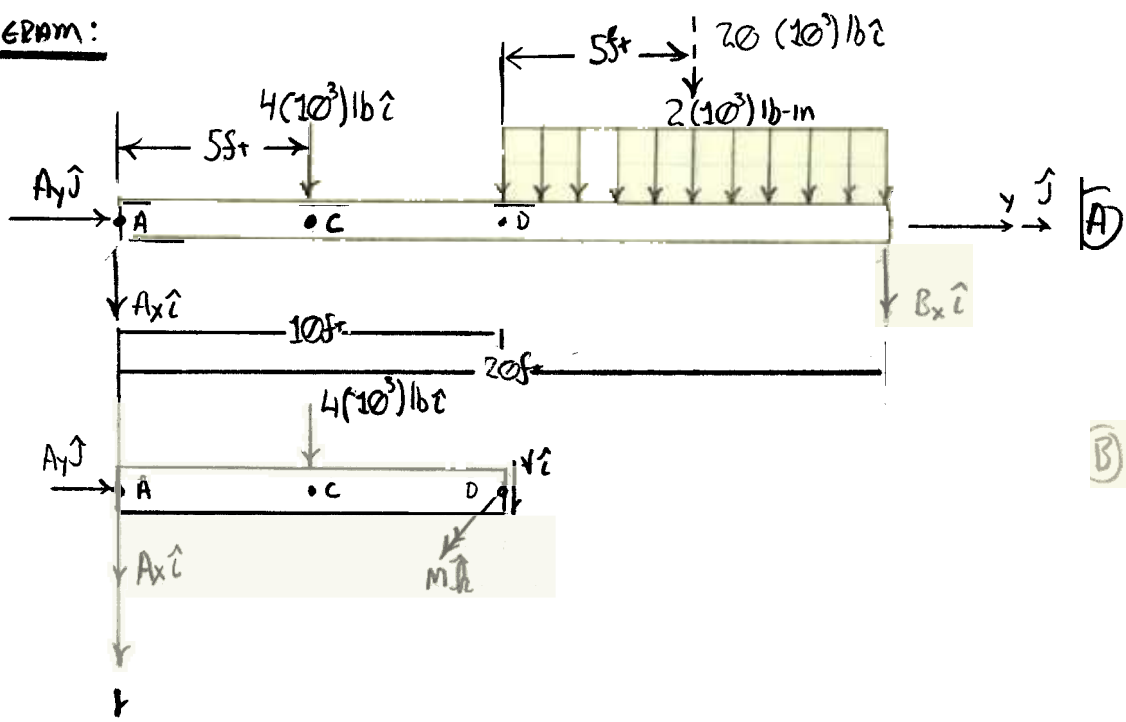
ASSUMPTIONS

1) MATERIAL RESPONSE IS LINEAR-ELASTIC
2) ALL DEFLECTIONS ARE SMALL
3) ALL LOADING IS IDEAL

FIND:

1) SHEAR AND BENDING MOMENT AT THE MIDPOINT OF THE BEAM

FREE BODY DIAGRAM:



MECHANICS:

STARTING BY DETERMINING THE REACTIONS AT A AND B

$$\Sigma F_y = 0 = A_y$$

$$\Sigma F_x = 0 = A_x + B_x + 4(10^3)\,lb + 20(10^3)\,lb = A_x + B_x + 24(10^3)\,lb \quad (1)$$

$$\Sigma M_{z/A} = 0 = -5\,ft \cdot 4(10^3)\,lb - 20(10^3)\,lb \cdot 15\,ft - B_x \cdot 20\,ft$$

$$\Rightarrow \underline{B_x = -16(10^3)\,lb} \quad (2)$$

$$(2) \rightarrow (1) \Rightarrow A_x - 16(10^3)\,lb + 24(10^3)\,lb = 0$$

$$\Rightarrow \underline{A_x = -8(10^3)\,lb} \quad (3)$$

FROM FREE BODY DIAGRAM (B), EQUILIBRIUM CONSIDERATIONS WILL ALLOW US TO DETERMINE THE THE SHEAR AND BENDING MOMENT AT THE MID SECTION.

$$\Sigma F_x = 0 = -8(10^3)\,lb + 4(10^3)\,lb + V = 0 \Rightarrow \boxed{V = 4(10^3)\,lb} \quad (4)$$

$$\Sigma M_{z/AT\,B} = 0 = 4(10^3)\,lb \cdot 5\,ft - 8(10^3)\,lb \cdot 10\,ft + M$$

$$\Rightarrow \boxed{M = 60(10^3)\,ft\text{-}lb}$$

SUMMARY:

THIS PROBLEM REQUEST THE VALUE OF THE SHEAR AND BENDING MOMENT AT A SPECIFIC POINT IN THE STRUCTURE. THIS IS TYPICALLY NOT THE CASE. USUALLY THE POINT WHERE THE SHEAR FORCE AND BENDING MOMENT MUST BE DETERMINED.