

Istituto B. MARSANO - GENOVA S. ILARIO



Rifacimento tetto VILLA MARSANO

Calcoli statici

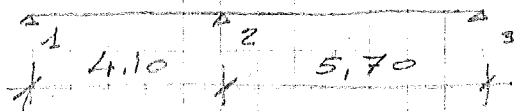
Solaio sottotetto

Carichi agenti

Peso proprio	0.25 t/mq
" pavim. e intonaco	0.08 "
	<u>0.33 t/mq</u>

Sovraccarico 0.17 t/mq

Schema di calcolo



$$M_{1-2} = (0.0465 \times 0.33 + 0.1003 \times 0.17) \times 4.10^2 = 0.54 \text{ tm}$$

$$H_2 = -0.5 \times 0.195 \times 4.10^2 = -1.64 \text{ tm} \quad \text{per } b = 100 \text{ cm}$$

$$b' = 18 \text{ cm} \quad x = 4.70 \text{ cm} \quad \sigma_c = 43 \text{ Kg/cm}^2 \quad f_c = 5,5 \text{ cm}$$

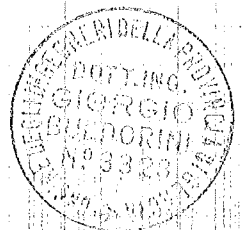
$$M_{2-3} = (0.1572 \times 0.33 + 0.1788 \times 0.17) \times 4.10^2 = 1.38 \text{ tm}$$

$$R_1 = (0.305 \times 0.33 + 0.4479 \times 0.17) \times 4.10 = 0.72 \text{ t}$$

$$R_2 = 1.5343 \times 0.5 \times 4.10 = 3.15 \text{ t}$$

$$R_3 = (0.5607 \times 0.33 + 0.5979 \times 0.17) \times 4.10 = 1.19 \text{ t}$$

Redazione



TRAVE DI SOSTEGNO SOLAIO

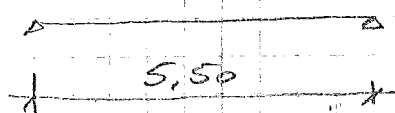
Carichi agenti

Peso proprio trave. $0,30 \times 0,50 \times 2,5 = 0,38 \text{ t/m}$

Reazione solai

$$\frac{3,15}{3,53} \text{ t/m}$$

Scheme di calcolo



$$M = 3,53 \times 5,50^2 \times 0,125 = 13,35 \text{ tm per } b = 70 \text{ cm}$$

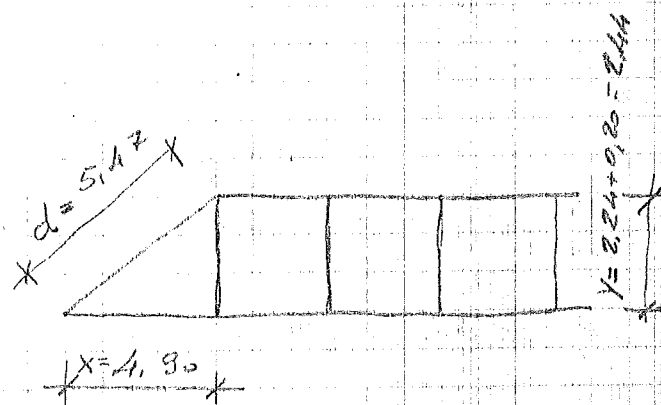
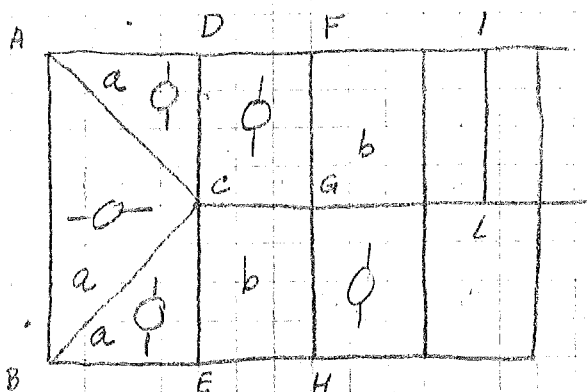
$$h' = 55 \text{ cm} \quad z = 15,5 \text{ cm} \quad \sigma_c = 50 \text{ Kg/cm}^2 \quad F_c = 14,2 \text{ cm}^2$$

