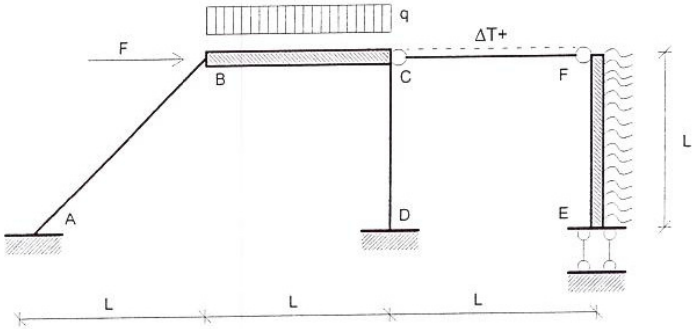
Università degli Studi di Salerno – Facoltà di Ingegneria
Corso di Tecnica delle Costruzioni I – Nuovo Ordinamento
Anno accademico 2008-2009
2ª Prova scritta intracorso - 10/07/2009

Esercizio n. 1 (Punti 10)
Si costruiscano i diagrammi delle Caratteristiche della Sollecitazione (N, V ,M) per la struttura rappresentata nella figura. Si assuma:

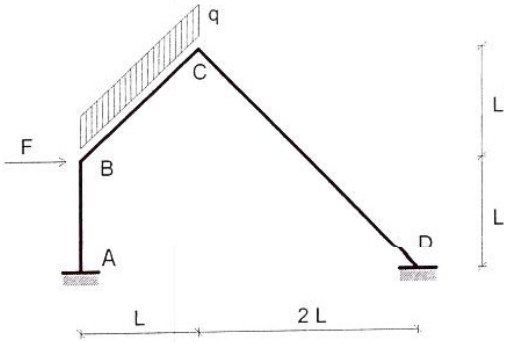
L=3.0+0.05(C-N) [m];
H=0.5 L
L_p=L/2
$\Delta T = +20°$
$\alpha = 10^{-5}\ °C^{-1}$

b_t=b_p=30 cm
h_t=h_p=50+0.05(N-C) [cm]
q=50.0+ (C-N) [kN/m]

F=qL/10
E_c=28848 MPa
A_p=900 cm^2



Esercizio n. 2 (Punti 10)
Si analizzi la struttura rappresentata nella figura e se ne traccino i diagrammi del momento flettente e del taglio.

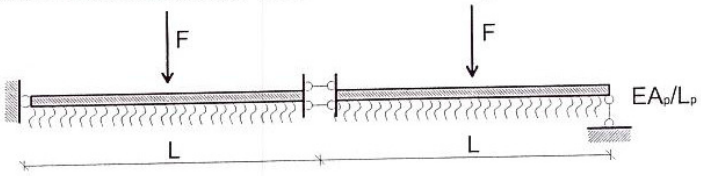


L = 300 + 12 *N* - 8 *C* cm;
Sezione asta AB e CD
b_t= 30 cm; h_t= (40 +*N*) cm;

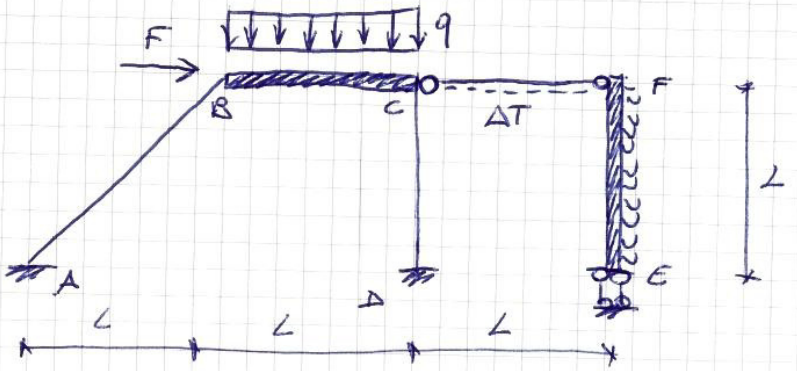
Sezione asta BC
b_t= 30 cm; h_t= 40 cm;

F = 200 - 6 *N* kN
q = 2 F/L
R_{ck} = 25.0 MPa

Esercizio n. 3 (Punti 10)
Si calcolino gli spostamenti e costruiscano i diagrammi delle Caratteristiche della Sollecitazione per la trave di fondazione riportata in figura. Si assuma k_0=0.01 N/mm^3 nonché i valori numerici delle grandezze geometriche e meccaniche dell'esercizio n. 1 con L_p = L /10.



