

# TECNICA DELLE COSTRUZIONI

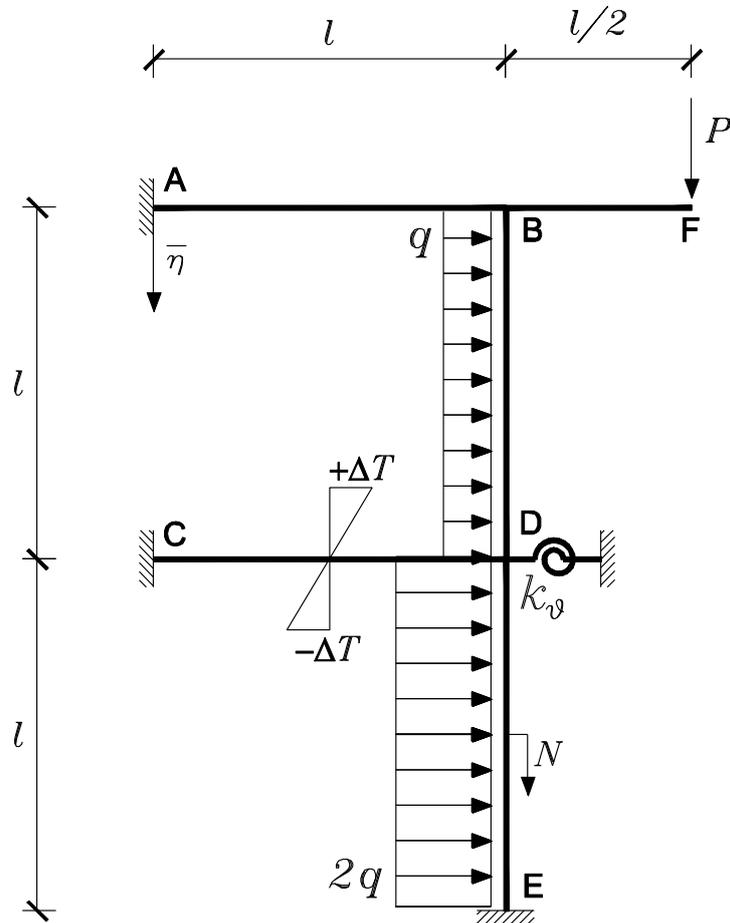
TEMA ESAME DELL'11 LUGLIO 2016

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ESERCITATORE: ING. LUCA FACCONI

PROF. FAUSTO MINELLI

## Esercizio



$$N = 2ql;$$

$$P = 6ql;$$

$$\frac{\alpha \Delta T}{h} = \frac{1}{2} \frac{ql^2}{EJ};$$

$$K_s = 2 \frac{EJ}{l};$$

$$\eta = \frac{1}{4} \frac{ql^4}{EJ}.$$

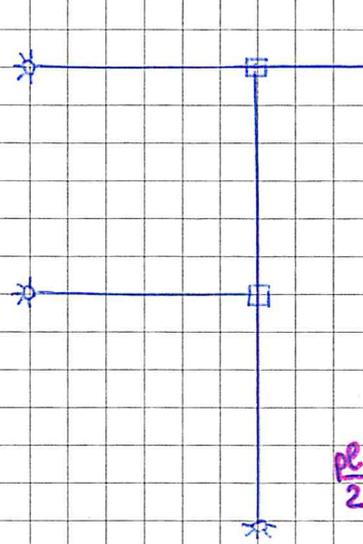
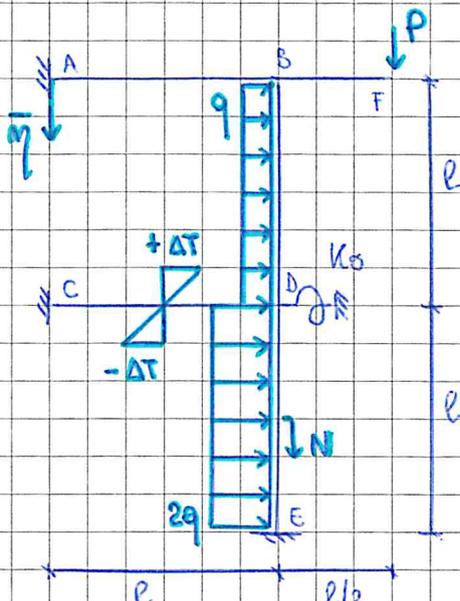
Dato il telaio in figura

**Si richiedono i grafici di:**

1. Momento flettente (con il valore e la posizione dei massimi);
2. Taglio;
3. Azione assiale;
4. Deformata qualitativa con posizione dei flessi.