$$\sigma_f = 1800 \text{ Kg/cm}^2$$

$$R = 3,53 \times 5,50 \times 0,5 = 9,71 \text{ t} \quad \sigma = \frac{9710}{30 \times 55 \times 0,9} = 66 \text{ Kg/cm}^2$$

$$T_{sf} = \phi 8/20 \quad F_p = 2,64 \text{ cm}^2$$

Solaio di copertura : solette a



$$\text{avendo } x = (10,30 + 9,30) \times 0,5 \times 0,5 = 4,90 \text{ m}, \quad y = 2,44 \text{ m}$$

$$\text{risulta } d = 5,17 \text{ m}$$

Carichi agenti

$$\text{Peso proprio } 0,25 \text{ t/m}$$

$$\begin{array}{rcl} & & 0,25 \\ \text{tegole} & & 0,05 \text{ t/m}^2 \\ \text{intonaco} & & 0,05 \text{ t/m}^2 \\ & & \hline & & 0,30 \end{array}$$

sovraccarico $0,10 \text{ t/m}^2$

$$q = 0,40 \times \frac{5,47}{4,9} = 0,45 \text{ t/m}$$

$$M = 0,45 \times 4,9^2 \times 0,125 = 1,34 \text{ tm} \quad \text{solai tipo Celerap}$$

TR 38/50 $h = 16,5 + 3,5$ trav. tipo 6

$$R = 0,45 \times 4,9 \times 0,5 = 1,10 \text{ t}$$

Travi B-C ; A-C

Carchi agenti

Peso proprio $0,30 \times 0,50 \times 2,5 = 0,38 \text{ t/m}$

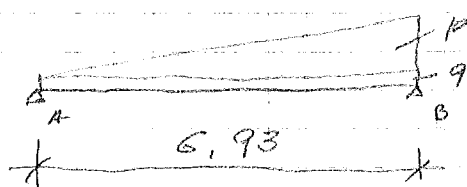
Reazione solai $p = 1,10 \times 2 = 2,20 \text{ t/m}$

essendo $L = \sqrt{(4,9 \times 1,41)^2 + 2,44^2} = 7,35 \text{ m}$

risultati:

$$q = \frac{0,38 \times 7,35}{6,93} = 0,40 \text{ t/m}$$

Schema di calcolo



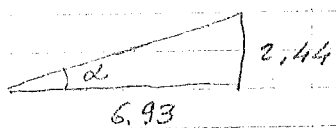
$$M = 0,06415 \times 2,20 \times 6,93^2 + 0,4 \times 6,93^2 \times 0,125 = 9,20 \text{ tm}$$

$$R_A = \frac{2,20 \times 6,93}{6} + 0,4 \times 6,93 \times 0,5 = 3,93 \text{ t}$$