Esercizio 1 del 10/07/2009



$L = 4\ m$ $\quad q = 50\ kN/m$ $\quad k_0 = 0{,}01\ N/mm^3$

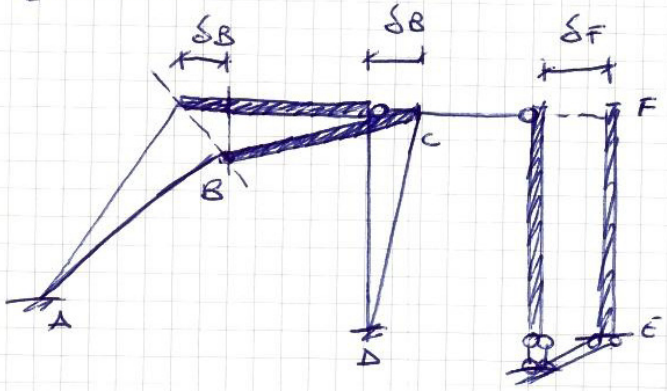
$\Delta T = 20°C$ $\quad F = 40\ kN$ $\quad B = 100\ cm$

$\alpha = 0{,}00001$ $\quad E_c = 30000\ MPa$

$b = 30\ cm$

$h = 50\ cm$ $\quad A_p = 900\ cm^2$

Cinematismo

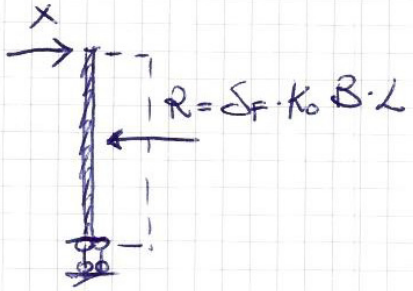


	δ'_B
δ_{AB}	$\sqrt{2}$
δ_{BC}	-1
δ_{CD}	1

$$\delta_B - \delta_F = \frac{X L_y}{E A_p} - \alpha \Delta T L_y$$

$$\varphi_B = \frac{\delta_{BC}}{L} = -\frac{\delta_B}{L}$$

$$\varphi_C = \frac{\delta_{BC}}{L} = -\frac{\delta_B}{L}$$



$$\Rightarrow X = \delta_F \cdot k_0 \cdot B \cdot L$$

da cui:

$$\delta_B - \delta_F = \frac{\delta_F K_0 B L \cdot L}{E A_p} - \alpha \Delta T L_p$$

$$\delta_B - \delta_F = \frac{K_0 B L^2}{E A_p}\delta_F - \alpha \Delta T L_p$$

$$\delta_F \left(\frac{K_0 B L^2}{E A_p} + 1\right) = \delta_B - \alpha \Delta T L_p$$

$$\delta_F = \delta_B \left(\frac{1}{\frac{K_0 B L^2}{E A_p} + 1}\right) - \alpha \Delta T L_p$$

$$\delta_F = 0{,}944\,\delta_B - 0{,}8$$

Eq. risolutiva PLV.

$$\frac{M_{AB}+M_{BA}}{\sqrt{2}L}\delta'_{AB} + \frac{M_{BC}+M_{CB}}{L}\delta'_{BC} + \frac{M_{CD}+M_{DC}}{L}\delta_{CD} + F\delta'_B - X\delta'_B + \frac{qL}{2}\frac{\delta'_B}{0} =$$

$$\frac{M_{AB}+M_{BA}}{\sqrt{2}L}\cdot\sqrt{2}\,\delta'_B - \frac{M_{BC}+M_{CB}}{L}\delta_B + \frac{M_{CD}+M_{DC}}{L}\delta'_B + F\delta_B - X\delta'_B + \frac{qL}{2} = 0$$

Asta AB

$$W_{AB} = W_{BA} = \frac{4EI}{L\sqrt{2}} = 6{,}63 \cdot 10^{10}\ N/mm$$

$$V_{AB} = V_{BA} = \frac{2EI}{L\sqrt{2}} = 3{,}31 \cdot 10^{10}\ N/mm$$

$$U_{AB} = U_{BC} = \frac{6EI}{(L\sqrt{2})^2} = 1{,}76 \cdot 10^{7}\ N$$

Asta CD $\quad W_{CD} = W_{DC} = \frac{4EI}{L} = 9{,}31 \cdot 10^{10}\ N/mm$

$$V_{CD} = V_{DC} = \frac{2EI}{L} = 4{,}69 \cdot 10^{10}\ N/mm$$

$$U_{CD} = U_{DC} = \frac{6EI}{L^2} = 3{,}52 \cdot 10^{7}\ N$$

$M_{AB} = 3{,}31 \cdot 10^{10} \cdot \varphi_B - 1{,}76 \cdot 10^7 \cdot \delta_{AB}$

$M_{BA} = M_{BC} = 6{,}63 \cdot 10^{10} \varphi_B - 1{,}76 \cdot 10^7 \delta_{AB}$