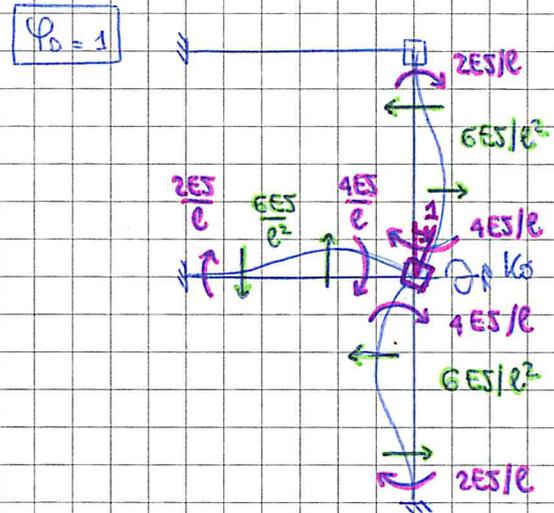
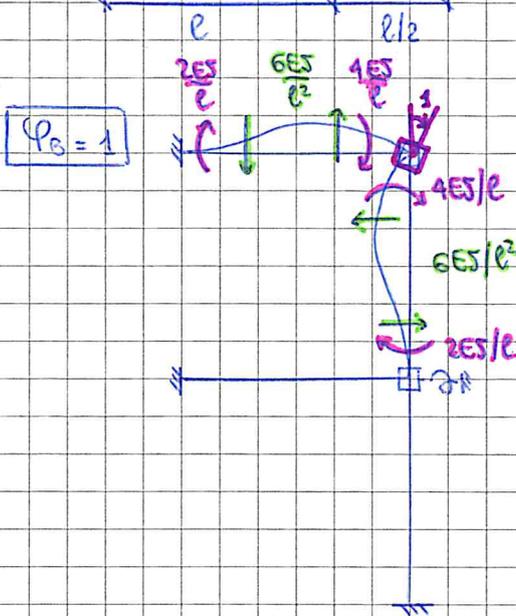
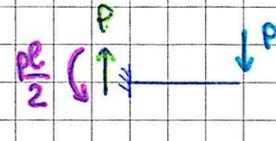
TELAIO 11/07/2016

NODI FISSI :



$$\begin{cases} m_{acc} \varphi_e + m_{ed} \varphi_d + m_{df} = 0 \\ m_{dc} \varphi_c + m_{dd} \varphi_d + m_{de} = 0 \end{cases}$$

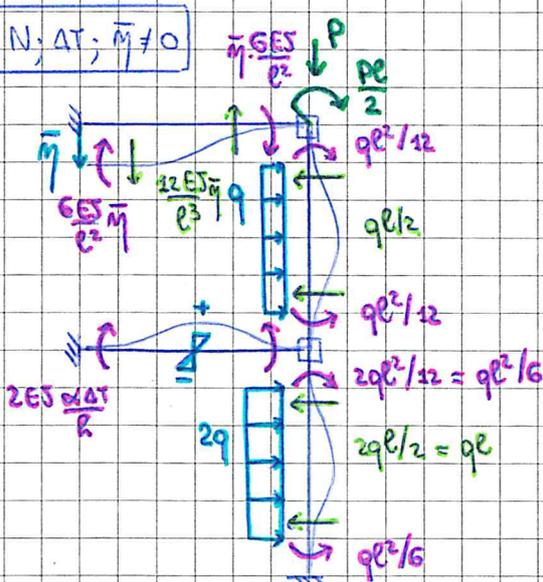
APPENDICE :



$$\begin{cases} m_{acc} = \frac{4ES}{l} + \frac{4ES}{l} = \frac{8ES}{l} \\ m_{dd} = \frac{2ES}{l} \end{cases}$$

$$\begin{cases} m_{ed} = \frac{2ES}{l} \\ m_{dc} = \frac{4ES}{l} + \frac{4ES}{l} + \frac{4ES}{l} + K_s \end{cases}$$