$$R_B = 6,47 \text{ t}$$

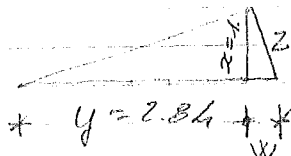
Verifiche ed orditura

Calcolo di w

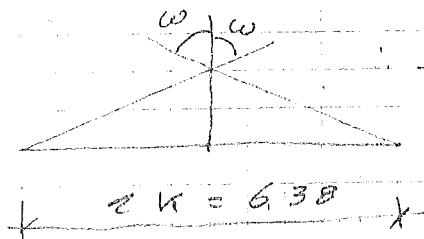


$\alpha = 19.40$ per $x = 1 \text{ m}$ $y = 2.84 \text{ m}$

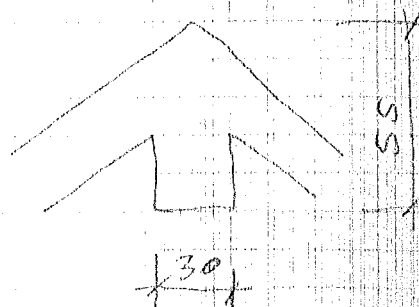
risulta $z = 1.06 \text{ m}$ $w = 0.35 \text{ m}$



$y + w = 3.19 = k$



$w = 71.63$



$$x^3 + 3\pi x + 2\Delta = 0$$

$\delta = 2 \lg w = 6.02$ $\pi = \frac{30}{6.02} \times 14 = 69.75$

$\Delta = -\frac{15}{6.02} \times 14 \times 50 = 5230.70$

$w = 69.75 \sqrt{69.75 + 2.25 \times 50^2} = 5263.43$

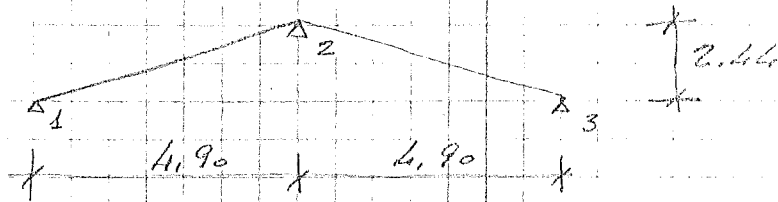
$x = 18.69$

$\sigma_c = \frac{6 \times 920000}{6.02 \times 18.69^2 \left(50 - \frac{18.69}{2}\right)} = 64.54 \text{ Kg/cm}^2$

$\sigma_s = \frac{920000}{14 \left(50 - \frac{18.69}{2}\right)} = 1617 \text{ Kg/cm}^2$

$R_{max} = 6.17 \text{ t}$ $\tau = \frac{6470}{28 + 45} = 5.33 \text{ Kg/cm}^2$

Soletta b



$$q_1 = 0.30 \times \frac{5.147}{4.9} = 0.33 \text{ t/m}^2 \quad p_1 = 0.10 \times \frac{5.147}{4.90} = 0.12 \text{ t/m}^2$$

$$R_1 = 0.33 \times 0.375 \times 4.9 + 0.437 \times 0.12 \times 4.9 = 0.86 \text{ t/me (1.108)}$$

$$H_{1-2} = \frac{0.33 \times 4.9^2}{14.3} + \frac{0.12 \times 4.9^2}{10.4} = 0.83 \text{ tm}$$

$$H_2 = -0.45 \times 4.9^2 \times 0.125 = -1.35 \text{ tm per } b=100 \text{ cm } b \leq 180 \text{ cm}$$

$$x = 4.30 \text{ cm} \quad \sigma_c = 38 \text{ kg/cm}^2 \quad f_o = 4.5 \text{ comp} \quad \sigma_g = 1310 \text{ kg/cm}^2$$

$$R_2 = 0.625 \times 0.45 \times 4.9 \times 2 = 2.76 \text{ t}$$

TAVOLA 1-L

Carichi agenti

$$\text{Peso proprio trave} \quad 0.30 \times 0.40 \times 2.5 = 0.30 \text{ t/me}$$

