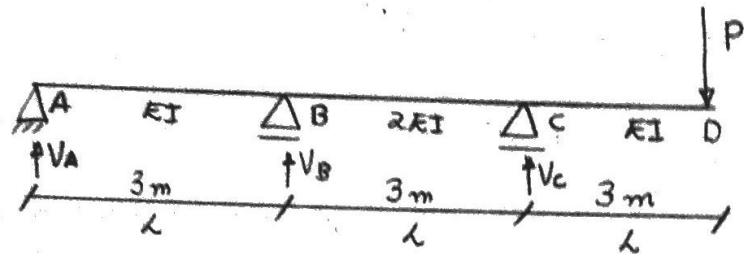


# Exercício 4:

Viga contínua 1x hiperestática

$P = (20+n)$  em KN

↳ último algoritmo não nulo do número USP



→ Traçar o diagrama dos esforços solicitantes

1º) Equações de equilíbrio

$$\sum F_H = 0 \therefore H_A = 0$$

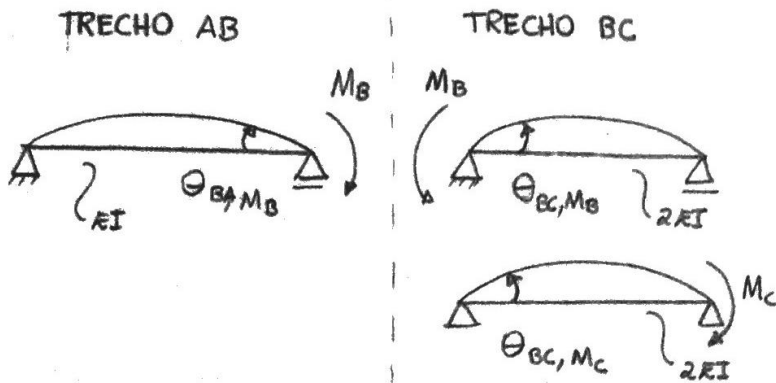
$$\sum F_V = 0 \therefore V_A + V_B + V_C = P$$

$$\sum M_A = 0 \therefore 3V_B + 6V_C - 9P = 0$$

$$V_A + 2V_C = 3P$$

2º) Equação de compatibilidade

$$\theta_{B,AB} = \theta_{B,BC}$$



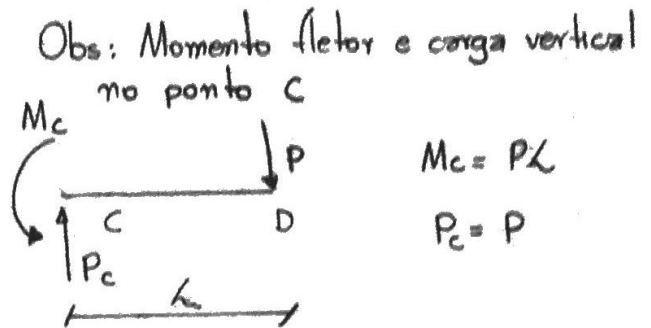
Eq. de compatibilidade no apoio B:

$$\theta_{BA,MB} = -\frac{M_B l}{3EI} \quad ; \quad \theta_{BC,MB} = +\frac{M_B l}{3(2EI)}$$

$$\theta_{BC,Mc} = +\frac{M_C l}{6(2EI)}$$

Logo,  $-\frac{M_B l}{3EI} = +\frac{M_B l}{3(2EI)} + \frac{M_C l}{6(2EI)}$

$$-\frac{M_B}{3} = \frac{M_B}{6} + \frac{Pl}{12} \therefore M_B = -\frac{Pl}{6}$$