$q; P; N; \Delta T; \bar{m} \neq 0$



$$\begin{cases} m_{ed} = \frac{6ES \bar{m}}{l^2} - \frac{Pl}{2} + \frac{ql^2}{12} \\ m_{dc} = -\frac{2ES \alpha \Delta T}{R} - \frac{ql^2}{12} + \frac{ql^2}{6} \end{cases}$$

$$\begin{cases} \frac{8 EJ}{l} \varphi_B + \frac{2 EJ}{l} \varphi_D + \left( \frac{6 EJ}{l^2} \bar{m} - \frac{Pl}{2} + \frac{ql^2}{12} \right) = 0 \\ \frac{2 EJ}{l} \varphi_B + \left( \frac{12 EJ}{l} + K_D \right) \varphi_D + \left( -2 EJ \frac{\alpha \Delta T}{l} - \frac{ql^2}{12} + \frac{ql^2}{6} \right) = 0 \end{cases}$$

- $P = 6ql$
- $N = 2ql$
- $\frac{\alpha \Delta T}{l} = \frac{1}{2} \frac{ql^2}{EJ}$
- $\bar{m} = \frac{1}{4} \frac{ql^3}{EJ}$
- $K_D = \frac{2 EJ}{l}$

$$\begin{cases} \frac{8 EJ}{l} \varphi_B + \frac{2 EJ}{l} \varphi_D + \left( \frac{6 EJ}{l^2} \cdot \frac{1}{4} \frac{ql^3}{EJ} - \frac{6ql}{2} + \frac{ql^2}{12} \right) = 0 \\ \frac{2 EJ}{l} \varphi_B + \left( \frac{12 EJ}{l} + \frac{2 EJ}{l} \right) \varphi_D + \left( -2 EJ \cdot \frac{1}{2} \frac{ql^2}{EJ} - \frac{ql^2}{12} + \frac{ql^2}{6} \right) = 0 \end{cases}$$

$$\begin{cases} \frac{8 EJ}{l} \varphi_B + \frac{2 EJ}{l} \varphi_D - \frac{17}{12} ql^2 = 0 \\ \frac{2 EJ}{l} \varphi_B + \frac{14 EJ}{l} \varphi_D - \frac{11}{12} ql^2 = 0 \end{cases}$$

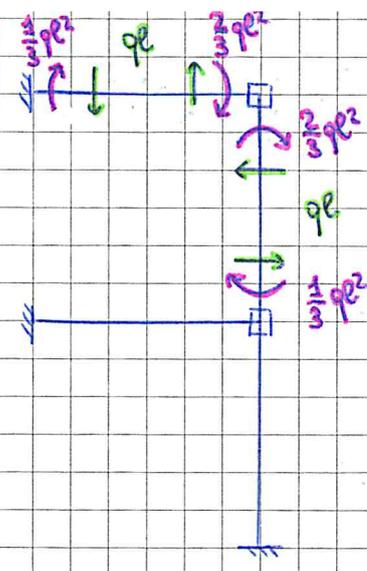
$$\begin{array}{ccc|c} 8 & 2 & -\frac{17}{12} & \times 7 \\ 2 & 14 & -\frac{11}{12} & \times 1 \end{array} \quad \begin{array}{ccc|c} 56 & 14 & -\frac{119}{12} & \\ 2 & 14 & -\frac{11}{12} & \end{array}$$