$M_{CB} = M_{CD} = 9{,}37 \cdot 10^{10} \varphi_C - 3{,}52 \cdot 10^7 \delta_{CD}$

$M_{DC} = 4{,}69 \cdot 10^{10} \varphi_C - 3{,}52 \cdot 10^7 \delta_{CD}$

$\Downarrow$

$M_{AB} = -8{,}27 \cdot 10^6 \delta_B - 2{,}49 \cdot 10^7 \delta_B = -3{,}32 \cdot 10^7 \delta_B$

$M_{BA} = -M_{BC} = -1{,}66 \cdot 10^7 \delta_B - 2{,}49 \cdot 10^7 \delta_B = -4{,}15 \cdot 10^7 \delta_B$

$M_{CB} = -M_{CD} = -2{,}34 \cdot 10^7 \delta_B - 3{,}52 \cdot 10^7 \delta_B = -5{,}86 \cdot 10^7 \delta_B$

$M_{DC} = -1{,}17 \cdot 10^7 \delta_B - 3{,}52 \cdot 10^7 \delta_B = -4{,}69 \cdot 10^7 \delta_B$

$$-\frac{1{,}47 \cdot 10^7}{4000}\delta_B - \frac{10{,}01 \cdot 10^7}{4000}\delta_B - \frac{10{,}55 \cdot 10^7}{4000}\delta_B + 4 \cdot 10^4 - 0{,}944\delta_B + 0{,}8 + \frac{40 \cdot 4000}{2} = 0$$

$\Downarrow$

$$-18675\delta_B - 25025\delta_B - 26375\delta_B + 4 \cdot 10^4 - 0{,}944\delta_B + 0{,}8 + 80000 = 0$$

$\Downarrow$

$$-70075{,}94\,\delta_B + 120.000{,}8 = 0$$

$\Downarrow$

$$\delta_B = \frac{120.000{,}8}{70075{,}94} = 1{,}71 \text{ mm}$$

$\delta_F = 0{,}944\delta_B - 0{,}8 = 0{,}81$ mm

$X = \delta_F K_0 B L = 32{,}4$ kN

$M_{AB} = -56,77\ KNm$

$M_{BA} = -70,96\ KNm$

$M_{BC} = 70,96\ KNm$

$M_{CB} = 100,21\ KNm$

$M_{CD} = -100,21\ KNm$

$M_{DC} = -80,20\ KNm$

$T_{AB} = T_{BA} = -\frac{M_{AB}+M_{BC}}{\sqrt{2}L} = 22,58\ KN$

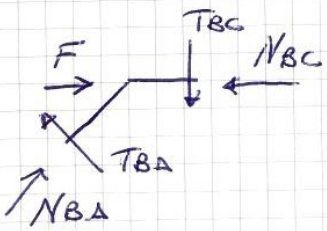
$T_{BC} = \frac{qL}{2} - \frac{M_{BC}+M_{CB}}{L} = 57,21\ KN$

$T_{CB} = -\frac{qL}{2} - \frac{M_{BC}-M_{CB}}{L} = -142,79\ KN$

$T_{CD} = -\frac{M_{CD}+M_{DC}}{L} = 45,10\ KN$

$M_{EF} = X \cdot L - X\frac{L}{2} = X \cdot \frac{L}{2} = 64,8\ KNm$

Nodo B



$F - N_{BC} + \frac{N_{BA}}{\sqrt{2}} - \frac{T_{BA}}{\sqrt{2}} = 0$

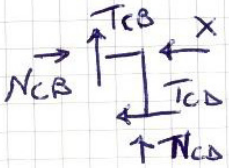
$\frac{N_{BA}}{\sqrt{2}} + \frac{T_{BA}}{\sqrt{2}} - T_{BC} = 0$

$\Downarrow$

$N_{BA} = \left(T_{BC} - \frac{T_{BA}}{\sqrt{2}}\right)\sqrt{2} = 58,33\ KN$

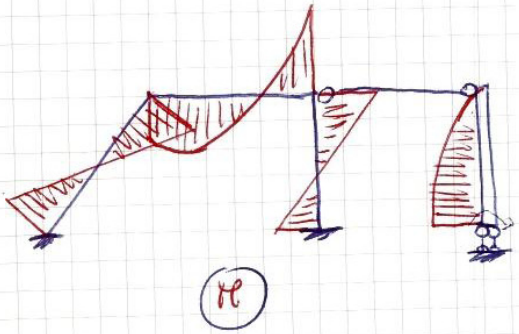
$N_{BC} = F + \frac{N_{BA}}{\sqrt{2}} - \frac{T_{BA}}{\sqrt{2}} = 65,28\ KN$

Nodo C



$N_{CD} = -T_{CB} = 142,79\ KN$

=



(M)