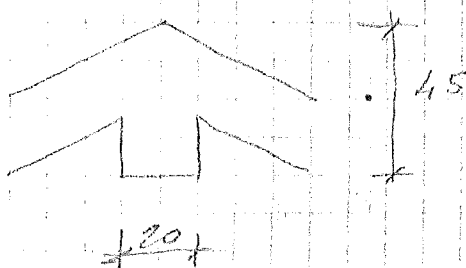
$$\text{Peso sfera e sovraccarico} \quad 0.45 \times 3.6 \times 0.5 = 0.77 \text{ "}$$

$$1.07 \text{ "}$$

$$H = 1.07 \times 4.90^2 \times 0.125 = 3.20 \text{ tm}$$

$$R = 1.07 \times 4.90 \times 0.5 = 2.62 \text{ ton}$$

Verifiche ed oscillazione



$$\delta = 2 \lg w = 4 \quad \pi = 41.25$$

$$w = 2689.11 \quad \Delta = -24.75$$

$$x = 14.60 \text{ cm}$$

$$\sigma_c = \frac{6 \times 320\,000}{4 \times 14,6^2 (40 - 7,3)} = 68,9 \text{ kg/cm}^2$$

$$\sigma_s = \frac{320\,000}{5,5 \times 32,7} = 1780 \text{ kg/cm}^2$$

$$R = 2,62 \text{ ton} \quad \tau = \frac{2620}{18 \times 35} = 4,16 \text{ kg/cm}^2$$

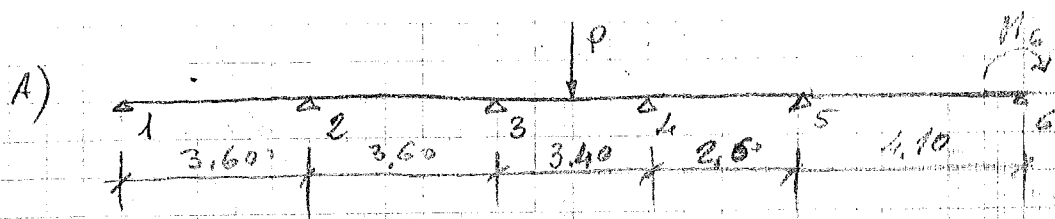
Trave di colmo.

Carichi agenti.

1^a, 2^a, 4^a, 5^a Campate peso proprio $0,30 \times 0,50 \times 2,50 = 0,38 \text{ t/m}$
 reazioni solette $\frac{2,76}{3,14}$

3^a Campata peso proprio $0,38 \text{ t/m}$
 carico concentrato $P = 2,62 \text{ t}$

Schema di calcolo



$$M_6 = -5,43 \text{ tm}$$

Sollecitazioni risultanti.

$$R_1 = 4,40 \text{ t} \quad M_{1-2} = 3,09 \text{ tm} \quad T_{2-1} = 6,90 \text{ t} \quad M_2 = -6,69 \text{ tm}$$

$$T_{2-3} = 6,24 \text{ t} \quad R_2 = 13,44 \text{ t} \quad M_{2-3} = 1,21 \text{ tm} \quad T_{3-2} = 5,07 \text{ t} \quad M_3 = -2,39 \text{ tm}$$

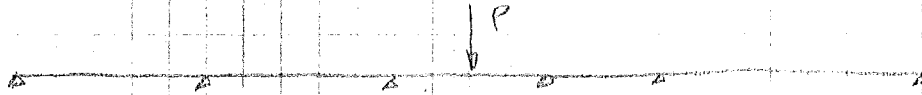
$$T_{3-4} = 3,45 \text{ t} \quad R_3 = 8,52 \text{ t} \quad M_{3-4} = 0,71 \text{ tm} \quad T_{4-3} = 3,08 \text{ t} \quad M_4 = -1,75 \text{ tm}$$

$$T_{4-5} = 4,21 \text{ t} \quad R_4 = 7,99 \text{ t} \quad M_{4-5} = 1,28 \text{ tm} \quad T_{5-4} = 2,95 \text{ t} \quad M_5 = -1,41 \text{ tm}$$

(7)

$$T_{5-6} = 5,466 \quad R_5 = 9,61 \quad M_{5-6} = 3,33 \quad R_6 = 7,126 \quad M_6 = -5,43 \text{ tm}$$