$$(56-2) \varphi_B + \left( -\frac{119}{12} + \frac{11}{12} \right) = 0$$

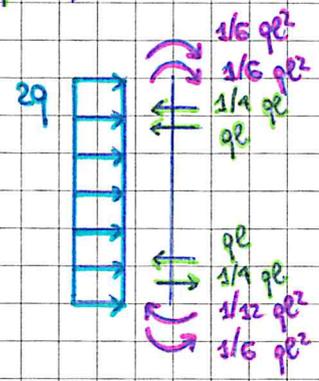
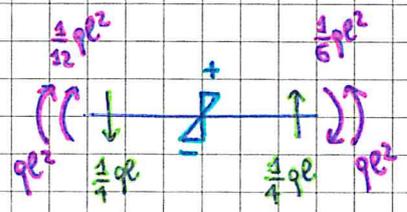
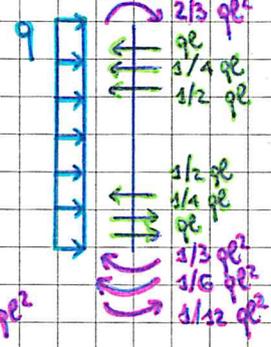
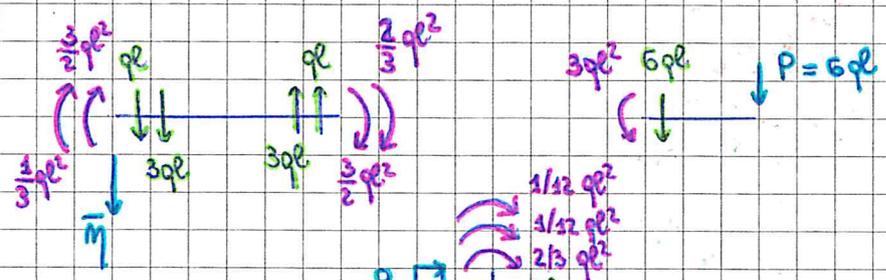
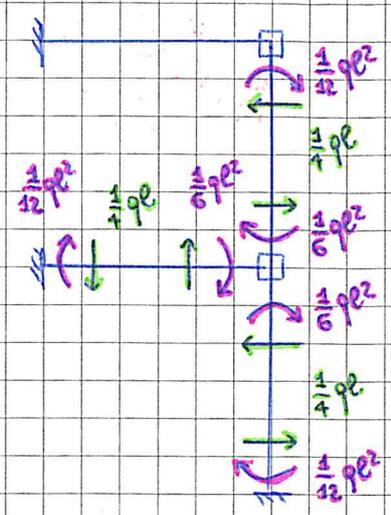
$$\varphi_B = \frac{9}{54} = \frac{1}{6} \frac{ql^3}{EJ}$$

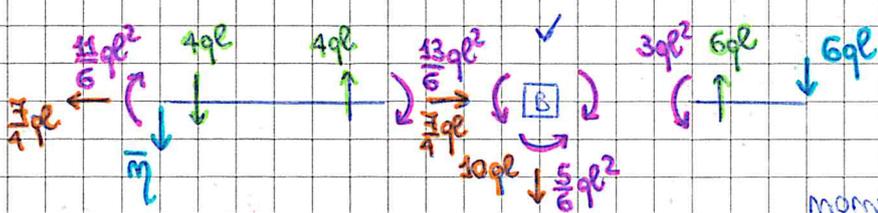
$$\varphi_D = \left( \frac{17}{12} ql^2 - \frac{8 EJ}{l} \cdot \frac{1}{6} \frac{ql^3}{EJ} \right) \frac{l}{2 EJ} = \frac{1}{24} \frac{ql^3}{EJ}$$