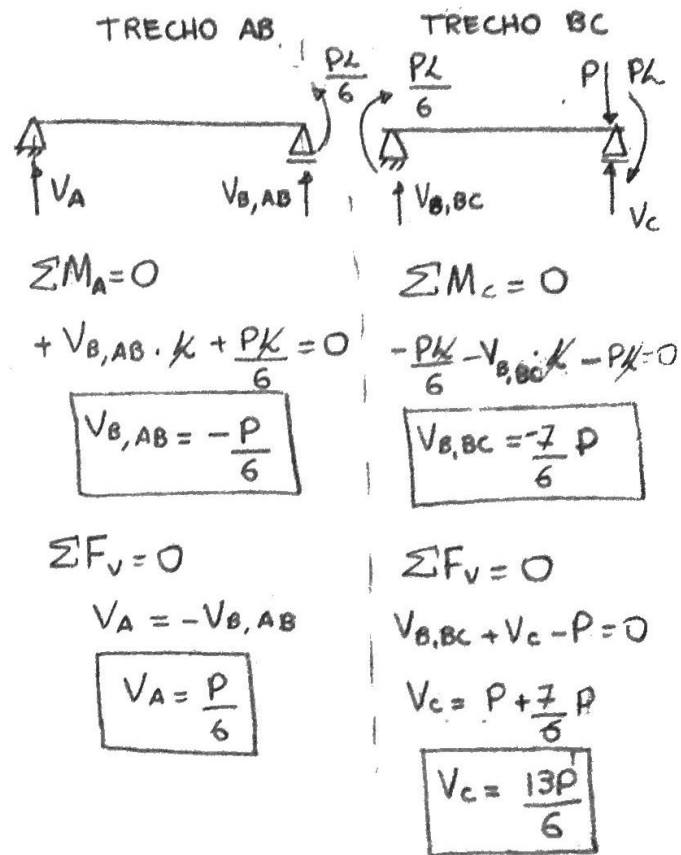


$$M_C = Pl$$

$$P_C = P$$

Continua...

3º) Equilíbrio dos trechos:



$$\sum M_A = 0$$

$$+V_{B,AB} \cdot l + \frac{Pl}{6} = 0$$

$$V_{B,AB} = -\frac{P}{6}$$

$$\sum F_V = 0$$

$$V_A = -V_{B,AB}$$

$$V_A = \frac{P}{6}$$

$$\sum M_C = 0$$

$$-\frac{Pl}{6} - V_{B,BC} \cdot l - Pl = 0$$

$$V_{B,BC} = -\frac{7P}{6}$$

$$\sum F_V = 0$$

$$V_{B,BC} + V_C - P = 0$$

$$V_C = P + \frac{7P}{6}$$

$$V_C = \frac{13P}{6}$$

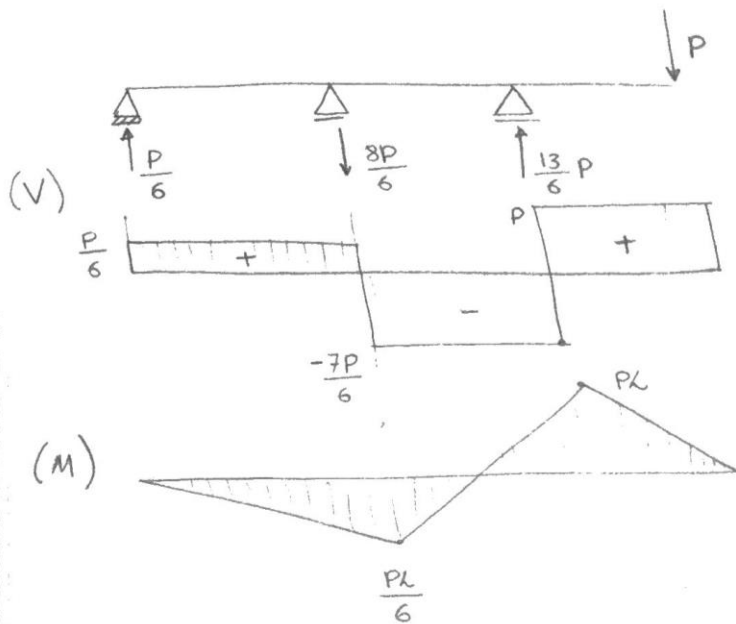
$$V_B = V_{B,AB} + V_{B,BC}$$

$$V_B = -\frac{P}{6} - \frac{7P}{6}$$

$$V_B = -\frac{8P}{6}$$

Continua

4º) Diagrama de esforços solicitantes



n	P (kN)	$M_C$	$M_B$	$V_A$	$V_{BA}$	$V_{BC}$	$V_B$	$V_C$
1	21	63	-10,5	3,5	-3,5	-24,5	-28,0	45,5
2	22	66	-11,0	3,7	-3,7	-25,7	-29,3	47,7
3	23	69	-11,5	3,8	-3,8	-26,8	-30,7	49,8
4	24	72	-12,0	4,0	-4,0	-28,0	-32,0	52,0
5	25	75	-12,5	4,2	-4,2	-29,2	-33,3	54,2
6	26	78	-13,0	4,3	-4,3	-30,3	-34,7	56,3
7	27	81	-13,5	4,5	-4,5	-31,5	-36,0	58,5
8	28	84	-14,0	4,7	-4,7	-32,7	-37,3	60,7
9	29	87	-14,5	4,8	-4,8	-33,8	-38,7	62,8