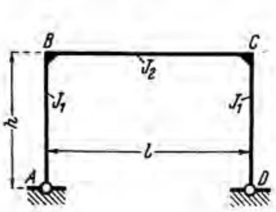
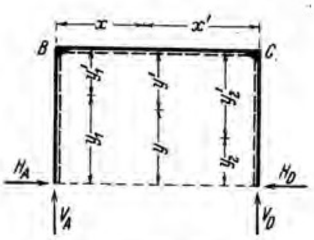
Frame 39

Symmetrical rectangular two-hinged frame



Shape of Frame
Dimensions and Notations

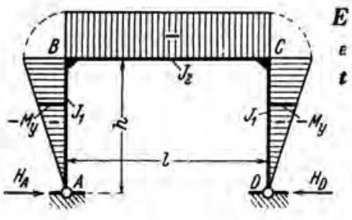


This sketch shows the positive direction of the reactions and the coordinates assigned to any point. For symmetrical loading of the frame use y and y'. Positive bending moments cause tension at the face marked by a dashed line.

Coefficients:

$$k = \frac{J_2}{J_1} \cdot \frac{h}{l} \qquad N = 2k + 3.$$

Case 39/1: Uniform increase in temperature of the entire frame



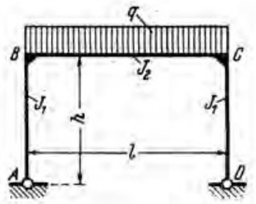
E = Modulus of elasticity
ε = Coefficient of thermal expansion
t = Change of temperature in degrees

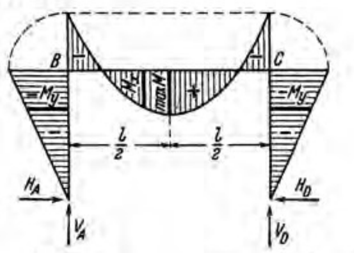
$$M_B = M_C = -\frac{3EJ_2\varepsilon t}{hN};$$

$$H_A = H_D = \frac{-M_B}{h}; \quad M_y = \frac{y}{h} M_B.$$

Note: If the temperature decreases, the direction of all forces is reversed, and the signs of all moments are reversed.

Case 39/2: Rectangular load on the girder

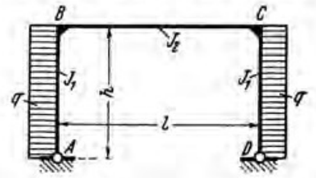


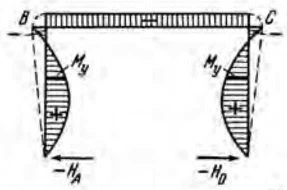


$M_B = M_C = -\frac{q\,l^2}{4\,N}$ $\quad \max M = \frac{q\,l^2}{8} + M_B$ $\quad M_x = \frac{q\,x\,x'}{2} + M_B$;

$V_A = V_D = \frac{q\,l}{2}$ $\quad H_A = H_D = \frac{-M_B}{h}$; $\quad M_y = \frac{y}{h}\,M_B$.

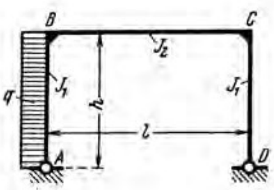
Case 39/3: Rectangular load on both legs

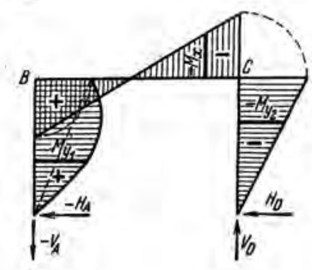




$M_B = M_C = -\frac{q\,h^2\,k}{4\,N}$ $\quad M_y = \frac{q\,y\,y'}{2} + \frac{y}{h}\,M_B$; $\quad H_A = H_D = -\left(\frac{q\,h}{2} + \frac{M_B}{h}\right)$.

Case 39/4: Rectangular load on the left leg





$$\begin{matrix} M_B \\ M_C \end{matrix} = \frac{q\,h^2}{4}\left[-\frac{k}{2\,N} \pm 1\right];$$

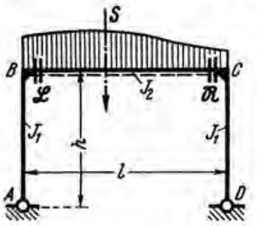
$H_D = \frac{-M_C}{h}$ $\quad H_A = -(q\,h - H_D)$; $\quad V_D = -V_A = \frac{q\,h^2}{2\,l}$;

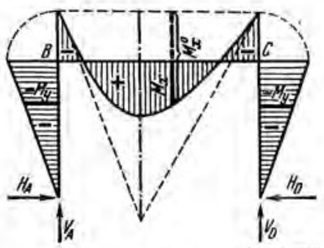
$M_{y1} = \frac{q\,y_1\,y_1'}{2} + \frac{y_1}{h}\,M_B$ $\quad M_x = M_C + V_D\,x'$ $\quad M_{y2} = -H_D\,y_2$.

FRAME 39

See Appendix A, Load Terms, pp. 440-445.

Case 39/5: Girder loaded by any type of vertical load





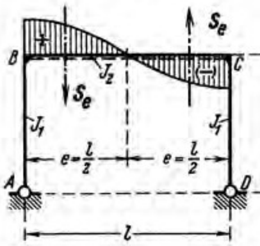
$$V_A = \frac{\mathfrak{S}_r}{l} \qquad V_D = \frac{\mathfrak{S}_l}{l}; \qquad M_B = M_C = -\frac{(\mathfrak{L}+\mathfrak{R})}{2N};$$

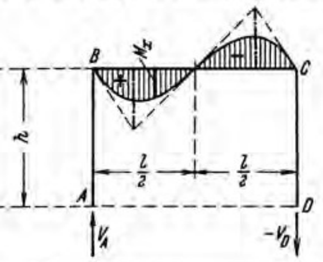
$$H_A = H_D = \frac{-M_B}{h}; \qquad M_x = M_x^0 + M_B \qquad M_y = \frac{y}{h} M_B.$$

Special case 39/5a: Symmetrical load ($\mathfrak{R} = \mathfrak{L}$)

$$V_A = V_D = S/2; \qquad M_B = M_C = -\mathfrak{L}/N.$$

Case 39/6: Girder loaded by any type of antisymmetrical load ($\mathfrak{R} = -\mathfrak{L}$)



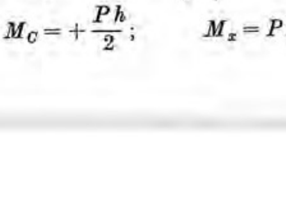


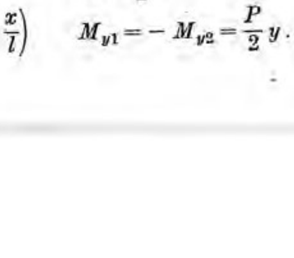
$$V_A = -V_D = \frac{\mathfrak{S}_r}{l};$$

$$M_B = M_C = 0;$$

$$H_A = H_D = 0.$$

Case 39/7: Horizontal concentrated load at the girder





$$V_D = -V_A = \frac{Ph}{l}; \qquad H_D = -H_A = \frac{P}{2};$$

$$M_B = -M_C = +\frac{Ph}{2}; \qquad M_x = Ph\left(\frac{1}{2} - \frac{x}{l}\right) \qquad M_{y1} = -M_{y2} = \frac{P}{2}y.$$