B)



sollecitazioni sui tratti

$$R_1 = 4,42 \quad M_{1-2} = 3,11 \text{ tm} \quad T_{2-1} = 6,34 \quad M_2 = -4,44 \text{ tm}$$

$$T_{1-3} = 6,16 \quad R_2 = 13,05 \quad M_{2-3} = 1,61 \text{ tm} \quad T_{3-2} = 5,14 \quad M_3 = -2,6 \text{ tm}$$

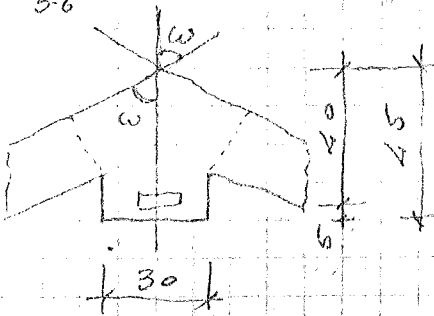
$$T_{3-4} = 3,76 \quad R_3 = 8,90 \quad M_{3-4} = 1,07 \text{ tm} \quad T_{4-3} = 2,77 \quad M_4 = -0,93 \text{ tm}$$

$$T_{4-5} = 2,56 \quad R_4 = 5,33 \quad M_{4-5} = 0,11 \text{ tm} \quad T_{5-4} = 5,61 \quad M_5 = -4,89 \text{ tm}$$

$$T_{5-6} = 7,63 \quad R_5 = 13,24 \quad M_{5-6} = 4,38 \text{ tm} \quad R_6 = 5,74 \quad T_6 =$$

Verifica ex armatura ferro

$$M_{5-6} = 4,38 \text{ tm}$$



$$\delta = 2 \lg w = 2 \times \frac{4,90}{2,15} = 4$$

$$\Pi = \frac{2 \times 15}{4} \times 7,70 = 57,75$$

$$\Delta = -\frac{8 \times 15}{4} \times 7,70 \times 40 = -34,65$$

$$w = 57,75 \sqrt{57,75 + 2,25 \times 10^2} = 34,92,68$$

$$ze = 16,07 \text{ cm}$$

$$\sigma_c = \frac{6 \times 438000}{4 \times 16,07^2 \left(\frac{40 - 16,07}{2} \right)} = 79,63 \text{ Kg/cm}^2$$

$$\sigma_f = \frac{438000}{7,70 \times 31,97} = 1780 \text{ Kg/cm}^2$$

(3)

$$- M_{2-3} = 1,71 \text{ tm} \quad \delta = 4,0 \quad \Pi = 7,5 \times 3,3 = 24,75$$

$$\Delta = -1485 \quad u = 1490,10 \quad x = 12,66 \text{ cm}$$

$$\sigma_c = \frac{6 \times 171000}{4 \times 12,66^2 (40 - 6,33)} = 47,5 \text{ Kgf/cm}^2$$

$$\sigma_f = \frac{171000}{3,30 (40 - 6,33)} = 1540 \text{ Kgf/cm}^2$$

$$- M_{1-2} = 3,11 \text{ tm} \quad \delta = 4,0 \quad \Pi = 7,5 \times 5,5 = 41,25$$

$$\Delta = -2475 \quad u = 2489,14 \quad x = 14,6 \text{ cm}$$

$$\sigma_c = \frac{311000 \times 6}{4 \times 14,6^2 (40 - 7,3)} = 66,90 \text{ Kgf/cm}^2$$

$$\sigma_f = \frac{311000}{5,50 \times 32,7} = 1730 \text{ Kgf/cm}^2$$

$$M_6 = -5,43 \text{ tm} \quad \text{per } b = 30 \text{ cm} \quad h' = 40 \text{ cm} \quad x = 14,7 \text{ cm}$$

$$\sigma_c = 71 \text{ Kgf/cm}^2 \quad F_c = 8,5 \text{ cm}^2 \quad \sigma_f = 1820 \text{ Kgf/cm}^2$$