$$\psi_B = \frac{1}{6} \frac{q \ell^3}{EI}$$



$$\psi_0 = \frac{1}{24} \frac{q \ell^3}{EI}$$

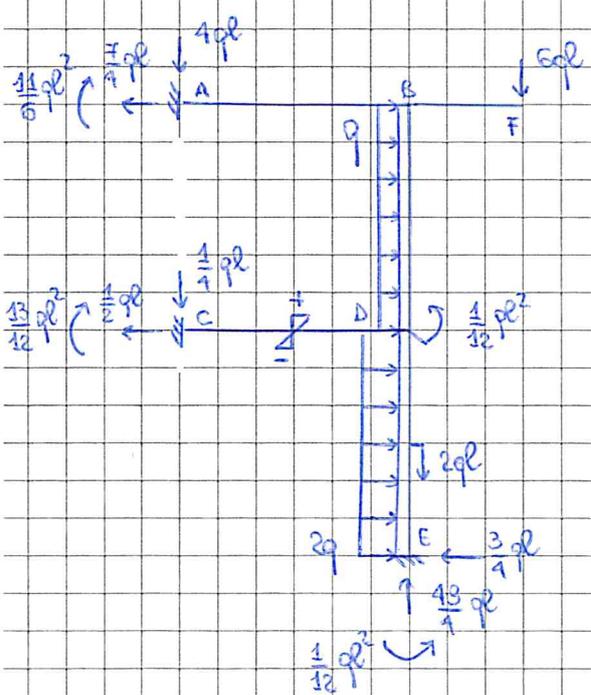
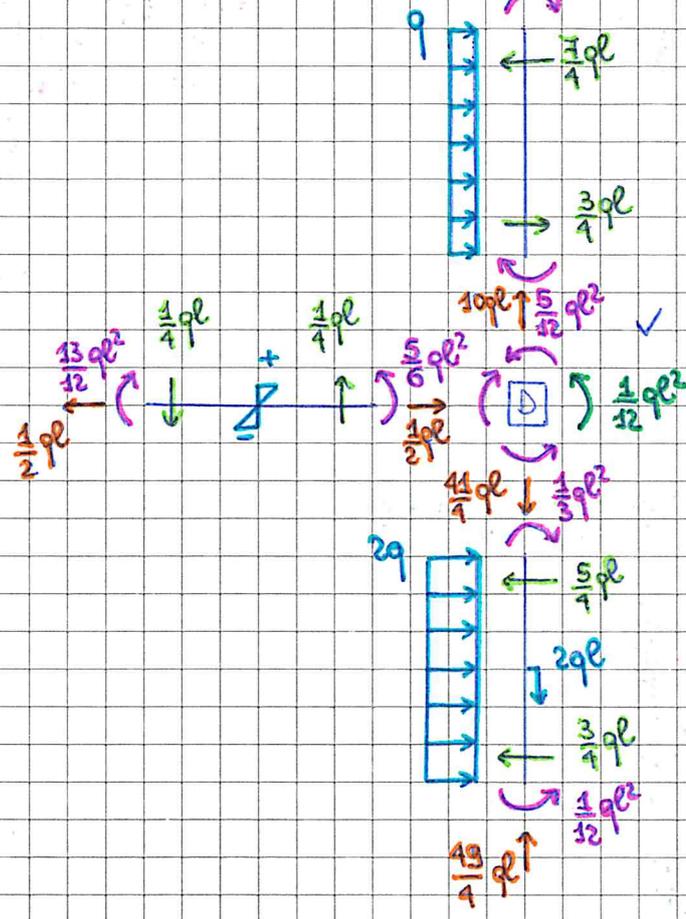




MOMENTO MOLLA:

$$M_D = K_D \cdot \varphi_D = \frac{2ES}{l} \cdot \frac{1}{24} \frac{ql^3}{ES} = \frac{1}{12} ql^2$$

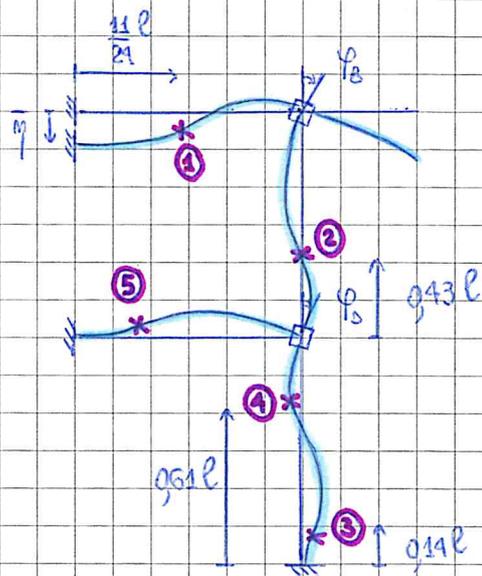
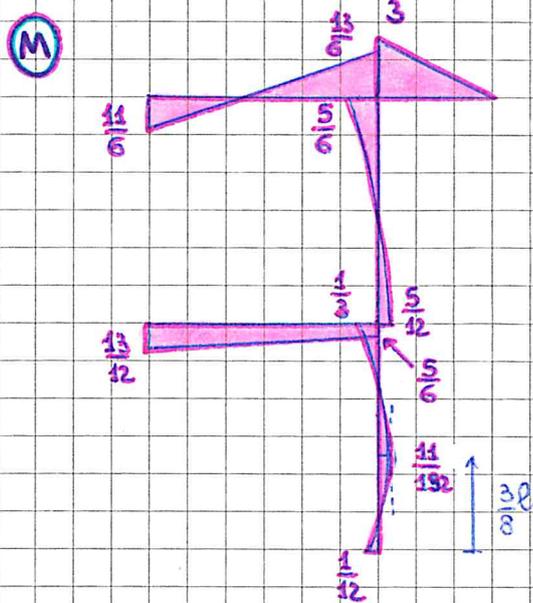
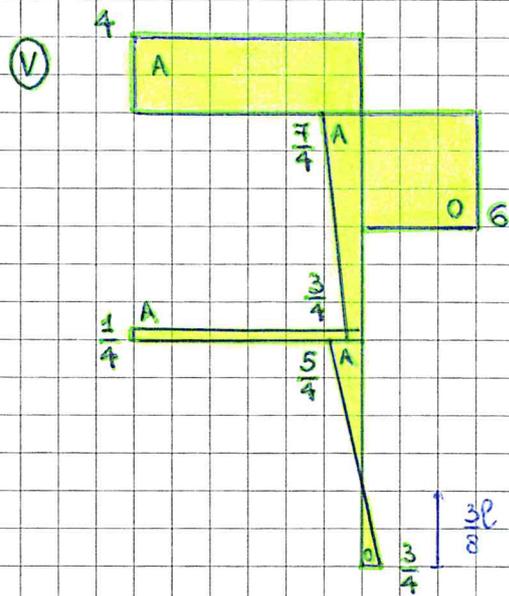
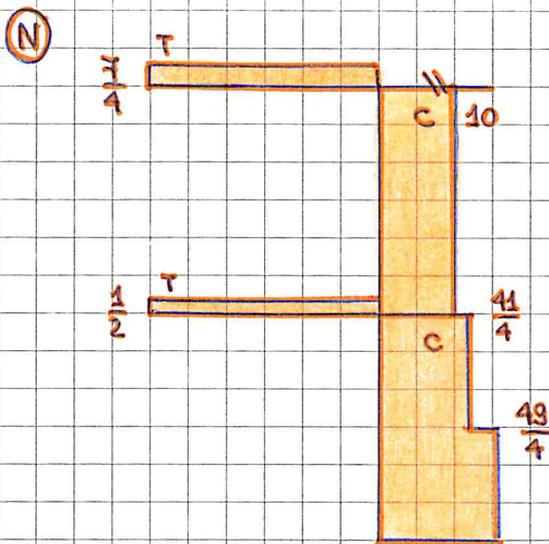
ANTIORARIO!