$$M_5 = -4,89 \text{ tm} \quad x = 14 \text{ cm} \quad \sigma_c = 66 \text{ Kgf/cm}^2 \quad F_c = 7,5 \text{ cm}^2 \quad \sigma_f = 1845 \text{ Kgf/cm}^2$$

$$M_3 = -2,60 \text{ tm} \quad x = 10,8 \text{ cm} \quad \sigma_c = 45 \text{ Kgf/cm}^2 \quad F_c = 4 \text{ cm}^2 \quad \sigma_f = 1800 \text{ Kgf/cm}^2$$

$$M_2 = -4,49 \text{ tm} \quad x = 13,6 \text{ cm} \quad \sigma_c = 63 \text{ Kgf/cm}^2 \quad F_c = 7 \text{ cm}^2 \quad \sigma_f = 1810 \text{ Kgf/cm}^2$$

$$T_{2-1} = 6,90 \text{ t} \quad \sigma = 6,39 \text{ Kgf/cm}^2 \quad F_{st} = 148/20 \quad F_p = 1,20 + 1,0$$

$$T_{3-2} = 5,07 \text{ t} \quad \sigma = 4,69 \text{ Kgf/cm}^2$$

$$T_{5-4} = 5,61 \text{ t} \quad \sigma = 5,19 \text{ Kgf/cm}^2$$

$$T_{5-6} = 7,63 \text{ t} \quad \sigma = 7,06 \text{ Kgf/cm}^2 \quad F_{st} = 410/25 \quad F_p = 1,2 + 1,0$$

(9)

$$R_c = 7.42 \text{ t} \quad v = 6.87 \text{ kg/cm}^2 \quad \delta_p = 1.2 + 1.0 \quad \text{Est} = \phi 14/25$$

Telaio sotto l'appoggio 1

Carichi agenti

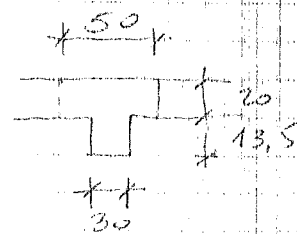
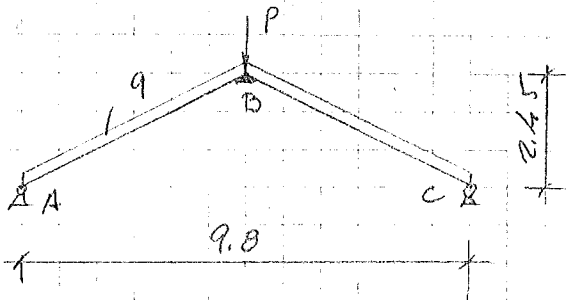
Peso proprio telaio 0.38 t/m

Risposta telaio 0.45 t

$$q = 0.83 \text{ t}$$

$$P = 4.42 + 6.47 \times 2 = 17.36 \text{ t}$$

Schema di calcolo



$$J = 120360 \text{ cm}^4$$

$$M_B = -\frac{0.83 \times 9.8^2}{32} + \frac{3 \times 2100000 \times 0.001 \times 0.000012 \times 30 \times 9.8}{2 \times 5.48 \times 2.45} = -3.32 \text{ tm}$$

$$M_{max} = \frac{9 \times 0.83 \times 9.8^2}{512} + \frac{0.83 \times 2 \times 1.84}{9.8} = 1.71 \text{ tm}$$

$$V_A = V_C = 0.83 \times 9.8 \times 0.5 + \frac{0.83}{2.45} + 17.36 \times 0.5 = 13.09 \text{ t}$$

$$H_A = H_C = \frac{5 \times 0.83 \times 9.8^2}{32 \times 2.45} + \frac{17.36 \times 9.8}{4 \times 2.45} = 22.44 \text{ t} \quad N = 25.98 \text{ t}$$

$$T = \frac{0.83 \times 9.8^2 \times 3}{2 \times 5.48 \times 16} = 1.36 \text{ t}$$

Verifiche ed orditure

Per $b = 50 \text{ cm}$ $b_0 = 30 \text{ cm}$ $h' = 30 \text{ cm}$ $\text{ti} \cdot R_e$

$M_B = -3.32 \text{ tm}$ $x = 12.5 \text{ cm}$ $\sigma_c = 71 \text{ kg/cm}^2$ $F_e = 7.5 \text{ cm}^2$ $\sigma_f = 1700 \text{ kg/cm}^2$

$M_{max} = 1.71 \text{ tm}$ $x = 7 \text{ cm}$ $\sigma_c = 36 \text{ kg/cm}^2$ $F_e = 3.5 \text{ cm}^2$ $\sigma_f = 1770 \text{ kg/cm}^2$

$$H = 22.44 \text{ t}$$

$$F_0 = \frac{22.44}{1.2} = 18.70 \text{ comp}$$

Verificare a pressoflessione

$$\text{Per } N = 25.98 \text{ t} \quad H = 3.32 \text{ ton} \quad F_0 = 7.5 \text{ comp.} \quad F_0' = 3.5 \text{ comp}$$

$$e = 12.78 \text{ cm}$$

$$y^3 - 3 \times 3.97 x^2 + \frac{90}{30} (7.5 \times 26.53 + 3.5 \times 0.97) - 3 (7.5 \times 26.53 \times 30.5 + 3.5 \times 0.97 \times 3) = 0$$

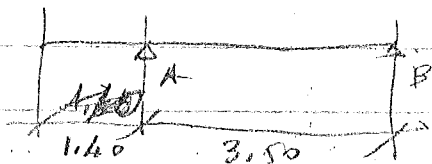
$$y^3 + 11.91 x^2 + 607.11 \times x - 18236.77 = 0$$

$$y = 22 \text{ cm}$$

$$\sigma_c = \frac{2 \times 25980 \times 26.53}{30 \times 22 \left(30.5 - \frac{22}{3} \right) + 30 \times \frac{19}{22} \times 3.5 (30.5 - 3)} = 77.5 \text{ Kg/cm}^2$$

$$\sigma_f = 15 \times 77.5 \left(\frac{30.5 - 22}{22} \right) = 450 \text{ Kg/cm}^2$$

Schema di calcolo



Carico agente $0.2 \times 0.4 \times 9.5 = 0.76 \text{ t/m}$

Solito e carico $0.45 \times 3.4 \times 9.5 = 1.45 \text{ t}$

0.97 t

$M_A = 0.97 \times 1.40^2 \times 0.5 = -0.95 \text{ tm}$

$M_{AB} = (0.33 \times 1.7 + 0.2) \times 0.125 \times 3.5^2 \left(1 - \frac{1.4^2}{3.5^2}\right) + 0.21 \times 3.5^2 \times 0.125 = 1.03 \text{ tm}$

$R_A = 0.5 \times 0.97 \times 3.5 \left(1 + 2 \times \frac{1.4}{3.5} + \frac{1.4^2}{3.5^2}\right) = 3.33 \text{ t}$

Trave trapezoidale

Carico agente

$0.10 \times 0.6 \times 2.5 = 0.15 \text{ t/m}$

$P = 3.33 \text{ t}$

$M = 0.15 \times 3.4^2 \times 0.125 + 3.33 \times 3.4 \times 0.26 = 3.26 \text{ tm}$ per $b = 20 \text{ cm}$

$h' = 35 \text{ cm}$ $\sigma_c = 78 \text{ Kg/cm}^2$ $F_c = 6 \text{ cm}^2$

$T = 3.33 \times 0.5 + 0.15 \times 3.4 \times 0.5 = 2.18 \text{ t}$

$\sigma = 34.5 \text{ Kg/cm}^2$

De Rosa