$$\sum F^{\rightarrow} = -\frac{7}{4} ql + ql + 2ql - \frac{1}{2} ql - \frac{3}{4} ql = 0$$

$$\sum F^{\uparrow} = -4ql - 6ql - \frac{1}{4} ql - 2ql + \frac{13}{4} ql = 0$$

$$\sum M^{\curvearrowright} = \frac{11}{6} ql^2 - \frac{7}{4} ql \cdot 2l - 4ql \cdot l + 6ql \cdot \frac{l}{2} + ql \cdot \frac{3l}{2} + \frac{13}{12} ql^2 - \frac{1}{2} ql \cdot l - \frac{1}{4} ql \cdot l - \frac{1}{12} ql^2 + 2ql \cdot \frac{l}{2} - \frac{1}{12} ql^2 = 0$$



$$M_{\max} \left| \frac{3l}{8} = \frac{1}{12} ql^2 - \frac{3}{4} ql \frac{3l}{8} + 2q \left( \frac{3l}{8} \right)^2 \cdot \frac{1}{2} = -\frac{11}{192} \right|$$

### FLESSI:

\*) asta  $\overline{AB}$ :  $\frac{11}{6} = x = \frac{13}{6} (l-x) \rightarrow \frac{11}{6} (l-x) = \frac{13}{6} x \rightarrow x_1 = \frac{11l}{24}$  da A

\*) asta  $\overline{BD}$ :  $M(x) = qx^2 + \frac{3}{4} qlx - \frac{5}{12} ql^2 = 0 \rightarrow x_2 = 0,43l$  da D  
NON ACC.

\*) asta  $\overline{DE}$ :  $M(x) = 2qx^2 - \frac{3}{4} qlx + \frac{1}{12} ql^2 = 0 \rightarrow x_{3/4} = 0,14l$  da E  
0,61l da E

\*) asta  $\overline{CD}$ :  $M(x) = +\frac{13}{12} ql^2 - \frac{1}{4} qlx$

$$y'' = -\frac{13}{12} \frac{ql^2}{ES} + \frac{1}{4} qlx + 2 \cdot \frac{1}{2} \frac{ql^2}{ES} = \frac{1}{4} \frac{qlx}{ES} - \frac{1}{12} \frac{ql^2}{ES}$$

$$= \frac{1}{4} \frac{ql}{ES} \left( x - \frac{l}{3} \right) \geq 0 \rightarrow x_5 \geq \frac{l}{3}$$

